AD-A145 273 TRANSPORTATION SYSTEMS CENTER BIBLIOGRAPHY OF TECHNICAL REPORTS JULY 1970 - DECEMBER 1976(U) TRANSPORTATION SYSTEMS CENTER CAMBRIDGE MA E W ALLEN APR 77 1/3

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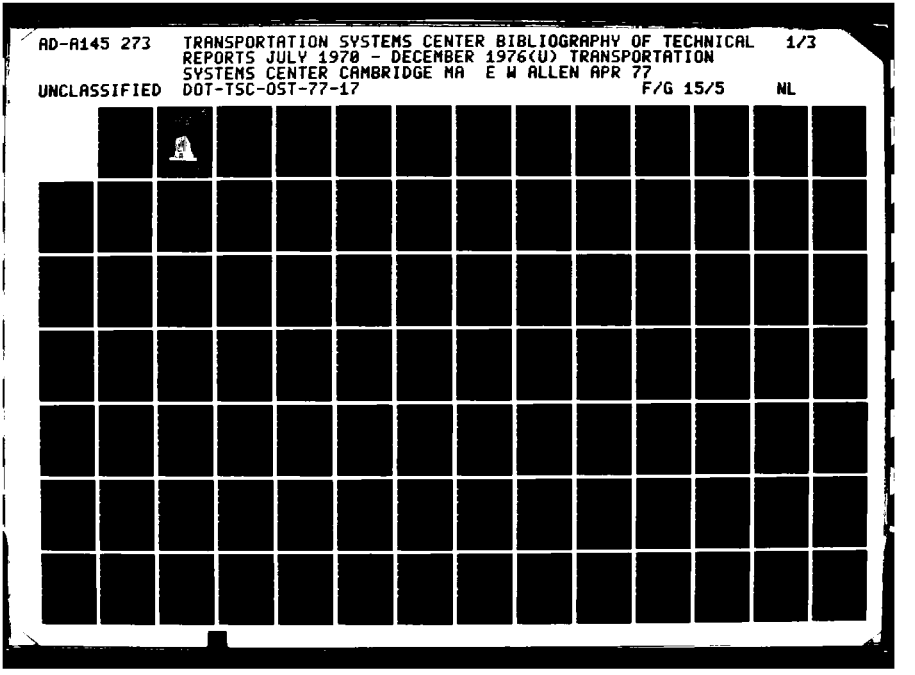

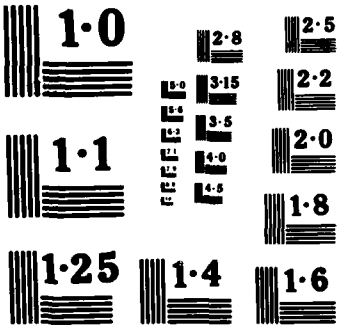
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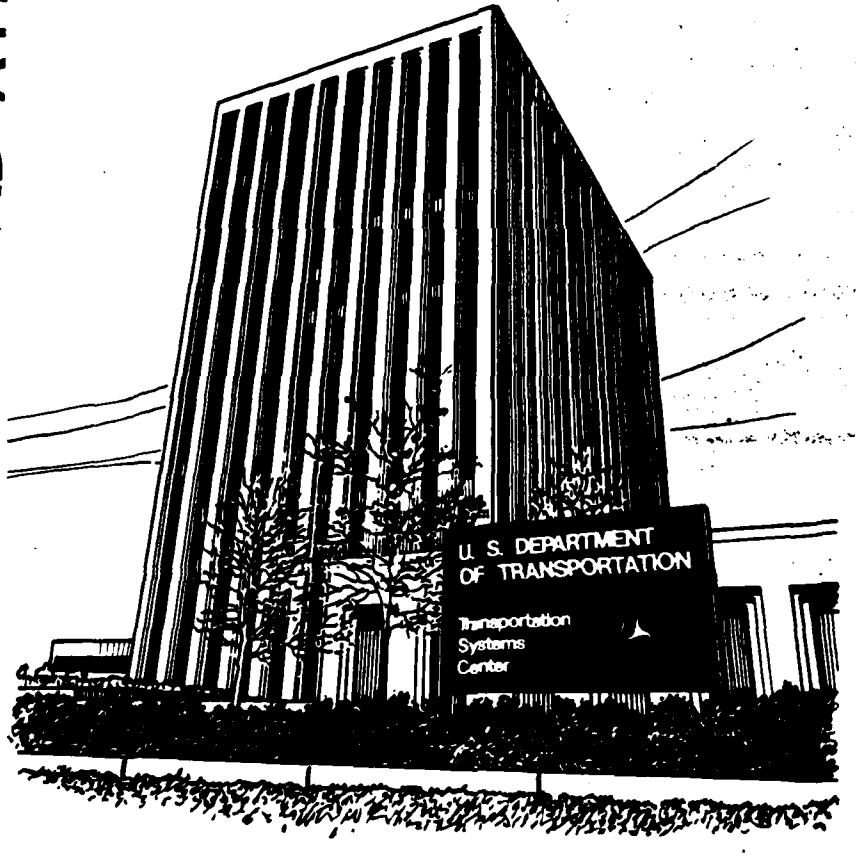

U. S. DEPARTMENT OF TRANSPORTATION
Transportation Systems Center
Kendall Square
Cambridge, Massachusetts 02142

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16. Abstract

This bibliography lists unlimited distribution reports released by the Transportation Systems Center from July 1970 through December 1976. Reports are listed by sponsoring agency, and are indexed by subject, personal author, corporate author, title, contract number, and report number.

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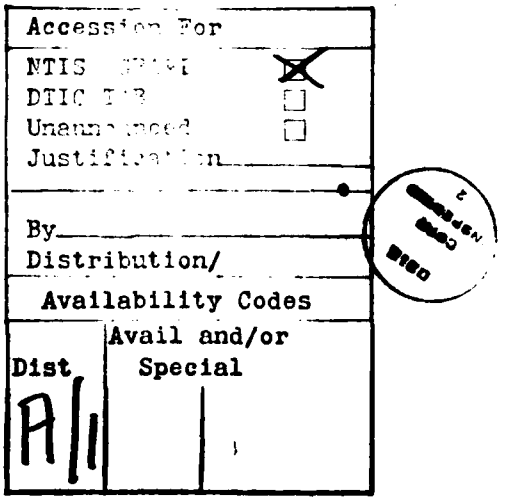
PREFACE

This bibliography lists unlimited distribution reports released by the Transportation Systems Center from July 1970 through December 1976. It supercedes the following publications: Transportation Systems Center Bibliography of Technical Reports (DOT-TSC-OST 73-21); Cumulative Reports Bibliography July 1970 - January 1975 (DOT-TSC-OST-74-21); Reports Bibliography, Suplement February - June 1975 (DOT-TSC-OST-75-47); and Reports Bibliography, Supplement July 1975 - June 1976 (DOT-TSC-OST-76-8).

The following indexes are included: subject, personal author, corporate author, title, contract number, and report number. The indexes were compiled and the subject terms assigned by Edith Allen, with assistance from Regina Clifton, Jeanne Horrigan, Mara Monroe, and Wayne Vargas of the Technical Information Center of the Transportation Systems Center.



INTRODUCTION

This bibliography lists unlimited distribution reports released by the Transportation Systems Center (TSC) from July 1970 through December 1976. Working papers, preliminary memoranda, and other limited distribution reports are excluded.

ARRANGEMENT OF THE BIBLIOGRAPHY

Reports are listed by sponsoring agency and arranged by DOT-TSC report number within each agency. A Department of Transportation Report Number/Transportation Systems Center Report Number Index is provided for cross reference.

Some contractor reports released between 1971 and 1973 were not assigned report numbers. These are listed by contract number in the Contractor Reports section of this bibliography. All other contractor reports are listed by DOT-TSC report number under their sponsoring agencies. All contractor reports are indexed by contract number and by corporate author.

Reports that were sponsored by two different Department of Transportation modal agencies and assigned two different DOT-TSC report numbers are listed under both numbers. Complete documentation is provided under the number that appears first on the Technical Report Documentation Page.

For each entry, the following information is given:

DOT-TSC report number.

Title.

Performing organization.

Personal author(s).

NTIS accession number (if known).

Sponsoring agency report number (if different from DOT-TSC report number)

Type of report (interim or final). This information is unavailable for some of the earlier reports.

Date. This indicates the date the report was approved by the sponsoring agency, and may not be the same as the publication date.

Number of pages.

Subject terms: assigned by the DOT-TSC Technical Information Center Staff.

Abstract: written by the author. For multi-volume reports with identical abstracts, the abstract is given for the first volume only.

SAMPLE ENTRY

DOT/TSC Report Number	DOT-TSC-FAA-74-16
Title	SYSTEM ACCESS CONTROL STUDY.
Performing Organization	Bell Aerospace Company.
Author(s)	L. Shub, D. Allen, E. Clune, T. Lerner.
NTIS Accession No.	AD-782 045
Sponsoring Agency Report No.	FAA-RD-74-107
Contract No.	DOT-TSC-539
Type of Report	Final Report. June 1974. 317p.
Date	
Number of Pages	
Subject Terms	Satellites-Aeronautical; Air Traffic Control-Satellite.
Abstract	This report presents a summary of a study conducted for the Transportation Systems Center of promising access control techniques which are applicable to an aeronautical satellite system. Several frequency division multiple access (FDMA) and time division multiple access (TDMA) configurations are analyzed and compared which are capable of providing voice, data and independent surveillance services. One of the FDMA concepts and a burst TDMA system are rated highest and are presented in greatest detail. Procedures are outlined for different types of interconnections. Included are preliminary designs of the avionics instrumentation.

The following indexes are included: subject, personal author, corporate author, title, contract number, and report number.

AVAILABILITY OF TSC REPORTS

All reports for which an NTIS accession number is included are available from the National Technical Information Service, Springfield, VA 22161. Current prices are listed in NTIS Government Reports Announcements.

A limited number of reports are available free of charge from the Technical Information Center/Code 8311, U. S. Department of Transportation, Transportation Systems Center, Kendall Square, Cambridge, MA 02142. Persons wishing to receive monthly announcements of new reports released by the Transportation Systems Center should also contact the Technical Information Center.

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OFFICE OF THE SECRETARY OF TRANSPORTATION

DOT-TSC-OST-71-4
A THEORY OF AIRCRAFT COLLISION AVOIDANCE SYSTEM DESIGN AND EVALUATION
Transportation Systems Center.
Edmund J. Koenke.
PB-213-205
March 1971. 184p.

Aircraft-Collision Avoidance Systems

The problem of aircraft anti-collision system design and evaluation is discussed in this work. Two evaluation criteria, conflict ratio and probability of missed critical alarm are formulated and are found to be independent of both traffic density and traffic model. These parameters depend only on the system alarm thresholds, critical miss distances and relative position prediction uncertainty. This results in a simple method for system evaluation and examination of new anti-collision concepts. A closed-form method for estimating system alarm rate is also developed based on both a new traffic model and empirical data. Anticollision systems are numerically compared by use of the criteria developed in this thesis. In the terminal area, it is found that the conflict ratio ranges from about 900 for a simple PWI device to about 25 for a full state collision avoidance system. The difference in the en-route environment is found to be less severe. The design of a low conflict ratio collision avoidance system is also discussed in this thesis and both an algorithm and display are developed.

DOT-TSC-OST-71-5
AIRCRAFT EMISSIONS SURVEY
Transportation Systems Center.
A. J. Broderick, W. F. Harriott, and R. A. Walter.
PB-204-794
March 1971. 44p.

Exhaust Emissions-Aircraft

This technical memorandum presents the preliminary results of a survey of transportation systems emissions monitoring requirements. Emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and particulates from aircraft power plants, with emphasis on gas turbine engines, are considered. Measurement rationale for various types of aircraft is summarized. Instrumentation available for measuring these emissions is reviewed and a tabulation made of those techniques in current use. Instrumentation requiring further engineering development is briefly discussed.

DOT-TSC-OST-71-7
VEHICULAR TRAFFIC FLOW THEORY AND TUNNEL TRAFFIC FLOW MEASUREMENTS
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin, P. Yoh.
PB-204-798
June 1971. 221p.

Traffic Flow-Models

Vehicular traffic flow has been investigated theoretically and experimentally in order that peak hour collective traffic flow dynamics be understood and that the peak hour flow through the Callahan Tunnel be improved by means of traffic flow control and modification. Two theoretical models are suggested, the finite reaction time model and the asymmetrical response model, as predictive of observed traffic density dynamics, wave growth and asymmetry. Experimentally, a traffic flow profile of capacities, vehicle speeds and traffic densities in the Callahan Tunnel has been obtained, and relationships between slowdown wave phenomena and traffic flow determined. Based on these, it is suggested that traffic flow may be improved with traffic flow modification procedures.

DOT-TSC-OST-71-8
A REVIEW OF AVAILABLE L-BAND AND VHF AIRCRAFT ANTENNAS FOR AN AIRCRAFT-SATELLITE COMMUNICATIONS LINK
Transportation Systems Center.
PB-204-799
May 1971. 93p.

Aircraft-Antennas

One of the problems encountered in designing an aircraft to use a satellite system for communicatons (and for surveillance and navigation) is that of finding a suitable aircraft antenna. There is, at present, no antenna which will satisfy all requirements. The purpose of this paper is to briefly review the characteristics of some of the L-Band and VHF antennas which have been proposed for an aircraft-satellite link.

DOT-TSC-OST-71-9
MODELING TRANSPORTATION SYSTEMS: AN OVERVIEW
Transportation Systems Center.
George Kovatch and George Zames.
PB-213-123
June 1971. 54p.

Transportation Systems-Models

The purpose of this report is to outline the role of systems analysis and mathematical modeling in the planning of trans-

portation systems. The planning process is divided into three sectors (demand, supply, and policy) reflecting the demand for transportation services by the public, the ability of the system to deliver these services, and the effects of management policies on the equilibriation between supply and demand. The composition of each sector is examined and illustrated by samples from recent major transportation studies and the modeling literature. Emphasis is placed on structure dynamics, and feedback effects.

DOT-TSC-OST-71-10
TRANSPORTATION SYSTEMS TECHNOLOGY: A TWENTY-YEAR OUTLOOK
Transportation Systems Center.
George Kovatch, John B. Barber, Robert F. Casey and George Zames.
PB-204-800
Final Report. August 1971. 198p.

Transportation Systems -- Innovations

In this report an overall technology assessment of new and improved transportation systems is given. A broad survey has been made of new systems concepts for passenger and freight transportation in urban and interurban applications. Results of the findings are reported and projections of expected innovations and improvements are made along with discussion of some of the major limitations to wide scale applications over the next two decades. Recommendations for research and development emphasis in some of the more promising areas are given where possible, although full analysis of cost factors and comparative analysis of competing systems were beyond the scope of this investigation.

DOT-TSC-OST-71-11
PERSONALIZED RAPID TRANSIT SYSTEMS: A FIRST ANALYSIS
Transportation Systems Center.
George Kovatch and George Zames.
PB-204-801
Final Report. August 1971. 94p.

Personal Rapid Transit

In this report a preliminary systems analysis of the Personalized Rapid Transit System concept is given. It includes presentation of the significant advantages and disadvantages of the concept. Questions of system capacity, station capacity, urban grid design, and headway requirements are addressed. A review of current manufacturers' concepts is given with a functional classification of their major characteristics. Major component and system needs, which require further research and analysis, are described. A brief discussion of cost factors is also given.

DOT-TSC-OST-71-12
AN AIRPORT AIRSIDE SYSTEM MODEL
Transportation Systems Center.
Irwin Englander.
PB-204-802
June 1971. 56p.

Airport Surface Traffic Control

This model of an airport airside system simulates aircraft operations and controller functions in the terminal area, both in the air and on the ground. The model encompasses all operations between the terminal gate and the point of handoff between the enroute controller and the terminal controller.

DOT-TSC-OST-71-13
DESIGN AND CONSTRUCTION OF A PORTABLE OCULOMETER FOR USE IN TRANSPORTATION ORIENTED HUMAN FACTORS STUDIES
Transportation Systems Center.
P. W. Davis, A. Iannini, J. Lutz and A. Warner.
PB-213-125
August 1971. 38p.

Human Factors; Vision-Measurement

This report describes development of an instrument designed to acquire and process information about human visual performance. The instrument has the following features: (1) It can be operated in a variety of transportation environments including simulators, cars, trucks, trains, and air traffic control stations; (2) The visual performance measurements are made without alteration of the subject's normal visual behavior; and (3) The data can be presented to the experimenter as either a video picture of the scene with the fixation point superimposed, or as derived eye-motion parameters.

DOT-TSC-OST-71-14
THE NOISE EXPOSURE MODEL MOD 4
Transportation Systems Center.
R. H. Hinckley and J. E. Wesler.
PB-211-977
August 1971. 90p.

Noise-Aircraft; Noise-Models

OFFICE OF THE SECRETARY OF TRANSPORTATION

The purpose of this report is threefold:

1. To record the results of efforts at the Transportation Systems Center to refine and expand the Noise Exposure Model, which have specifically resulted in the MOD 4 version described herein;
2. To serve as a User's Manual for the preparation of input information for the Noise Exposure Model MOD 4; and
3. To document the computer program for the Noise Exposure Model MOD 4, primarily for the guidance of computer programmers.

DOT-TSC-OST-71-16
APPENDIX C: THE NOISE EXPOSURE MODEL MOD 4
Transportation Systems Center.
PB-211-978
August 1971. 57p.

Noise-Aircraft; Noise-Models

DOT-TSC-OST-71-19
MULTI-MODAL TRANSPORTATION SYSTEM SIMULATION
Transportation Systems Center.
Robert C. Ricci and Jean R. Roy.
PB-213-124
July 1971. 24p.

Air Traffic Control-Models; Transportation Systems-Models

A laboratory with real-time simulation capability is being developed for simulating the command and control functions related to transportation systems. The initial effort in Advanced Air Traffic Control Techniques is defining and evaluating the most effective role of controllers in future ATC systems. The present laboratory status, the simulation models and structure, and programming techniques that are being used are discussed.

DOT-TSC-OST-72-1
A COMMUNITY NOISE SURVEY OF MEDFORD, MASSACHUSETTS
Transportation Systems Center.
PB-211-975
August 1971. 594p.

Noise-Traffic; Noise-Measurement

A noise measurement survey was conducted in Medford, Massachusetts, in order to assess the effect of transportation noise sources on the noise levels in a typical small city, and to obtain data to validate a mathematical simulation model developed for the prediction of community noise levels. Weekday measurements were made at 49 locations in the city. At five of these locations, measurements were taken for approximately 40 minutes each hour for an entire 24 hour period. At the remaining 44 locations, measurements were made for approximately one hour during the morning traffic rush hour, and for an hour at midday.

This report of the noise measurement survey contains detailed tabulations of the noise levels measured, time history charts, noise level analyses, site descriptions, and other information pertinent to the evaluation of community noise levels.

The overall average median noise level from all locations was 55.0 dBA for the morning rush hour, and 51.8 dBA for the midday period. The highest noise levels were measured near heavily traveled highways. Railroad traffic had no significant influence on the community noise levels, and aircraft influenced the overall noise levels only to a limited extent.

DOT-TSC-OST-72-2
MEASUREMENT OF AMBIENT NOISE LEVELS IN THE FLORIDA EVERGLADES
Transportation Systems Center.
Robert W. Quinn.
PB-212-197
September 1971. 54p.

Noise-Measurement

Noise data recorded in and around a 100-square mile area of southern Florida during the period 16-22 March 1971 have been analyzed in the Noise Abatement Laboratory, Transportation Systems Center, Cambridge, Massachusetts. Nine locations were selected for measurement to obtain representative ambient noise levels in the area.

Tabulated data display a summary of the measured noise levels at each location, and include calculated values, including the A-weighted noise levels exceeded 10%, 50%, and 90% of the measurement periods at each location.

DOT-TSC-OST-72-3
MODERN CONTROL ASPECTS OF AUTOMATICALLY STEERED VEHICLES
Transportation Systems Center.
Sam Pasternack.
PB-211-955
December 1971. 20p.

OFFICE OF THE SECRETARY OF TRANSPORTATION

Automated Guideway Transportation; Personal Rapid Transit; Dual Mode Systems

In the study of automatically steered rubber tired vehicles, little emphasis in the past has been placed on the steering control laws. This report examines the control law problem from the state variable point of view and it is shown that, except for possibly one velocity, the system is both controllable and observable allowing arbitrary system dynamics. It is also shown how optimal control theory may be used to select the feedback gains in order to minimize a cost function containing the square of the vehicle lateral acceleration.

DOT-TSC-OST-72-5.I
THE NOISE EXPOSURE MODEL MOD 5. VOLUME I
Transportation Systems Center.
J. Taub, T. Foreman and B. Brownfield.
PB-211-979
November 1971. 94p.

Noise-Aircraft; Noise-Models

This report contains three sections. The first two sections are contained in Volume 1 and may be described as follows:

Section 1. Airport Analysis This section describes the Noise Exposure Model MOD-5 from the perspective of analysing an airport in order to develop the program input model.

Section 2. User's Manual This section describes the process of developing the input model for the Noise Exposure Model MOD-5 from input data.

DOT-TSC-OST-72-5.II
THE NOISE EXPOSURE MODEL MOD 5. VOLUME II
Transportation Systems Center.
J. Taub, T. Foreman and B. Brownfield
PB-211-976
November 1971. 175p.

Noise-Aircraft; Noise-Models

This volume is the Programmer's Manual describing the Noise Exposure Model MOD-5 Computer Program.

Volume 1 is the airport analysis and user manual. Volume 2 was revised in March of 1972 to correct inconsistencies in the initial version.

DOT-TSC-OST-72-7
AUTOMATED GUIDEWAY NETWORK TRAFFIC MODELING
Transportation Systems Center.
Charles R. Toye.
PB-211-956
February 1972. 30p.

Automated Guideway Transportation; Traffic Flow-Models; Dual Mode Systems

In the literature concerning automated guideway transportation systems, such as dual mode, a great deal of effort has been expended on the use of deterministic reservation schemes and the problem of merging streams of vehicles. However, little attention has been focused on the problem of developing models to determine space allocation on the guideway as a function of the user service level required for satisfactory operation of the system. The problem must be addressed in the early design phase of any automated guideway system and is pertinent to site selection. This paper develops probability models and uses statistical variance analysis techniques to develop procedures which can be used to determine the required guideway space necessary to satisfy a user service level for a particular demand rate. It provides the building blocks upon which various network traffic management strategies can be developed.

The paper contains an explanation of the methodology involved, gives sample problems, and describes the simulation procedures that were employed to verify the results.

DOT-TSC-OST-72-10
ALTERNATIVE DUAL MODE NETWORK CONTROL STRATEGIES
Transportation Systems Center.
Ronald D. Kangas.
PB-211-957
March 1972. 29p.

Dual Mode Systems

From a literature survey a qualitative evaluation was made of four network control strategies for the fundamental control philosophy of the moving synchronous slot. In the literature concerning automated transportation systems, such as dual mode, a great deal of effort has been expended in discussing the pros and sometimes the cons of a specific control concept without reviewing other control strategies that may be available. This paper summarizes the major advantages and disadvantages associated with four control strategies for the moving synchronous slot. A description of each of these control strategies is provided and conclusions are made showing that the deterministic slot/cycle concept and

the quasi-synchronous slot concept with entrance station throughout modulated by historic demand data are the most promising. Additional investigations of these two concepts showed that a further study of alternative network control strategies is needed, oriented towards addressing the issues of network capacity, interchange design, passenger convenience and system failure and recovery.

DOT-TSC-OST-72-11
THE USE OF FAR INFRA-RED RADIATION FOR THE DETECTION OF CONCEALED METAL OBJECTS
Transportation Systems Center.
Michael Scotto.
November 1971. 155p.

Metal Detectors

The use of infra-red radiation for the detection of concealed metal objects has been investigated both theoretically and experimentally. The investigation was divided into two phases, one which considered passive techniques, and another which involved active sources of radiation to probe the subject. Because of the limited amount of time and equipment available, only primitive systems were studied, but the results serve as a fundamental guide to the requirements of a field operational system. The results obtained show that metals concealed by clothing can definitely be detected by observing the far infra-red radiation from the region of the hidden object. This type of system has the very attractive feature of high spatial resolution, and can easily distinguish between dangerous weapons and harmless objects.

DOT-TSC-OST-72-13
CLIMATIC IMPACT ASSESSMENT PROGRAM, PROCEEDINGS OF THE SURVEY CONFERENCE, FEBRUARY 15-16, 1972
Transportation Systems Center.
A. E. Barrington, Editor.
PB-204-807
Conference Proceedings. September 1972. 281p.

Supersonic Aircraft-Emissions

This volume contains the proceedings of a survey conference, held at the DOT Transportation Systems Center, which was the first of the reporting milestones of the Climatic Impact Assessment Program. CIAP, managed within the Office of the Secretary of Transportation, will assess, by report in 1974, the impact of climatic changes which might result from perturbation of the upper atmosphere by the exhaust effluent of a world high-altitude aircraft fleet, as projected to 1990.

The primary objective of this conference was to introduce the objectives and scope of CIAP to domestic and foreign representatives of industry, universities, and government agencies. Nineteen speakers were invited, at very short notice, to prepare informal introductory surveys in their respective disciplines which would be instructive to specialists in other areas and would illustrate the range of activities related to CIAP. These tutorials dealt with the general categories of engine emissions, the natural stratosphere, the physical and biological impact of stratospheric perturbations, and risk/benefit analysis. All but one of the talks are included in this volume, each followed by an abbreviated version of the ensuing open discussion.

DOT-TSC-OST-72-15
A BRIEF SURVEY OF TSC COMPUTING FACILITIES
Transportation Systems Center.
Andres Zellweger.
May 1972. 31p.

Computers

The Transportation Systems Center (TSC) has four, essentially separate, in-house computing facilities. We shall call them Honeywell Facility, the Hybrid Facility, the Multimode Simulation Facility, and the Central Facility. In addition to these four, several laboratories have their own minicomputers. This report reviews the hardware and software capabilities of these facilities. A final section discusses the strength and weaknesses of the current in-house general purpose computer capability.

DOT-TSC-OST-72-16
A MICROWAVE TECHNIQUE FOR DETECTING AND LOCATING CONCEALED WEAPONS
Transportation Systems Center.
R. M. Weigand.
PB-213-323-9
Final Report. December 1971. 44p.

Metal Detectors

The subject of this report is the evaluation of a microwave technique for detecting and locating weapons concealed under clothing. The principal features of this technique are: (1) Persons subjected to search are not exposed to "objectional" microwave radiation; (2) A simple threshold detector can be used as the decision element obviating complex signal processing; (3) System operation does not require extensive

operator training; (4) The resolution of the system (2 inches x 2 inches) permits location of a suspected weapon. This letter feature eliminates the need for a complete search of a passenger. Results of a laboratory measurement program are presented in support of the technique. An engineering analysis of the system implementation identifies an optimum operating frequency and an estimate of system cost is presented. Finally, several areas requiring additional experimental evaluation preceeding a system implementation are identified.

DOT-TSC-OST-72-17
A SURVEY OF AIRPORT ACCESS ANALYSIS TECHNIQUES – MODELS, DATA AND A RESEARCH PROGRAM
Transportation Systems Center.
L. Brown, G. E. Paules, E. Roberts, K. H. Schaeffer.
PB-220-988
June 1972. 172p.

Airport Access; Modal Split

The report points up the differences and similarities between airport access travel and general urban trip making. Models and surveys developed for, or applicable to airport access planning are reviewed. A research program is proposed which would generate a standard airport technical planning package and establish a federal airport access planning assistance program to help local agencies in planning airport access demonstrations and improvements.

DOT-TSC-OST-72-19
AMBIENT NOISE LEVEL MEASUREMENTS IN PROPOSED FLORIDA AIRPORT AREA
Transportation Systems Center.
Robert W. Quinn.
PB-214-459
Final Report. December 1972. 120p.

Noise-Measurement

This report documents the results of measurements made at ten locations near the three remaining sites being studied for the "South Florida Regional Airport."

Tabulated data display a summary of the measured noise levels at each location expressed as noise levels exceeded 1, 10, 50, 90 and 99 percent of the time in A-weighted decibels. The standard deviation, minimum and maximum A-weighted levels are also tabulated.

DOT-TSC-OST-72-20
COMPUTER MODELING OF TRANSPORTATION-GENERATED AIR POLLUTION. A STATE-OF-THE-ART SURVEY
Transportation Systems Center.
Eugene M. Darling Jr.
PB-213-013
Final Report. June 1972. 131p.

Air Pollution-Models

This report surveys the state-of-the-art in air pollution modeling with particular emphasis on the modeling of dispersion from transportation sources. Models which have actually been implemented are stressed and the computational aspects of these models are treated in detail. Applications are discussed and validations are critically assessed. It was found that Gaussian and conservation of mass models are currently the most widely used tools for analyzing the dispersion of pollutants in the atmosphere. Models presently in operation are run on medium to large-scale computers of the IBM 360/50 class or greater and nearly all of these models are programmed in FORTRAN IV. Although existing models have been applied to a wide variety of air pollution problems, their performance has not been adequately evaluated. This deficiency is primarily due to the fact that, until recently, instrumented transportation test sites have not existed and hence very little validation data have heretofore been generated. However, such test sites do now exist and data from them is beginning to become available, hence the validation of dispersion models will soon be feasible.

DOT-TSC-OST-72-23
FIVE-YEAR COMPUTER TECHNOLOGY FORECAST
Transportation Systems Center.
Andres Zellweger.
PB-214-577
Final Report. December 1972. 102p.

Computers

This report delineates the various computer system components and extrapolates past trends in light of industry goals and physical limitations to predict what individual components and entire systems will look like in the second half of this decade. The report will emphasize the nature of components (e.g. CPUs, primary memories, secondary memories, ultra large storage devices, etc.) and the system architectures that will be commercially available as "off-the-shelf" items rather than one-of-a-kind systems that might exist in five years.

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DOT-TSC-OST-72-20
FY 72 COMPUTER UTILIZATION AT THE TRANSPORTATION SYSTEMS CENTER
Transportation Systems Center.
David B. Hiatt.
PB-218-461
Final Report. August 1972. 21p.

Computers

The Transportation Systems Center currently employs a medley of on-site and off-site computer systems to obtain the computational support it requires. Examination of the monthly User Accountability Reports for FY72 indicated that during the fiscal year TSC personnel made direct expenditures for the use of eighteen different digital computer systems – eight on-site systems and ten systems owned and maintained outside TSC. The magnitude of this usage was equivalent to a single CDC 6600 computer system. The total computation hours utilized were equivalent to 1860 CDC 6600 CPU hours – a single shift – and the estimated dollar value was $1.38 million – approximately the annual rental cost of a CDC 6600.

Examination of the pattern of this usage indicated that (a) TSC was still oriented toward hardware testing and component design – generally termed hard technology – in FY 72, and (b) TSC's scientific computer users rely on off-site systems for the bulk (69%) of their computer support.

DOT-TSC-OST-72-25
THE USE OF MODELS IN URBAN TRANSPORTATION PLANNING
Transportation Systems Center.
William G. Barker.
PB-222-893
Final Report. April 1973. 82p.

Urban Transportation-Models;
Urban Transportation-Planning

The report describes the most commonly used models in urban transportation planning. A background on urban transportation planning is given including changes in planning objectives and the effects of Federal legislation. General concepts and problems in the use of the models are also presented. An assessment of the situation is made and recommendations for improvement are suggested.

DOT-TSC-OST-72-30
ACCUMULATIVE PROBABILITY MODEL FOR AUTOMATED NETWORK TRAFFIC ANALYSIS
Transportation Systems Center.
Charles R. Toye.
PB-218-460
Final Report. October 1972. 68p.

Automated Guideway Transportation;
Dual Mode Systems

This report presents an illustration of the accumulative probability model which is applicable to ground transportation systems where high-speed and close headways are a performance requirement. The paper describes the model, illustrates it with a hypothetical problem, and then applies it to a network route that was actually configurated in a dual mode system study.

The paper also describes and gives a listing of a computer program called Dual which is used to illustrate the model and simulate various route structures.

DOT-TSC-OST-72-31
MBTA RAPID TRANSIT SYSTEM (RED LINE) WAYSIDE AND IN-CAR NOISE AND VIBRATION LEVEL MEASUREMENTS
Transportation Systems Center.
Edward J. Rickley, Robert W. Quinn.
PB-257-127
Final Report. August 1972. 246p.

Noise-Rapid Transit; Massachusetts Bay Transportation Authority

Wayside and in-car noise and vibration characteristics of a late-model mass transit car making up 2-car and 4-car trains are tabulated and analyzed in this report. The MBTA Type 1 South Shore Rapid Transit Car, designed and built by Pullman Standard, Chicago, Illinois, and currently in operation on the Red Line of the Massachusetts Bay Transportation Authority (MBTA) was measured.

Wayside measurements had been made by the tracks of the South Shore Extension of the Red Line 58 days after the official September 1, 1971 opening of this extension. These wayside measurements were repeated six months later.

In-car noise and vibration measurements are made in a selected 2-car train on a typical run over various sections of the Red Line.

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DOT-TSC-OST-72-32
ANALYSIS AND COMPARISON OF SOME AUTOMATIC VEHICLE MONITORING SYSTEMS
Transportation Systems Center.
R. Buck, R. Esposito and M. Unkauf.
PB-222-152/1
Interim Report. July 1973. 72p.

Automatic Vehicle Monitoring

In 1970 UMTA solicited proposals and selected four companies to develop systems to demonstrate the feasibility of different AVM techniques. The demonstrations culminated in experiments in Philadelphia to assess the performance capabilities of each system. The purpose of this report is to analyze and compare those different AVM systems and to answer some specific questions that appear on the FCC Docket No. 18302. These questions are on the performance comparisons of the AVM systems with respect to accuracy, bandwidth, update rate, and data transmission capability. In addition some general considerations on the different AVM systems have been made with respect to performance.

DOT-TSC-OST-72-33
EXPERIMENTAL PLAN FOR CONDUCTING IONOSPHERIC SCINTILLATION MEASUREMENTS USING ATS GEOSTATIONARY SATELLITES AT 136 AND 1550 MHz
Transportation Systems Center.
W. E. Brown III, G. G. Haroules and W. I. Thompson III.
PB-220-564
Interim Report. April 1973. 138p.

Ionosphere-Measurements;
Applications Technology Satellite

An experimental plan for conducting ionospheric scintillation measurements using the geostationary Applications Technology Satellites of 136 MHz and 1550 MHz is presented. A remote unmanned data collection platform is proposed together with detailed design configurations and data collection and analysis procedures. The data collection platform provides a real time readout capability utilizing the ATS-1 or the ATS-3 satellites as a convenient radio relay link. A comprehensive literature search and bibliography are presented in support of the analysis which lead to the design of the remote data collection platform.

DOT-TSC-OST-72-35
SUMMARY DATA FOR SELECTED NEW URBAN TRANSPORTATION SYSTEMS
Transportation Systems Center.
Robert F. Casey.
PB-219-254
Final Report. November 1972. 152p.

Urban Transportation-Planning;
Transportation Systems-Innovations

In this report a selected set of information is presented for the most advanced of the new, unconventional or innovative urban transportation systems. Capsulized are system and vehicle physical characteristics, performance capabilities, costs and availabilities. A functional classification was developed and each system was categorized according to type of service provided. A method for using this data in the development of transportation plans for metropolitan areas is outlined.

DOT-TSC-OST-73-1
ELECTROMECHANICAL POWER SOURCES FOR ELECTRIC HIGHWAY VEHICLES
Arthur D. Little, Inc.
J. H. B. George.
PB-216-622
Final Report. June 1972. 26p.

Fuel Cells; Electric Vehicles

This report summarizes an assessment of electro-chemical power sources (batteries and fuel cells) which are relevant to electric vehicle propulsion. The developments reported herein have taken place since a previous assessment on the same subject was completed by Arthur D. Little, Inc. in 1968 for the U. S. Department of Health, Education and Welfare.

DOT-TSC-OST-73-2
DESCRIPTION OF A GROUND FACILITY FOR CONDUCTING IONOSPHERIC SCINTILLATION MEASUREMENTS WITH THE ATS-5 SPACECRAFT
Transportation Systems Center.
W. E. Brown, III, G. G. Haroules and W. I. Thompson III.
PB-236-651/AS
Interim Report. July 1974. 166p.

Ionosphere-Measurement;
Applications Technology Satellite

Some of the capabilities of the DOT/TSC/Westford Propagation Facility located in Westford, Massachusetts (Latitude: 42.60° N; Longitude: 71.50° W) as they relate to ionospheric scintillation measurements will be described. In particular the following systems will be detailed:

(a) A two element coherent L-band interferometer comprised of 10-foot (3.05 m) diameter antennas spaced 130 feet (39.6 m) on an east-west baseline.

(b) An L-band receiving system with a 10-foot (3.05 m) diameter antenna.

(c) An L-band transmitting system with 225 watts of radio frequency power and a 15-foot (4.75 m) diameter antenna.

(d) A VHF (135.6 MHz) receiving system with a 6 element Yagi array antenna.

(e) An automatic data processing system which includes a minicomputer, a magnetic tape system and a disc system.

A detailed bibliography with over 400 citations is also included.

DOT-TSC-OST-73-3
AIRPORT AND AIR SERVICE ACCESS
Massachusetts Institute of Technology, Department of Civil Engineering
Richard de Neufville, Nigel Wilson, Harley Moore III, Walter Gelerman, Uzi Landau and John Yaney
PB-220-646
DOT-TSC-309
Final Report. March 1973. 156p.

Airport Access

The problems of airport and air service access are investigated in this report. Airport access, primarily an urban transportation system problem, is investigated using data obtained from the Cleveland-Hopkins Airport Access Study and other surveys and studies. The nature of airport access and of passenger behavior with regard to it is investigated to determine what governmental policies might be appropriate. Many of the factors that determine how passengers choose their access mode and, consequently, how they would use a new mode that might be provided cannot readily be affected by governmental action. Massive investment in access modes is not a cost-effective method of changing passenger flows to the airport; improvements in these modes should be of an operational nature.

Airport access is a subset of air service access; attention to problems of the latter may provide more chance to improve service for the air passenger. This study investigates two aspects of the air service access problem: air network configuration and use of satellite airports. Using aggregate delay time as a measure of effectiveness, the most efficient network was found to be one in which traffic is concentrated, reducing network connectivity. However, trade-offs between average quality of service & distributional effects must be considered in policy making. Satellite airports may seem to be a convenient means to improve access to air service in a region, but competitive economic forces discourage both airlines and air passengers from using satellite airports and impel them to concentrate at major terminals. Satellite or reliever fields will not be used significantly by air carriers without some form of governmental coercion.

DOT-TSC-OST-73-4
PROCEEDINGS OF THE SECOND CONFERENCE ON THE CLIMATIC IMPACT ASSESSMENT PROGRAM
Transportation Systems Center.
Anthony J. Broderick, Editor.
PB-221-166
Conference Proceedings. April 1973. 437p.

Atmospheric Measurement; Supersonic Aircraft-Emissions

This volume contains the proceedings of the Second Conference on the Climatic Impact Assessment Program (CIAP), held at the DOT Transportation Systems Center on November 14-17, 1972. It includes 37 invited papers, four unscheduled presentations, three edited panel discussions, and edited question-and-answer sessions following some of the papers. The conference was essentially a progress report on CIAP. Therefore, some of the papers contain new data not yet published elsewhere, others describe detailed experiment plans or hardware for use in the near future, and a few deal with proposed investigations which may be directly relevant to CIAP. The subjects covered include aircraft-engine emissions, the nature of the "undisturbed" stratosphere of 1974, the nature of the "perturbed" stratosphere of 1990-2025, the possible resulting tropospheric perturbations, and the biological and economic effects of such perturbations.

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DOT-TSC-OST-73-9
A SUMMARY OF OPTIMUM TECHNIQUES THAT CAN BE APPLIED TO SUSPENSION SYSTEM DESIGN
Arizona State University, Dept. of Mechanical Engineering.
J. Karl Hedrick.
PB-220-553
Final Report. March 1973. 44p.

Tracked Levitated Vehicles

Summaries are presented of the analytic techniques available for three levitated vehicle suspension optimization problems: optimization of passive elements for fixed configuration; optimization of a free passive configuration; optimization of a free active configuration. The techniques are applied to a heave dynamic model which includes gravity forces, random aerodynamic forces and random guideways making use of penalty functions which include vehicle acceleration, suspension displacement, gap variation, power requirements.

DOT-TSC-OST-73-10
FREIGHT TRANSPORTATION INFORMATION SYSTEMS AND THEIR IMPLICATIONS FOR R&D POLICY
Transportation Systems Center.
Kenneth F. Troup III.
PB-231-049
Final Report. March 1974. 88p.

Freight Transportation-Management

The current use of computerized management information and control systems in intercity freight transportation is examined. Each of the four modes (railroad, motor carrier, maritime and air cargo industries) is investigated. In each case, computer information systems can help improve the operational efficiency of the mode and provide management (and regulators) with more accurate data for decision making. The intermodal data standard and exchange problem is also discussed. Appropriate recommendations for DOT research and development policy are made. These include development of a national railroad management system, development of terminal control systems for railroad yards and intermodal terminals, support to development of a maritime industry information system and increased effort in the area of data facilitation.

DOT-TSC-OST-73-11
INVESTIGATION OF JET NOISE USING OPTICAL HOLOGRAPHY
Massachusetts Institute of Technology, Department of Mechanical Engineering.
Richard F. Salant.
PB-214-112
DOT-TSC-146
Final Report. April 1973. 60p.

Noise-Aircraft

Holographic interferograms have been made of cold, laboratory scale, supersonic air and nitrogen jets in the mach number range of 2.1 to 3.4, and of helium jets in the mach number range of 1.5 to 2.95. These holograms demonstrate that the acoustic field in the vicinity of such jets is dominated by mach waves, each of which can be traced back to a generating disturbance within the jet. The mach waves are generated from an axial position slightly downstream of the nozzle exit to a position near the tip of the potential core. Measurements of each angle indicate that the average convection velocity of the generating disturbances in the air/nitrogen jet is approximately 84% - 90% of the jet velocity for the mach number range 2.1 - 2.7, and approximately 77% of the jet velocity for each mach number range of 2.8 - 3.4. The average convestion velocity of the generating disturbances in the helium jet is approximately 67% of the jet velocity. The disturbances appear to be coherent instabilities rather than turbulent eddies, and extend into the potential core. Accelerometer measurements of nozzle vibration suggest that the disturbances originate upstream of the nozzle.

DOT-TSC-OST-73-12
TRUCK NOISE VI A – DIESEL EXHAUST & AIR INTAKE NOISE
Stemco Manufacturing Company.
Raymon E. Hunt, Kenneth C. Kirkland, Stanley P. Reyle.
PB-222-624
DOT-TSC-533
Final Report. July 1973. 328p.

Noise-Diesel Engines; Noise-Trucks

Exhaust and air intake noise is studied on five truck and bus diesel engines; the Detroit Diesel 6-71 and 8V-71, the Cummins NHC-250 and NTC-350 and the Mack ENDT-675. The noise source is isolated and its sound level measured at a distance of 50' in accordance with SAE-J366a test site conditions.

Detailed exhaust tests are conducted on all engines with three basic styles of exhaust systems. Each system is tested with several mufflers from different manufacturers. Sound

levels without mufflers are also measured on each engine. The results of these tests are summarized and comparisons are made of exhaust systems, engines and mufflers.

Air intake noise tests are conducted with and without air cleaners installed. At least two different air cleaners are tested on each engine. A comparison is made of air intake sound levels between the engines and intake systems.

A survey is made of muffler and air cleaner manufacturers to obtain information on size, price, and expected performance of the products tested.

A survey on engine specifications is also included.

DOT-TSC-OST-73-14
RESEARCH AND DEVELOPMENT OPPORTUNITIES FOR IMPROVED TRANSPORTATION ENERGY USAGE
Transportation Systems Center.
PB-220-612
September 1972. 94p.

Fuel Consumption-Transportation

The almost complete dependence of transportation systems upon petroleum products makes the transportation sector vulnerable to increased prices of petroleum or insecure sources of petroleum. Since the dependence of transportation upon imported petroleum is projected to increase substantially over the next two decades, both short- and long-term remedial actions should be initiated now and in the next few years because of the long time needed to bring about evolutionary changes in the Nation's transportation systems. Possible remedial actions include:

1. Technological improvements for more efficient use of petroleum by transportation.
2. Technological changes to permit greater use of non-petroleum energy resources by transportation.
3. Shift of transportation demand to more efficient modes from less efficient modes.
4. Reduction of demand for transportation services.

Transportation energy demand projections are given and R&D tasks in each of the first three categories are assessed.

DOT-TSC-OST-73-16A, I
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME I: SUMMARY
Transportation Systems Center.
Peter Benjamin, J. Barber, R. Favout, D. Goeddel, C. Heaton, R. Kangas, G. Paules, E. Roberts, L. Vance.
PB-236-425/5GI
Final Report. December 1973. 40p.

Automated Guideway Transportation; Dual Mode Systems

Various forms of Dual Mode transportation were analyzed in order to assess the economic viability of the Dual Mode concept. A Dual Mode vehicle is one which operates under manual control on a street network for some portion of its trip, and operates under automatic control on an exclusive guideway for some other portion. Specially designed, new, small Dual Mode vehicles, modifications of existing automobiles, and pallet systems, all operating in conjunction with Dual Mode buses, were examined. The study was conducted in a Boston 1990 scenario, in which an extensive Dual Mode system providing service for the entire urban region was presumed to exist. This study was not intended to be a proposal for Dual Mode in Boston. The following conclusions are considered to be generally applicable to other large urban areas as well: (a) Dual Mode systems appear to be sufficiently attractive to warrant further technological development; (b) for urban-wide applications, a Dual Mode system which includes both buses and personal vehicles is more effective than one consisting of either fleet of vehicles alone; (c) a Dual Mode transportation system benefits from the use of various Dual Mode concepts throughout its development.

An effective first step might be to install a limited network Dual Mode minibus system, with capacity for ultimate growth to a longer guideway network with personal vehicles and buses.

DOT-TSC-OST-73-16A, II
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME II: STUDY RESULTS
Transportation Systems Center.
Peter Benjamin et al.
PB-236-426/3GI
Final Report. April 1974. 242p.

Automated Guideway Transportation; Dual Mode Systems

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DOT-TSC-OST-73-16A, III
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME III: DESCRIPTION OF THE ANALYSIS TECHNIQUES AND DATA SOURCES
Transportation Systems Center.
Peter Benjamin et al.
PB-236-427/1GI
Final Report. December 1973. 344p.

Automated Guideway Transportation; Dual Mode Systems

DOT-TSC-OST-73-16A, IIIA
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME IIIA: APPENDIXES
Transportation Systems Center.
Peter Benjamin et al.
PB-236-428/9GI
Final Report. December 1973. 152p.

Automated Guideway Transportation; Dual Mode Systems

DOT-TSC-OST-73-16A, IVA
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME IVA: PROGRAM DOCUMENTATION OF THE TRANSPORTATION ECONOMIC ANALYSIS MODEL
Transportation Systems Center.
Peter Benjamin, et al.
PB-241-361
Final Report. December 1973. 236p.

Automated Guideway Transportation; Dual Mode Systems

DOT-TSC-OST-73-16A IVB
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME IVB (CONTINUED)
Transportation Systems Center.
Peter Benjamin et al.
PB-241-362
Final Report. December 1973. 248p.

Automated Guideway Transportation; Dual Model Systems

DOT-TSC-OST-73-16A, IVC
ANALYSIS OF DUAL MODE SYSTEMS IN AN URBAN AREA, VOLUME IVC (CONCLUDED)
Transportation Systems Center.
Peter Benjamin et al.
PB-241-363
Final Report. December 1973. 204p.

Automated Guideway Transportation; Dual Mode Systems

DOT-TSC-OST-73-17
DESCRIPTION OF A REMOTE IONOSPHERIC SCINTILLATION DATA COLLECTION FACILITY
Transportation Systems Center.
W. E. Brown, III, G. G. Haroules and W. I. Thompson, III.
PB-230-893
Interim Report. March 1974. 96p.

Ionosphere-Measurement; Applications Technology Satellite

An experimental technique is described which measures L-band ionospheric scintillation at a remote, unmanned site. Details of an automatic data collection facility are presented. The remote facility comprises an L-band receiver, and a complete VHF command and control telemetry link which are coupled through an integral computer. The remote facility is controlled from a central data collection facility via the VHF link through either the ATS-1 or ATS-3 spacecrafts. L-band scintillation measurements taken at the remote facility are also relayed through the spacecraft to the central facility.

DOT-TSC-OST-73-18
WAYSIDE NOISE AND VIBRATION SIGNATURES OF HIGH-SPEED TRAINS IN THE NORTHEAST CORRIDOR
Transportation Systems Center.
Edward J. Rickley, Robert W. Quinn, Norman R. Sussan.
PB-224-120
Final Report. September 1973. 144p.

Noise-Railroads

Measurements were made of the wayside noise and ground vibration levels generated during the passby of high-speed Metroliner and Turbotrains operating on the tracks of the Penn-Central Railroad. The Metroliner in operation on the New York-to-Washington line was measured in Plainsboro, New Jersey. The Turbotrain in operation on the Boston-to-New York line was measured in West Mansfield, MA. In addition, freight trains and conventional passenger trains were measured and recorded.

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This report contains tabulations of the passby noise and vibration levels measured, time history level recordings and 1/3-octave frequency analyses of representative passby data. Pertinent comments on information obtained are included.

DOT-TSC-OST-73-19
PREDICTION OF V/STOL NOISE FOR APPLICATION TO COMMUNITY NOISE EXPOSURE
United Aircraft Corporation, Sikorsky Aircraft Division.
Charles L. Munch.
PB-221-140
DOT-TSC-438
Final Report. May 1973. 280p.

Noise-Aircraft; STOL Aircraft

A computer program to predict the Effective Perceived Noise Level (EPNL), the tone corrected Perceived Noise Level (PNLT), and the A-Weighted Sound Level (dBA) radiated by a V/STOL vehicle as it flies along a prescribed takeoff, landing, or cruise flight path is described in detail and a complete users guide for the program is presented. The procedures used to predict the noise radiated by helicopter rotors, propellers, turboshaft engines, lift and cruise fans, and jets are described in detail. Helicopter rotor noise and jet noise are theoretically predicted with some empirical modifications while propeller, fan, and turboshaft engine noise is calculated with primarily empirical procedures. The program is designed to be easy to use; thus it should be useful in V/STOL-port planning studies.

There are major limitations of current technology on the use of the program; the noise of VTOL vehicles characterized by impulsive type noise signatures should not be predicted and, because there are not yet adequate methods for predicting the noise from deflected jets, augmentor wings, blown flaps, and the like, noise of augmented lift STOL aircraft cannot yet be predicted. There is, in fact, some evidence to indicate that the EPNL measure does not adequately predict the annoyance of impulsive noise signatures and it is hoped that improved measures to account for the annoyance of impulsive noise will be developed in the near future.

DOT-TSC-OST-73-22
COMPARATIVE STUDIES OF THE SUPERSONIC JET NOISE GENERATED BY RECTANGULAR AND AXISYMMETRIC NOZZLES
Massachusetts Institute of Technology, Department of Aeronautics and Astronautics.
Khoon Cheang Low, Jean F. Louis.
PB-221-855
DOT-TSC-142
Final Report. June 1973. 118p.

Noise-Aircraft; Supersonic Aircraft-Noise

The main purpose of this study is to develop experimental scaling laws useful for predicting the overall sound power of supersonic jets operating under a range of high stagnation temperatures and pressures and under various exit Mach numbers. A shock tube is used as a flexible tool to provide the range of high stagnation temperatures and pressures associated with the supersonic jets in this investigation. The range of stagnation pressures chosen (for a given temperature and Mach number) correspond to overexpanded, perfectly expanded and underexpanded conditions of the jet. Two different nozzle configurations: a rectangular and an axisymmetric, are examined to determine how a basic difference in shape of the jet changes the relative importance of the different noise generating mechanisms. Measured sound directivity and Mach waves propagation direction obtained from shadowgraphs indicate that Mach waves contribute importantly to the noise produced by a rectangular jet. Similar measurements made on the axisymmetric jet indicate stronger influence of shock-induced noise and in particular of shock turbulence interaction. To guide the formulation of scaling laws for the prediction of overall sound power, a theoretical model is proposed which derives expressions for the power sound level associated with Mach waves and for shock turbulence interaction. Concurrent use of the model and of experimental data allow the formulation of scaling laws for the overall sound power. The quasi two-dimensional flow from the rectangular nozzle gave an opportunity to study Mach and nozzle lip waves for both low and high temperature jets.

DOT-TSC-OST-73-24
THE TRANSPORTATION AIR POLLUTION STUDIES (TAPS) SYSTEM
Transportation Systems Center.
David S. Prerau, Paul J. Downey.
PB-230-919
Interim Report. March 1971. 124p.

Air Pollution-Models

This report describes the Transportation Air Pollution Studies (TAPS) Data Base and the Software System which

has been developed in association with it.

The TAPS Data Base will be used to store the transportation air pollution data (including emissions, meteorological and other data) which are required for the TSC model validation program. The TAPS System is a package of computer programs for storing, manipulating and retrieving data. The system also contains routines for analyzing the performance of dispersion models as well as programs to generate both tabular and graphical output.

Users guides for both the storage and retrieval programs of the TAPS System are included as well as examples of how these programs might be used. The report also contains complete listings for the TAPS System.

DOT-TSC-OST-73-25
COMPARISON OF MULTIPLE BEAM COVERAGE TO EARTH COVERAGE FOR A MARITIME SATELLITE SYSTEM
Transportation Systems Center.
C. J. Murphy.
PB-226-664
Interim Report. December 1973. 46p.

Maritime Communication-Satellite; Satellites-Maritime

Preliminary tradeoff comparisons are analyzed for a possible baseline L-Band maritime communications satellite system. Primary emphasis is given to major shipping routes with secondary coverage elsewhere. A low cost satellite configuration is postulated based on a Thor-Delta class satellite. Computer analyses are conducted to assess tradeoffs between satellite antenna complexity, in terms of multiple beam vs. earth coverage, and user access delay time and shipboard antenna complexity in terms of gain. Tentative conclusions show that under the constraints imposed by weight (but disregarding reliability) multiple beam satellite coverage vs. earth coverage may result in from 3 to 5 dB reduction in shipboard antenna gain. This reduction is based strictly on a link power margin point of view. In making the comparisons user access delay was an arbitrating factor. Many other system tradeoffs must be considered. The methodology and computer programs prepared for the preliminary analyses reported herein are the main contributions at this time. The results of these analyses should be useful in establishing maritime satellite system guidelines.

DOT-TSC-OST-73-26.I
GAS TURBINE ENGINE PRODUCTION IMPLEMENTATION STUDY, VOLUME I: EXECUTIVE SUMMARY
Aerospace Corporation, Urban Programs Division.
D. E. Lapedes, L. Forrest, F. G. Ghahremani, O. Hamberg, W. U. Roessler, W. M. Smalley, M. Hinton, T. Iura, J. Meltzer
PB-225-465
EPA 68-01-0417
Final Report. July 1973. 48p.

Motor Vehicles-Design; Gas Turbines

This report presents a summarization and assessment of available information pertaining to the potential for implementing mass production of gas turbine engine-powered automobiles. The main topic covered is the schedule requirement for that implementation. Emphasis has been directed toward identifying those critical or limiting factors affecting timely introduction of gas turbine engine concepts on a mass production basis. A description of basic automotive product development phases, engine manufacturing processes, and gas turbine engine current technology status are included to clarify and augment the discussions, and to permit the necessary understanding of the developed implementation schedules.

Based on data acquired during the period February 28 to April 30, 1973, a period of 8 to 10 years is a best estimate of the elapsed time until 300,000 gas turbine engines are mass produced annually. This estimate is based on a postulated overall product development schedule of slightly more than 11 years. Prior to major commitment of capital resources necessary for adherence to this schedule, automobile manufacturers must resolve three major issues: 1) improvements in engine fuel economy and exhaust emissions; 2) development of new mass production fabrication processes directed at reducing engine unit cost, and 3) statistical evidence of engine durability in fleet test cars.

DOT-TSC-OST-73-26.II
GAS TURBINE ENGINE PRODUCTION IMPLEMENTATION STUDY, VOLUME II: TECHNICAL DISCUSSION
Aerospace Corporation, Urban Programs Division.
D. E. Lapedes, L. Forrest, F. G. Ghahremani, O. Hamberg, W. U. Roessler, W. M. Smalley, M. Hinton, T. Iura, J. Meltzer.
PB-225-466
EPA 68-01-0417
Final Report. July 1973. 260p.

Motor Vehicles-Design; Gas Turbines

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DOT-TSC-OST-73-27
TARGET ACQUISITION PERFORMANCE OF A SATELLITE BASED MULTIPLE ACCESS SURVEILLANCE SYSTEM
Transportation Systems Center.
H. D. Goldfein.
PB-241-633/AS
Final Report. March 1975. 100p.

AATMS; Air Traffic Control-Satellite

A quantitative description of the detection performance of a satellite-based surveillance system is presented. This system is one which has been proposed for CONUS coverage in an advanced air traffic control system. In addition, the computer program which was used to simulate the random access surveillance link for this system is described. This computer program is applicable for analysis of a broad range of random access surveillance systems.

DOT-TSC-OST-73-29, I
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME I. SUMMARY
Autonetics
H. T. Freedman, C. S. Hoffman, B. N. Gaon, T. Felisky, W. Fried.
PB-234-264
DOT-TSC-508
Final Report. February 1974. 138p.

Air Traffic Control-Satellite; SAATMS (Satellite-Based Advanced Air Traffic Management System)

This report contains the results of studies and analyses directed toward the definition of a Satellite-Based Advanced Air Traffic Management System (SAATMS). This system is an advanced, integrated air traffic control system which is based on the use of a satellite constellation for surveillance, navigation, and communications. The system is designed to service the anticipated air traffic density (commercial, military, and general aviation), predicted for the period from 1995 and beyond. The major items discussed in this report include the definition of user classes, the management concept, the system services and functions, the system description, system costs, the system performance, transition into full system operation, and the RDT&E plan. The report is presented in ten volumes. This volume summarizes the study findings.

DOT-TSC-OST-73-29, II
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME II. SYSTEM FUNCTIONAL DESCRIPTION AND SYSTEM SPECIFICATION
Autonetics.
R. G. Loeliger, J. H. Mitzel, C. S. Hoffman, H. T. Freedman, K. C. Kochi, C. A. Wolfe, W. R. Fried.
PB-234-265
DOT-TSC-508
Final Report. February 1974. 152p.

Air Traffic Control-Satellite; SAATMS

This volume provides a functional description and specification for the Satellite-Based Advanced Air Traffic Management System. The system description is presented in terms of the surveillance, navigation, and communications functions along with the additional supportive sub-functions needed to implement the basic functions. The volume includes a description of the basic system and backup philosophy, the system architecture and information flow between the elements required to achieve a cohesive system organization, and the satellite constellation and tracking subsystem. A preliminary system specification in the format of MIL-STD-490A is also presented.

DOT-TSC-OST-73-29, III
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME III, SUBSYSTEM FUNCTIONAL DESCRIPTION
Autonetics.
R. G. Loeliger, F. S. Nakamoto, R. A. Gronlund, H. T. Freedman, J. W. Petway, R. J. Meisch, C. A. Wolfe.
PB-234-266
DOT-TSC-508
Final Report. February 1974. 218p.

Air Traffic Control-Satellite; SAATMS

This volume presents a detailed description of the subsystems that comprise the Satellite-Based Advanced Air Traffic Management System. Described in detail are the surveillance, navigation, communications, data processing, and airport subsystems. The electronics required to implement each subsystem is also presented. The subsystem descriptions include a detailed description of the subsystem mechanization, the rationale for its selection, and the expected performance of each subsystem. The electronics are presented in block diagram form. Particular emphasis is placed on the integrated avionic hardware associated with each subsystem mechanization.

Included in the mechanization description of each subsystem are the basic analyses, algorithms, and equations that were used to implement the subsystem. The details of the analyses and assumptions underlying the data presented in this volume can be found in Volume IX of this report.

DOT-TSC-OST-73-29, IV
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME IV. OPERATIONAL DESCRIPTION AND QUALITATIVE ASSESSMENT
Autonetics.
C. S. Hoffman, H. T. Freedman, C. V. Hamilton, W. R. Fried.
PB-234-267
DOT-TSC-508
Final Report. February 1974. 118p.

Air Traffic Control-Satellite; SAATMS

This volume presents a description of how the Satellite-Based Advanced Air Traffic Management System operates and a qualitative assessment of the system. The operational description includes the services, functions and tasks performed by the system, a description of user classes, the airspace structure, and rules and procedures. The concept for managing air traffic is then presented. It is characterized by pilot responsibility for conforming to a flight path while the ground concentrates on assuring flight safety, minimizing capacity, and minimizing delay. A discussion of the SAATMS automation philosophy and a description of how an aircarrier and a GA aircraft fly through the system complete the operational description. The qualitative assessment is concerned with three main issues: can the SAATMS readily be built as defined, what happens to the system after it is built and conditions change from what was assumed during the development stage, and the extent to which the system is vulnerable to intentional and unintentional interference.

DOT-TSC-OST-73-29, V
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME V. SYSTEM PERFORMANCE
Autonetics.
J. C. Elsey, J. B. King, I. M. Weiss, K. M. Armstrong, C. Chen, J. Hsu, T. C. Lu, R. P. Utsumi.
PB-234-268
DOT-TSC-508
Final Report. February 1974. 150p.

Air Traffic Control-Satellite

This volume presents the results of the performance evaluation of the Satellite-Based Advanced Air Traffic Management System (SAATMS). The evaluation established the capacity, safety, and delay performance of the system for the Los Angeles Basin terminal area operations. The results of the performance evaluation were compared to the established performance specification. SAATMS provides capacity exceeding the highest traffic demand projected for 1995 while meeting the delay specification and maintaining the safety level provided by the present system. An evaluation of enroute safety is presented, along with a comparison of the enroute safety provided by the present system and a Ground-Based Advanced Air Traffic Management System (GAATMS). The system and subsystem parameters which influence the functioning of SAATMS are discussed, as are the functional relationships between the system performance measures and the system and subsystem parameters. The analytical expressions and the digital simulation used to evaluate SAATMS are presented along with a discussion of the methodology, the scenarios, and the constraints used in the evaluation. This volume also presents the results of a sensitivity analysis which shows the impact of the system and subsystem parameters on the capacity, safety, and delay performance measures.

DOT-TSC-OST-73-29, VI
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME VI. DEVELOPMENT AND TRANSITION PLANS
Autonetics.
H. T. Freedman, W. R. Fried, C. S. Hoffman, J. B. King, C. V. Hamilton.
PB-234-269
DOT-TSC-508
Final Report. February 1974. 116p.

Air Traffic Control-Satellite; SAATMS

This volume presents the plans for implementing the Satellite-Based Advanced Air Traffic Management System (SAATMS) described in Volume II, III, and IV. Two plans are presented: an RDT&E plan and a transition plan. The RDT&E is presented as a series of task descriptions which delineate the activities that must be performed to generate requirements and to develop the hardware and software that comprise the various components of the system. The plan also describes those management tasks necessary to document and control the orderly development of the system. Development schedules and associated costs are also presented.

The transition plan presents a two-phase, 13-year program for transition from the in-being system to the SAATMS. The plan describes how the facilities, services, equipment, and

rules governing operation in the SAATMS are phased in and the in-being system is phased out. The plan is designed to minimize user costs and avoid federal government budget peaks. A schedule of various regulations governing the installation of SAATMS avionics equipment in user aircraft is also presented.

DOT-TSC-OST-73-29, VII
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME VII. SYSTEM COST
Autonetics.
T. Felisky, H. T. Freedman.
PB-234-270
DOT-TSC-508
Final Report. February 1974. 164p.

Air Traffic Control-Satellite; SAATMS

This volume presents estimates of the federal government and user costs for the Satellite-Based Advanced Air Traffic Management System and the supporting rationale. The system configuration is that presented in Volumes II and III. The cost estimates are also based upon the development and transition plans in Volume VI. The costing methodology and procedures used are presented. Cost summaries and detailed cost breakdowns by Research and Development, Facilities and Equipment, and Operations and Maintenance costs for the ground sites and satellites are provided for the federal government costs. Summaries and breakdowns by user class and by purchase, installation, and maintenance costs are provided for the user avionics costs. Various cost analyses are also provided, including the estimated annual expenditures for various transition schedules and comparisons with ground-based ATC systems.

DOT-TSC-OST-73-29, VIII
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME VIII. OPERATIONAL LOGIC FLOW DIAGRAMS FOR A GENERIC ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
Autonetics.
C. V. Hamilton, C. S. Hoffman, J. B. King, R. J. Knight.
PB-234-271
DOT-TSC-508
Final Report. February 1974. 184p.

Air Traffic Control-Satellite; SAATMS

This volume presents a description of the services a generic Advanced Air Traffic Management System (AATMS) should provide to the users of the system to facilitate the safe, efficient flow of traffic. It provides a definition of the functions which the system must perform to provide these services and relates them to the various phases or segments of flight encountered in a general flight profile. This document also presents a series of detailed operational logic flow diagrams which specify individual tasks or activities which must be accomplished to complete each function. These flow diagrams were generated as an aid in the development of a digital simulation of an AATMS. They are required as a basis for subsystem mechanization and for the analysis of system implementations.

DOT-TSC-OST-73-29, IX
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME IX. SYSTEMS AND SUBSYSTEM PERFORMANCE MODELS
Autonetics.
C. Chen, R. G. Loeliger, F. S. Nakamoto, J. C. Elsey, J. B. King, J. H. Mitzel, J. W. Petway, I. M. Weiss, C. A. Wolfe.
PB-234-272
DOT-TSC-508
Final Report. February 1974. 140p.

Air Traffic Control-Satellite; SAATMS

This volume presents the models used to analyze basic features of the system, establish feasibility of techniques, and evaluate system performance. The models use analytical expressions and computer simulations to represent the relationship between system structure and state variables, system inputs, and system output measures.

This volume presents the following information: (1) Descriptions of the performance models and simulations used in the evaluation of the Satellite-Based Advanced Air Traffic Management System (SAATMS), (2) the simulation used to determine the capacity and delay performance of SAATMS, (3) the language, simulation methods, and basic structure of the simulation, (4) the models used in the evaluation of the SAATMS safety, (5) the criteria used in the selection of the safety model along with its derivation and application, (6) a description of the subsystem performance models used in the analysis of the surveillance detection scheme, (7) the covariance analyses for the satellite tracking, surveillance, and navigation subsystems, and (8) the analysis of the satellite constellation to determine the effect of the constellation on the geometric dilution of precision.

This volume should be used in conjunction with Volume III where subsystem mechanizations are presented and Volume V where system performance is analyzed.

DOT-TSC-OST-73-29, X
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM, VOLUME X. SUBSYSTEM PERFORMANCE REQUIREMENTS
Autonetics.
J. B. King, C. I. Chen, R. P. Utsumi
PB-234-273
DOT-TSC-508
Final Report. February, 1974. 96p.

Air Traffic Control-Satellite; SAATMS

This volume presents the results of the subsystem performance requirements study for an Advanced Air Traffic Management System (AATMS). The study determined surveillance and navigation subsystem requirements for terminal and enroute area operations. It also established the approach guidance requirements for VOR, Category I, and Category II landing conditions. Subsystem requirements were based on a specified system operating point, namely, a peak busy hour runway capacity of over 100 operations/hour, protection against blunder accelerations of 22 ft/sec^2 or less, and an IFR separation standard of 1.5 nmi without considering the effects of wake turbulence. The study assumed that requirements for surveillance and navigation position accuracy should be identical to provide a fail-operational system. The enroute surveillance and navigation subsystem requirements were based on the same safety level as used in the terminal area (i.e., protection against blunders of less than 22 ft/sec^2) and on specified separation distances of 5, 7, and 10 nmi. The results of the VVOR suitability analysis indicated that approach guidance requirements for VOR landing conditions were approximately the same as those for terminal area operations. A discussion of the methodology used in the study and a description of the models and simulations utilized to establish the subsystem performance requirements is also presented.

DOT-TSC-OST-73-32, I
AIRPORT ACCESS/EGRESS SYSTEMS STUDY, VOLUME I – TEXT
Wilbur Smith and Associates.
Edward M. Whitlock and David B. Sanders.
PB-223-842-1
DOT-TSC-462
Final Report. September 1973. 172p.

Airport Access

Studies of airport activities and user characteristics at 34 high volume U. S. Airports indicate that disbursed trip origins cannot economically justify rapid transit corridor investments dedicated to airport access travel. Generally, airports have too much off-roadway parking in central terminal areas and this concentration of vehicular activities near terminal building congests internal roadways. The study proposes a number of low-capital improvement concepts to airport access/egress. These improvements are generally directed towards improving the traffic flow in the central terminal area through better flow controls, diversion of automobile traffic from the central terminal area, and changes in travel patterns. The latter can be changes in mode and/or time of travel. Three specific operational experiments are proposed to evaluate the effectiveness of the proposed concepts. The experiments are a remote parking experiment at Detroit Metropolitan Airport, bus-rail links from LaGuardia and Kennedy Airports in New York and evaluation of a garage-baggage handling system at Seattle-Tacoma Airport. Cost of implementing all these experiments is estimated to be $1.444 million. The report is presented in two volumes; the first includes airport and user characteristics and details on the execution of the operational experiments; and, the second, an appendix volume, describes supporting data and airport master plans collected in the field surveys.

DOT-TSC-OST-73-32, II
AIRPORT ACCESS/EGRESS SYSTEMS STUDY, VOLUME II – APPENDIXES
Wilbur Smith and Associates
Edward M. Whitlock and David B. Sanders.
PB-223-842-2
DOT-TSC-462
Final Report. September 1973. 202p.

Airport Access

DOT-TSC-OST-73-33
CHANNEL MEASUREMENTS FOR AUTOMATIC VEHICLE MONITORING SYSTEMS
Transportation Systems Center and Proteon Associates.
R. Buck and H. Salwen.
PB-231-604
DOT-TSC-545
Final Report. March 1974. 72p.

Automatic Vehicle Monitoring

Co-channel and adjacent channel electromagnetic interference measurements were conducted on the Sierra Research Corp. and the Chicago Transit Authority automatic vehicle monitoring systems. These measurements were made to determine if the automatic vehicle monitoring systems could operate in the land mobile communication channels without affecting the performance of existing channel users.

Evaluation measurements were also performed on the Chicago Transit Authority AVM system to determine the cause

of failures between the base control station and the mobile vehicles.

DOT-TSC-OST-73-34
ENERGY STATISTICS. A SUPPLEMENT TO THE SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
Gill V. Hicks.
PB-225-331
Final Report. September 1973. 112p.

Fuel Consumption-Statistics

This report is a compendium of selected time-series data describing the transportation, production, processing, and consumption of energy. The statistics have been assembled from a wide variety of sources, such as the U. S. Department of the Interior, the Interstate Commerce Commission, and the American Petroleum Institute.

The report is divided into three main sections. The first, entitled "Energy Transport", contains such items as the revenues and expenses of oil pipeline companies, number and capacities of U. S. tank ships, and the total crude oil transported in the U. S. by method of transportation.

The second section, entitled "Reserves, Production, and Refining", reveals the growth over time of the U. S. oil and natural gas reserves, refinery capacity, and yields.

Trends in the demand for fuel and power are displayed in the third section, entitled "Energy Consumption". Throughout this part, the transportation sector is emphasized. Included are the gasoline and oil costs of automobiles of different sizes, the consumption of petroleum by type of product, the energy intensiveness of the air carriers, the electrical energy consumed by the local transit industry, and other important statistics describing the supply and demand for energy.

DOT-TSC-OST-73-35
A CARGO DATA MANAGEMENT DEMONSTRATION SYSTEM
Transportation Systems Center.
Juris G. Raudseps, Robert S. Tinkham.
PB-229-997
Final Report. February 1974. 92p.

Freight Transportation Management

Delays in receipt and creation of cargo documents are a problem in international trade. The work described in this report was performed to demonstrate to interested parties some of the advantages and capabilities of a computer-based cargo data management system. A demonstration system for data management and transmission was assembled at the Transportation Systems Center in Cambridge, MA, tested, and demonstrated. Terminals were installed at a site (Washington, D. C.) remote from the central processor at TSC, with which they communicated by direct distance dialing over telephone lines. The processor prepared tapes for transmission of data to Heathrow Airport, London, via teletype circuits. The tests demonstrated remote data entry, validation, editing, updating, retrieval, privacy protection, and teleprinting of multiple documents from a common data base. This report first broadly describes the technical approach taken and the principal lessons learned. Succeeding chapters describe the capabilities of the demonstration system, specify operating procedures, and document the data structure, the hardware, and the software in detail.

DOT-TSC-OST-73-36
SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
Gill V. Hicks, Sherri Y. Sheppard
PB-226-747
Final Report. November, 1973. 128p.

Transportation-Statistics

This report is a compendium of selected national-level transportation statistics. Included are cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water, and oil pipeline. Published annually in November, the report includes basic descriptors of U. S. transportation, such as operating revenues and expenses, number of vehicles and employees, vehicle-miles and passenger miles, etc.

As its name implies, the report is a summary of a larger data base, consisting of time-series collected from a variety of government and private statistical handbooks. In this edition, the selected data cover the period 1961 through 1971.

OFFICE OF THE SECRETARY OF TRANSPORTATION

DOT-TSC-OST-73-37
COMPUTER ANALYSIS OF AIR POLLUTION FROM HIGHWAYS, STREETS, AND COMPLEX INTERCHANGES. A CASE STUDY: PORTIONS OF THE PROPOSED 3-A SYSTEM IN 1978, BALTIMORE, MD.
Transportation Systems Center.
Eugene M. Darling Jr., David S. Prerau, Paul J. Downey.
PB-231-334
Final Report. March 1974. 158p.

Air Pollution-Models

In connection with Mr. Darling's appearance as an expert on air quality for the Government in the trial of a citizen suit (filed to stop construction of the 3-A System of highways in Baltimore) under the Clean Air Act, the Transportation Systems Center prepared a detailed computer analysis of air quality for a complex highway interchange, using an in-house version of the Environmental Protection Agency's Gaussian Highway Line Source Model. This analysis showed that the levels of air pollution near this interchange in the year 1978 would not exceed established standards.

This analysis is treated as a case study, illustrative of a methodology which is useful for computing air pollution levels associated with many highway configurations. The individual ingredients of the analysis are described in detail, including the handling of road geometry, the calculation of emissions, the estimation of meteorological parameters and the selection of receptor locations. A complete listing of the computer program used in these studies is included.

It is concluded that the air quality analysis methodology developed for this case is an easy-to-use, straightforward procedure of general applicability. Within the limitations of the model and subject to the accuracy of the input data, this approach can produce reasonable estimates of worst-case pollutant concentrations for comparison with national ambient air quality standards.

DOT-TSC-OST-73-38
TRUCK NOISE VI B, A BASELINE STUDY OF THE PARAMETERS AFFECTING DIESEL ENGINE INTAKE AND EXHAUST SILENCER DESIGN
Donaldson Company, Inc.
Thomas Donnelly, Joseph Tokar, Wayne Wagner.
PB-230-317
DOT-TSC-532
Final Report. January 1974. 232p.

Noise-Diesel Engines; Noise-Trucks

A survey of diesel engine, truck, intake system, and exhaust system manufacturers was made for the purpose of compiling detailed information on: 1) all major mass-produced diesel engines currently used in the United States for trucks and buses, and on 2) existing or available-for-order diesel engine intake and exhaust silencers. This survey was conducted by written questionnaire.

Survey information was supplemented with comparative data on the acoustic characteristics of diesel engines and the acoustic performance of selected intake and exhaust systems. These data were obtained through engine dynamometer and vehicle drive-by tests.

All survey and test information was compiled and presented in tabular form by engine model to allow data comparison and silencer system selection.

DOT-TSC-OST-73-39, I-III
IMPROVING THE TRANSPORTATION PLANNING PROCESS IN SMALL CITIES, VOLUMES I - III
City of Cambridge, Massachusetts, Department of Traffic & Parking
Edward A. Handy & Michael M. Bernard.
PB-225-575/0
DOT-TSC-296
Final Report. November 1973. 406p.

Urban Transportation-Planning

This report consists of three volumes bound together: Vol. I — The Organizational Framework; Vol. II — The Planning Program; Vol. III — Recommendations for Small Cities.

An advance in the state-of-the-art of municipal transportation planning is described. A planning process that fully considers community value and land use was designed by and for the City of Cambridge with the expectation that such a process could also be used in similar cities.

Volume I of the report describes the existing planning process participants. The concept of a transportation form is then advanced and the establishment, authority and operation of the forum are described.

Volume II, the nature of the City of Cambridge is described as background to a discussion of current transportation problems, goals, and derived policies. A transportation sketch plan for the City is developed which integrates transportation goals with those of land use and social planning. Initial actions to improve the organizational framework for transportation planning are outlined. Specific technical studies needed to support the planning process are then described.

Volume III is a distillation of the material in Volumes I and II into a set of recommendations for other small cities.

OFFICE OF THE SECRETARY OF TRANSPORTATION

DOT-TSC-OST-73-42
FINAL REPORT PROGRAM PLAN FOR SEARCH AND RESCUE ELECTRONICS ALERTING AND LOCATING SYSTEM
Transportation Systems Center.
C. Mundo, L. Tami, G. Larson.
PB-229-998
Final Report. February 1974. 102p.

Search and Rescue-Electronic Aids

This study investigates the requirements that exist for electronic devices for alerting and locating distress incidents and presents a plan for acquiring an adequate capability. Data are provided that bound the problem. Possible alternatives are examined and compared. As a result, the GRAN-DILS concept is selected upon the basis of cost/benefits. A plan for acquiring the GRAN-DILS system is provided. Recommendations are made for the interim period prior to GRAN-DILS availability.

DOT-TSC-OST-73-43
HIGHWAY FUEL CONSUMPTION, COMPUTER MODEL (VERSION I)
Transportation Systems Center.
H. H. Gould, A. C. Malliaris.
PB-231-880
Final Report. April 1974. 134p.

Fuel Consumption-Motor Vehicles

A Highway Fuel Consumption Computer Model is given. The model allows the computation of fuel consumption of a highway vehicle class as a function of time. The model is of the initial value (in this case initial inventory) and lumped parameter type. Parameters included in the analysis are (a) vehicle population in the initial year by fuel economy category and age, (b) the miles driven as a function of age, (c) vehicle survival as a function of age, (d) projections of vehicle populations as a function of time, and (e) the projected fractional mix, by fuel categories, of new vehicles introduced in the vehicle population.

DOT-TSC-OST-73-44, I
NATIONAL GEOCODING CONVERTER FILE 1 VOLUME I, STRUCTURE AND CONTENT
Transportation Systems Center.
Santo LaTores, Editor.
Final Report. February 1974. 40p.

Geocoding

This document describes the structure and content of the DOT National Geocoding Converter File 1. The file is available on magnetic tape and in a printout format, which is printed in Volumes II and III. The file provides the capability of relating spatially oriented data under the various county based geocoding systems which have been developed. It contains a record for each county, county equivalent, Standard Metropolitan Statistical Area (SMSA), county segment or Standard Point Location Code (SPLC) county segment in the U. S., identifying for that county all major county codes and the associated county aggregate codes. The file is of great benefit in coordinating data sets at the national, regional and state wide levels and has useful planning and management and operations applications.

DOT-TSC-OST-73-44, II
NATIONAL GEOCODING CONVERTER FILE I VOLUME II, ALABAMA TO MISSOURI
Transportation Systems Center.
Santo La Tores, Editor.
Final Report. March 1974. 260p.

Geocoding

This document is the printed version of the DOT National Geocoding Converter File 1. The report is arranged alphabetically by state and in ascending sequence by FIPS (Federal Information Processing Standard) code and contains codes for the states Alabama through Missouri. Volume I explains the structure and content of the Converter File.

DOT-TSC-OST-73-44, III
NATIONAL GEOCODING CONVERTER FILE I VOLUME III, MONTANA TO WYOMING
Transportation Systems Center.
Santo La Tores, Editor.
Final Report. March 1974. 244p.

Geocoding

This document is the printed version of the DOT National Geocoding Converter File 1. The report is arranged alphabetically by state and in ascending sequence by FIPS (Federal Information Processing Standard) code and contains codes for the states Montana through Wyoming. Volume I explains the structure and content of the Converter File.

OFFICE OF THE SECRETARY OF TRANSPORTATION

DOT-TSC-OST-73-45
REVIEW OF SAFETY RELATED STATUTORY AUTHORITY ADMINISTERED BY THE DEPARTMENT OF TRANSPORTATION
Transportation Systems Center.
David S. Glater and Nancy Accola.
PB-226-894
Interim Report. October 1973. 40p.

Transportation-Safety-Legislation

This interim report is an overview of the legislative authority giving the Department of Transportation responsiblity for transportation safety. These responsibilities are summarized by mode and modal administration with special emphasis on the R&D role. Legislation dealing with environmental protection which has only incidental impacts on safety has been omitted, as has legislation administered by the Secretary of Transportation for the protection of common carrier employees. Appropriate legislative and regulatory authorities are cited which identify the authorization to perform the R&D in support of the safety responsibilities.

DOT-TSC-OST-73-46
NOISE LEVEL MEASUREMENTS OF RAILROADS: FREIGHT YARDS AND WAYSIDE
Transportation Systems Center.
E. J. Rickley, R. W. Quinn and N. R. Sussan.
PB-234-219
Final Report. May 1974. 248p.

Noise-Railroads

Noise from railroad operations were measured. Noise level data from freight yard operations were measured at the Argentine Freight Yard of the Santa Fe Railroad in Kansas City, Kansas and on a smaller scale in three facilities of the Boston and Maine Railroad in Boston, Massachusetts. In addition, wayside noise data from passenger and line-haul operations were measured on the Penn Central Railroad in New Jersey and Massachusetts, and on the Sante Fe Railroad in Kansas.

This report contains statistical temporal noise data, graphical time history level recordings, and one-third octave frequency spectra of selected data.

DOT-TSC-OST-74-3, I
STRATEGIC CONTROL ALGORITHM DEVELOPMENT VOLUME I: SUMMARY
Beoing Commercial Airplane Company.
R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, A. L. Yarrington et al.
PB-236-719/1GI
DOT-TSC-538
Final Report. August 1974. 76p.

Air Traffic Control-Models

Strategic control is an air traffic management concept wherein a central control authority determines, and assigns each participating airplane, a conflict-free, four-dimensional route-time profile. The route-time profile assignments are long term as compared with the short-term, immediate nature of tactical control instructions. The route-time profiles are determined in a manner that provides for predictable and efficient use of both airspace and available runway operation times. This concept results in terminal area capacity increases, delay reductions, safety improvement, and controller workload reductions. Maximum benefits are expected to occur at the busy terminal areas where demand is high and airspace is at a premium.

This volume summarizes the results of a study to develop the basic algorithm for strategic control of arrivals. The strategic control concept is described as to operational concept, ATC system, airplane system, and application to U. S. airspace. The requirements placed on the algorithm by airplane performance and runway operation are discussed. The logic of the developed algorithm is presented. The algorithm performance was evaluated with a fast-time terminal area simulation; the simulation and algorithm performance are described. The benefits of strategic control in terms of increased airfield capacity, reduced airspace requirements, improved airplane flight economics, and reduced workload and communications are analyzed. Included is a research, development, test, and evaluation (RDT&E) plan for development of strategic control into an operational capability.

DOT-TSC-OST-74-3, IIA
STRATEGIC CONTROL ALGORITHM DEVELOPMENT VOLUME IIA: TECHNICAL REPORT
Boeing Commercial Airplane Company.
R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, A. L. Yarrington et al.
PB-236-720/9GI
DOT-TSC-538
Final Report. August 1974. 238p.

OFFICE OF THE SECRETARY OF TRANSPORTATION

Air Traffic Control-Models

The technical report presents a detailed description of the strategic control functional objectives, followed by a presentation of the basic strategic control algorithm and how it evolved. Contained in this discussion are results of analyses that constrain the design and operation of the strategic control algorithm and a description of the model developed to simulate strategic terminal area operation in order to develop and evaluate the algorithm. The data processing sizing requirements and the application of the strategic control algorithm in terms of time periods and airspace to be served are presented with an overall summary of the benefits of the system. Finally, a proposed research, development, test, and evaluation plan is detailed for developing the strategic control system capabilities for implementation as the primary air traffic management technique for high-density air routes and terminal areas.

Volume IIA includes sections 1 through 5 inclusive. Volume IIB includes sections 6 through 9 inclusive.

DOT-TSC-OST-74-3, IIB
STRATEGIC CONTROL ALGORITHM DEVELOPMENT
VOLUME IIB: TECHNICAL REPORT (CONCLUDED)
Boeing Commercial Airplane Company.
R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell,
A. L. Yarrington et al.
PB-236 721/7GI
DOT-TSC-538
Final Report. August 1974. 182p.

Air Traffic Control-Models

The technical report presents a detailed description of the strategic control functional objectives, followed by a presentation of the basic strategic control algorithm and how it evolved. Contained in this discussion are the results of analyses that constrain the design and operation of the strategic control algorithm and a description of the model developed to simulate strategic terminal area operation in order to develop and evaluate the algorithm. The data processing sizing requirements and the application of the strategic control algorithm in terms of time periods and airspace to be served are presented with an overall summary of the benefits of the system. Finally, a proposed research, development, test, and evaluation plan is detailed for developing the strategic control system capabilities for implementation as the primary air traffic management technique for high-density air routes and terminal areas.

Volume IIA includes sections 1 through 5 inclusive. Volume IIB includes sections 6 through 9 inclusive.

DOT-TSC-OST-74-3, III
STRATEGIC CONTROL ALGORITHM DEVELOPMENT
VOLUME III: STRATEGIC ALGORITHM REPORT
Boeing Commercial Airplane Company.
R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell,
A. L. Yarrington et al.
PB-236-722/5GI
DOT-TSC-538
Final Report. August 1974. 94p.

Air Traffic Control-Models

The strategic algorithm report presents a detailed description of the functional basic strategic control arrival algorithm. This description is independent of a particular computer or language. Contained in this discussion are the geometrical and environmental considerations and the required arrival traffic data requirements. The methods of providing sequencing and control point scheduling are discussed as is the means of developing a conflict-free, four-dimensional route-time profile that achieves the scheduling objectives.

DOT-TSC-OST-74-3, IVA
STRATEGIC CONTROL ALGORITHM DEVELOPMENT
VOLUME IVA: COMPUTER PROGRAM REPORT
Boeing Commercial Airplane Company
R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell,
A. L. Yarrington, et al.
PB-236-723/3GI
DOT-TSC-538
Final Report. August 1974. 272p.

Air Traffic Control-Models

A description of the strategic algorithm evaluation model is presented, both at the user and programmer levels. The model representation of an airport configuration, environmental considerations, the strategic control algorithm logic, and the airplane simulation model are delineated, together with data inputs and outputs. Detailed instructions for running the model include the input deck setup. Listings on the complete program, as well as detailed logic flow charts and a variable dictionary, are included. Program storage requirements and machine dependence considerations are also discussed.

Volume IVA includes sections 1 through 4.2.15; Volume IVB includes sections 4.2.16 through 5.

DOT-TSC-OST-74-3, IVB
STRATEGIC CONTROL ALGORITHM DEVELOPMENT VOLUME IVB: COMPUTER PROGRAM REPORT (CONCLUDED)
Boeing Commercial Airplane Company
R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, A. L. Yarrington et al.
PB-236-724/1GI
DOT-TSC-538
Final Report. August 1974. 272p.

Air Traffic Control-Models

A description of the strategic algorithm evaluation model is presented, both at the user and programmer levels. The model representation of an airport configuration, environmental considerations, the strategic control algorithm logic, and the airplane simulation model are delineated, together with data inputs and outputs. Detailed instructions for running the model include the input deck setup. Listings of the complete program, as well as detailed logic flow charts and a variable dictionary, are included. Program storage requirements and machine dependence considerations are also discussed.

Volume IVA includes sections 1 through 4.2.15; Volume IVB includes sections 4.2.16 through 5.

DOT-TSC-OST-74-4
SAFETY AND AUTOMATIC TRAIN CONTROL FOR RAIL RAPID TRANSIT SYSTEMS
Transportation Systems Center.
R. J. Pawlak, A. M. Colella, N. Knable, R. H. Robichaud, E. D. Sussman.
PB-235-492/AS
Final Report. July 1974. 278p.

Rapid Transit-Safety; Automatic Train Control

The anticipated construction and expansion of rail rapid transit systems in the United States over the next 10-15 years implies major capital expenditures. A significant level of automation in train control is likely to be central to these systems. The potential safety problems associated with various implementation alternatives, several possible levels of automation, and uncertainty in the corresponding proper role of the human operator raise issues requiring timely resolution. This report describes the state-of-the-art in rail rapid transit system automatic train control, assesses the safety related interrelations between the train control system, functions of the human operator and other portions of the total system, and makes recommendations, based on current experience, to aid the process of planning, funding approval, design, implementation, test, safety certification and operation of new systems or modifications of existing systems. The study suggests that the Federal Government develop safety criteria by which to evaluate future proposals and establish guidelines for safety certification procedures. It also concludes that knowledgeable application of system engineering skills and advanced development program techniques together as a process, are probably more important to achieving a successful new rail rapid transit system than are individual design decisions or application of advanced technology.

DOT-TSC-OST-74-5
NOISE CONTROL HANDBOOK FOR DIESEL-POWERED VEHICLES
Cambridge Collaborative
R. J. Damkevala, J. E. Manning, R. H. Lyon.
PB-236-382
DOT-TSC-587
Interim Report. May 1974. 218p.

Noise-Diesel Engines; Noise-Trucks

This handbook has been prepared with the intention of assisting the truck fleet operator and the independent truck owner/operator in understanding and diagnosing noise problems and in selecting retrofittable components to lower truck exterior and interior noise levels. The handbook includes procedures for identifying and evaluating major truck noise sources, considerations for selection of acoustic materials, procedures for minimizing exhaust, intake and cooling fan noise, and methods for the minimization of in-cab noise levels. Appendixes give standard noise measurement procedures, muffler and intake filter selection data, cooling system design considerations and a list of known manufacturers of acoustic materials.

DOT-TSC-OST-74-6.I
BASIC UNDERSTANDING OF EARTH TUNNELING BY MELTING, VOLUME I – BASIC PHYSICAL PRINCIPLES
Westinghouse Electric Corporation, Astronuclear Laboratory
D. L. Black et al.
PB-235-085/AS
DOT-TSC-591
Final Report. July 1974. 188p.

Tunnels-Construction

A novel technique, which employs the melting of rocks and soils as a means of excavating or tunneling while simultaneously generating a glass tunnel lining and/or primary support, was studied. The object of the study was to produce a good basic understanding of the fundamental process, its limits and

capabilities, as applied to large scale (~10 m diameter) transportation tunnels.

A description of process is developed through the use of functional flow diagrams, from which five modes of thermal tunneling are defined, ranging from complete debris consolidation into the liner to complete extrusion and removal of the debris.

For calculation purposes, five geologic modes of the near-surface continental crust are presented representative of approximately 95% of the total land area, from unconsolidated sediments to igneous rocks. Thermophysical properties are synthesized from the composition of the components.

Basic physical principles are used to derive functional equations governing the primary process variables in five separate areas: thermal power and penetrator temperature (end of Volume I), thrusting force earth structural, glass liner structural, and melt cooldown. These were related to independent variables of penetration velocity and tunnel geometry and to the geologic model properties.

Some potential design solutions are proposed to obviate some problems and limitations. A comparison with small scale test data indicates that the process is predictable but that thermal stress cracking of the glass liner would minimize its consideration for the primary tunnel support.

DOT-TSC-OST-74-6.II
BASIC UNDERSTANDING OF EARTH TUNNELING BY MELTING, VOLUME II – EARTH STRUCTURE AND DESIGN SOLUTIONS
Westinghouse Electric Corporation, Astronuclear Laboratory
D. L. Black et al.
PB-235-086
DOT-TSC-591
Final Report. July 1974. 274p.

Tunnels-Construction

DOT-TSC-OST-74-7
DEPARTMENT OF TRANSPORTATION COUNTY DIME FILE TECHNOLOGY SUMMARY
Charles Stark Draper Laboratory, Inc.
Chris L. Davis.
Final Report. March 1974. 20p.

Geocoding

This document describes the DOT County DIME (Dual Independent Map Encoding) File available in sequenced and compressed versions from the Information Division of the Transportation Systems Center. The file provides the capability to produce maps of county-base data with display software systems currently in wide use. The Sequenced County DIME File has been arranged so that each county has a complete boundary whose segments are internally structured in a clockwise manner. The Compressed County DIME File is composed of variable length records that contain all the segment data for a county boundary common to two and only two counties.

The technical specifications necessary to run the Sequenced File on 32 bit machines and the Compressed File on IBM 360/370 equipment are included.

DOT-TSC-OST-74-8
SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
William F. Gay.
AD/A-001-017/3GI
Final Report. June 1974. 156p.

Transportation-Statistics

This report is a compendium of selected national-level transportation statistics. Included are cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water, and oil pipelines. The report includes basic descriptors of U. S. transportation, such as operating revenues and expenses, number of vehicles and employees, vehicle-miles and passenger miles, etc.

As its name implies, the report is a summary of a larger data base, consisting of time-series collected from a variety of government and private statistical handbooks. In this edition, the selected data cover the period 1962 through 1972.

DOT-TSC-OST-74-10
THE DEVELOPMENT OF A CONTINUOUS DRILL AND BLAST TUNNELING CONCEPT, PHASE II
RAPIDEX, INC.
Carl R. Peterson
PB-234-204
DOT-TSC-611
Final Report. May 1974. 86p.

Tunnels-Construction

A spiral drilling pattern is described which offers high efficiency drill and blast tunneling via frequent small blasts

rather than occasional large blasts. Design work is presented for a machine which would stay at the face to provide essentially continuous drilling, loading, blasting, and mucking. Field tests of the concept are described and photos of the spiral tunnel advance are provided. Successful testing of a suitable blast shield is also described and photos provided. Advance rates of four times conventional drill and blast practice are projected at about half the conventional cost per foot.

DOT-TSC-OST-74-11.I
THE YEAR-ROUND DAYLIGHT SAVING TIME STUDY. VOLUME I -- INTERIM REPORT ON THE OPERATION AND EFFECTS OF YEAR-ROUND DAYLIGHT SAVING TIME
Transportation Systems Center.
Nancy Ebersole, David Rubin, William Hannan, Eugene Darling, Lothar Frenkel, David Prerau, Klaus Schaeffer.
PB-234-592-1
Interim Report. June 1974. 200p.

Daylight Saving Time

The Emergency Daylight Saving Time Energy Conservation Act of 1973 requires the Secretary of Transportation to submit an interim report to Congress by June 30, 1974 on the operation and effects of the Act.

As a result of the Act, Daylight Saving Time went into effect nationally on January 6, 1974. Exceptions are operative in Arizona, Hawaii, eastern Indiana, Puerto Rico, the Virgin Islands, and American Samoa. Further exemptions will go into effect in October 1974 in portions of Michigan and Idaho. The time zone boundary was shifted in Kentucky.

The analyses of the effects of Year-Round Daylight Saving Time were not conclusive because they could not be reliably separated from other changes occuring simultaneously including fuel availability constraints, speed limit reductions, Sunday gasoline stations closings, etc. However, there were indications of: some electricity savings; slight increase in gasoline use; ambiguous effects on traffic safety and school children safety; adverse effects for some radio stations; and widespread popularity for daylight savings in the summer but not the winter months.

DOT-TSC-OST-74-11. II
THE YEAR-ROUND DAYLIGHT SAVING TIME STUDY VOLUME II. SUPPORTING STUDIES: INTERIM REPORT ON THE OPERATION AND EFFECTS OF YEAR-ROUND DAYLIGHT SAVING TIME
Transportation Systems Center.
Nancy Ebersole, David Rubin, William Hannan, Eugene Darling, Lothar Frenkel, David Prerau, Klaus Schaeffer.
PB-234-592-2
Interim Report. June 1964. 436p.

Daylight Saving Time

This volume contains detailed background material in support of findings of the Interim Report. It includes the findings of a survey of attitudes toward daylight saving conducted by the National Opinion Research Center; description of sunrise and sunset times; analyses of the effects of the change to year-round daylight saving time on electricity, travel, and heating fuel, and on motor vehicle fatalities and accidents and the safety of school children; and a description of the equivalent day methodology devised for this study.

The appendix contains the legislative background to daylight saving time, and decisions on four states' requests for exemptions.

DOT-TSC-OST-74-12
ENERGY STATISTICS. A SUPPLEMENT TO THE SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
William F. Gay.
PB-238-767/AS
Final Report. August 1974. 156p.

Fuel Consumption-Statistics

This annual report is a compendium of selected time-series data describing the transportation, production, processing, and consumption of energy. The statistics have been assembled from a wide variety of sources, including the U. S. Department of the Interior, the Interstate Commerce Commission, and the American Petroleum Institute.

The report is divided into three main sections. The first, entitled "Energy Transport", contains such items as the revenues and expenses of oil pipeline companies, number and capacities of U. S. tank ships, and the total crude oil transported in the U. S. by method of transportation.

The second section, entitled "Reserves, Production, and Refining", reveals the growth over time of the U. S. oil and natural gas reserves, refinery capacity, and yields.

Trends in the demand for fuel and power are displayed in the third section, entitled "Energy Consumption". Throughout this part, the transportation sector is emphasized. Included are the gasoline and oil costs of automobiles of different sizes, the consumption of petroleum by type of product, the electrical energy consumed by the local transit industry, and other important statistics describing the supply and demand for energy.

DOT-TSC-OST-74-14. I
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM.
VOLUME I: SUMMARY
TRW Incorporated.
F. Mertes, L. Jenney.
PB-236-801/7GI
DOT-TSC-512
Final Report. August 1974. 196p.

AATMS (Advanced Air Traffic Management System)
Air Traffic Control-Automation
Human Factors-Air Traffic Control

The Advanced Air Traffic Management System (AATMS) program is a long-range investigation of new concepts and techniques for controlling air traffic and providing services to the growing number of commercial, military, and general aviation users of the national airspace. This study of the applications of automation was undertaken as part of the AATMS program. The purposes were to specify and describe the desirable extent of automation in AATMS, to estimate the requirements for man and machine resources associated with such a degree of automation, and to examine the prospective employment of humans and automata as air traffic management is converted from a labor-intensive to a machine-intensive activity.

Volume I is a summary document, stating the background and objectives of the study and describing the major study results. It also contains a discussion of the implications of the results for an advanced air traffic management system and a suggested strategy for implementation of automation.

DOT-TSC-OST-74-14. IIA
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME IIA – FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT
TRW Incorporated.
F. Mertes, L. Jenney, R. Jones.
PB-236-802/5GI
DOT-TSC-512
Final Report. August 1974. 210p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume II contains the analysis and description of air traffic management activities at three levels of detail – functions, subfunctions, and tasks. A total of 265 tasks are identified and described, and the flow of information inputs and outputs among the tasks is specified.

DOT-TSC-OST-74-14, IIB
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME IIB – FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT (CONT'D)
TRW Incorporated.
F. Mertes, L. Jenney, R. Jones.
PB-236-803/3GI
DOT-TSC-512
Final Report. August 1974. 264p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume II contains the analysis and description of air traffic management activities at three levels of detail – functions, subfunctions, and tasks. A total of 265 tasks are identified and described, and the flow of information inputs and outputs among the tasks is specified.

DOT-TSC-OST-74-14. IIC
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME IIC – FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT (CONT'D)
TRW Incorporated.
F. Mertes, L. Jenney, R. Jones.
PB-236-804/1GI
DOT-TSC-512
Final Report. August 1974. 198p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume II contains the analysis and description of air traffic management activities at three levels of detail — functions, subfunctions, and tasks. A total of 265 tasks are identified and described, and the flow of information inputs and outputs among the tasks is specified.

DOT-TSC-OST-74-14. IID
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME IID — FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT (CONCLUDED)
TRW Incorporated.
F. Mertes, L. Jenney.
PB-236-805/8GI
DOT-TSC-512
Final Report. August 1974. 228p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume II contains the analysis and description of air traffic management activities at three levels of detail — functions, subfunctions, and tasks. A total of 265 tasks are identified and described, and the flow of information inputs and outputs among the tasks is specified.

DOT-TSC-OST-74-14. III
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME III: METHODOLOGY FOR MAN-MACHINE TASK ALLOCATION
TRW Incorporated.
F. Mertes, L. Jenney.
PB-236-806/6GI
DOT-TSC-512
Final Report. August 1974. 224p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume III describes the methodology for man-machine task allocation. It contains a description of man and machine performance capabilities and an explanation of the methodology employed to allocate tasks to human or automated resources. It also presents recommended allocations of tasks at five incremental levels of automation.

DOT-TSC-OST-74-14. IVA
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME IVA: AUTOMATION REQUIREMENTS
TRW Incorporated.
F. Mertes, L. Jenney.
PB-236-807/4GI
DOT-TSC-512
Final Report. August 1974. 176p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume IV describes the automation requirements. A presentation of automation requirements is made for an advanced air traffic management system in terms of controller work force, computer resources, controller productivity, system manning, failure effects, and control/display requirements. It also includes a discussion of the application of the study results to the design and development of AATMS.

Volume IVA includes Sections 1.0 through 4.3; Volume IVB includes Sections 5.0 through Appendix C and References.

DOT-TSC-OST-74-14. IVB
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME IVB: AUTOMATION REQUIREMENTS (CONCLUDED)
TRW Incorporated.
F. Mertes, L. Jenney.
PB-236-808/2GI
DOT-TSC-512
Final Report. August 1974. 230p.

AATMS; Air Traffic Control-Automation;
Human Factors-Air Traffic Control

Volume IV describes the automation requirements. A presentation of automation requirements is made for an advanced air traffic management system in terms of controller work force, computer resources, controller productivity,

system manning, failure effects, and control/display requirements. It also includes a discussion of the application of the study results to the design and development of AATMS.

Volume IVA includes Sections 1.0 through 4.3; Volume IVB includes Sections 5.0 through Appendix C and References.

DOT-TSC-OST-74-14. VA
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME VA: DELTA SIMULATION MODEL-USER'S GUIDE
TRW Incorporated.
F. Mertes, K. Willis, E. C. Barkley.
PB-236-809/0GI
DOT-TSC-512
Final Report. August 1974. 200p.

AATMS; Air Traffic Control-Automation; Human Factors-Air Traffic Control

Volume V describes the DELTA Simulation Model. It includes all documentation of the DELTA (Determine Effective Levels of Task Automation) computer simulation developed by TRW for use in the Automation Applications Study. Volume VA includes a user's manual, test case, and test case results. Volume VB includes a programmer's manual.

DOT-TSC-OST-74-14. VB
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
VOLUME VB: DELTA SIMULATION MODEL-PROGRAMMER'S GUIDE
TRW Incorporated.
F. Mertes, K. Willis, E. C. Barkley.
PB-236-810/8GI
DOT-TSC-512
Final Report. August 1974. 158p.

AATMS; Air Traffic Control-Automation; Human Factors-Air Traffic Control

Volume V describes the DELTA Simulation Model. It includes all documentation of the DELTA (Determine Effective Levels of Task Automation) computer simulation developed by TRW for use in the Automation Applications Study. Volume VA includes a user's manual, test case, and test case results. Volume VB includes a programmer's manual.

DOT-TSC-OST-74-15
PROCEEDINGS OF THE THIRD CONFERENCE ON THE CLIMATIC IMPACT ASSESSMENT PROGRAM
Transportation Systems Center.
Anthony J. Broderick and Thomas M. Hard, Editors.
AD-A003-846
Conference Proceedings. November 1974. 670p.

Atmospheric Measurement; Supersonic Aircraft-Emissions

This volume contains the proceedings of the Third Conference on the Climatic Impact Assessment Program (CIAP), held at the DOT Transportation Systems Center from February 26 to March 1, 1972. It includes 45 invited papers, 20 unscheduled presentations, and edited question-and-answer sessions following some of the papers. The conference was essentially a progress report of CIAP. Therefore, some of the papers contain new data not yet published elsewhere, and others describe experimental equipment. Reports on work relevant to CIAP, though not sponsored by it, are also included. The subjects covered include aircraft-engine emissions, the nature of the "undisturbed" stratosphere of 1974, the nature of the "perturbed" stratosphere of 1990-2025, the possible resulting tropospheric perturbations, and the biological and economic effects of such perturbations.

DOT-TSC-OST-74-17
THE DOT NATIONAL COUNTY COMPONENT CONVERTER FILE: PROSPECTS, PROBLEMS, FEASIBILITY
Massachusetts Institute of Technology, Urban Systems Laboratory.
Pamela Werner.
PB-235-707/AS
DOT-TSC-692
Final Report. August 1974. 58p.

Geocoding

Systematic review of factors affecting the feasibility of developing a county component geocoding converter file is made. Discussion of staged evaluation of such a file is presented.

DOT-TSC-OST-74-18
AIR TRAFFIC DEMAND ESTIMATES FOR 1995
Transportation Systems Center.
R. H. Reck, J. B. Hagopian.
PB-241-083/AS
Final Report. March 1975. 98p.

AATMS; Air Traffic Control; Airports-Capacity

This Department of Transportation report is a projection of 1995 air traffic environment used in connection with the Department's Advanced Air Traffic Management System Study. The forecasts provide a range of reasonable 1995 activity levels for analyzing and comparing cost and performance characteristics of future air traffic management system concept alternatives. High and low estimates of the various demand measures are given, reflecting the uncertainty in any long-term projection. The demand measures are based on FAA ten year projections to 1984 and include the fleet size and number of operations for air carrier, general aviation, and military aircraft, the number of airports and hubs, and the peak number of airborne aircraft in both terminal and en route airspace regions. The results of one analysis on high density airport capacity are included. Data in this report are presented for 1972, 1984, and 1995.

Forecast growth in the demand for air transportation between 1972 and 1995 is predicted to result in fleet of 362,000 aircraft (7,000 air carrier, 335,000 general aviation, and 20,000 military); tripled general aviation operations, an increase in the number of IFR operations by a factor of 13; a 50 percent increase in the number of civil airports; and a 250 percent increase in the number of aircraft airborne at the peak instant of time (about a third of these will be IFR in 1995).

DOT-TSC-OST-74-19
URBAN TRANSPORTATION ALTERNATIVES – A MACRO ANALYSIS
Transportation Systems Center.
Peter Benjamin, John Barber, Carla Heaton, Granville Paules, Donald Ward
PB-238-775/AS
Final Report. December 1974. 142p.

Transportation-Systems Analysis; Rapid Transit; Bus Transit; Demand Responsive Systems; Personal Rapid Transit; Urban Transportation-Planning

The objective of this study was to evaluate the relative performance and effectiveness of seven transportation systems deployed on a regional basis: Highway (with limited bus), Comprehensive Bus, Exclusive Bus, Rapid Rail, Dial-A-Ride, Dual Mode, and PRT. The systems were analyzed in a hypothetical scenario reflecting the projected 1990 characteristics of the 30 largest U. S. urban areas (excluding the three biggest). A consistent basis for comparison was established by requiring approximately equivalent service and coverage for all systems. From the results of this analysis – expressed in terms of service, cost and impact parameters – the following conclusions were drawn. (1) Increased transit ridership is obtained when quality and level of service are increased, which, in turn, requires greater expenditures. (2) Each transportation system seems to have a given application for which it appears to be most suited; system effectiveness can be characterized by attributes such as trip length, service area trip density, system loading, and coverage. (3) Total urban transportation needs can best be filled by a combination of systems, each of which is utilized in the application for which it is most suited. (4) Further research and analysis effort should be devoted to obtaining increased understanding of the appropriate design and application of public transportation systems, expanding public transportation system options for service of short suburban trips, and establishing the relative effectiveness of various regional transportation system combinations.

DOT-TSC-OST-74-20
DUAL MODE POTENTIAL IN URBAN AREAS
Transportation Systems Center.
Carla Heaton, John Barber, Peter Benjamin, Granville Paules, Donald Ward
PB-240-411/AS
Final Report. February 1975. 92p.
Dual Mode Systems; Demand Responsive Systems; Automated Guideway Transportation

The purpose of this study was to determine the potential national applicability of an urbanwide Dual Mode system. The system, consisting of a mixed filet of specially designed small personal vehicles and 12-passenger dial-a-ride minibuses operating on local streets and on a network of guideways, was examined in three hypothetical urbanized areas reflecting a broad spectrum of 1990 city types. After determining system cost and ridership in each scenario, Dual Mode's applicability as an urbanwide system was determined on the basis of three criteria: the abstract city's ability to pay for the system, the regional cost-benefit characteristics of Dual Mode, and the degree of need for additional high-capacity transportation facilities within the abstract city. The classification of the abstract cities as definite or doubtful candidates for Dual Mode was used to generate population-based applicability ranges, which in turn were used to identify the urbanized areas where Dual Mode appears to have definite or possible potential. It was found that 44 out of the nation's 372 urbanized areas, representing 68% of the projected1990 urbanized area population, may be potential sites for urbanwide Dual Mode systems. The remainder of the urbanized areas should not, however, be excluded from consideration as possible sites for urbanwide Dual Mode systems. Detailed analyses of specific areas having a need for corridor or limited area circulation systems may lead to the identification of additional locales where Dual Mode could be applicable.

OFFICE OF THE SECRETARY OF TRANSPORTATION

DOT-TSC-OST-74-26
A SURVEY OF NATIONAL GEOCODING SYSTEMS
Massachusetts Institute of Technology, Urban Systems Laboratory
Pamela A. Werner
PB-239-601
DOT-TSC-692
Final Report. November 1974. 356p.

Geocoding

This document describes major geocoding systems. It is organized into sections that categorize geocoding systems by type. Section 2 deals with systems that are primarily geopolitical in nature and provide general reference coding structures for administrative or other purposes. Section 3 includes those geocoding systems that reference either special significance locations or a combination of geopolitical, geostatistical and special significance locations. The geosystems in Section 4 include those that reference areas delineated according to special criteria, such as economic or postal distribution patterns. Finally, Section 5 discusses those systems based on grid networks.

DOT-TSC-OST-74-27
FEDERAL LEGISLATION AFFECTING MOTOR VEHICLE DESIGN
Transportation Systems Center.
David Glater, Sarah Redfield.
PB-241-154/AS
Interim Report. March 1975. 68p.

Motor-Vehicles Design; Motor Vehicles-Legislation

This report discusses federal legislation and regulations affecting, or having the potential to affect, the design and manufacture of motor vehicles.

The regulations included in this report are those in effect as of April 1, 1974. This report does not reflect changes in automobile emission standards under the Clean Air Act, which would result from enactment of H.R. 14368, the "Energy Supply and Environmental Coordination Act of 1974". Appendix E describes these changes.

DOT-TSC-OST-74-29. I
MARITIME DYNAMIC TRAFFIC GENERATOR VOLUME I: SUMMARY DOCUMENTATION
Transportation Systems Center.
Franklin D. MacKenzie.
AD-A012-221
Final Report. June 1975. 40p.

Maritime Communication-Satellite

To determine the number of maritime vessels which are potential users of a satellite communications service and the required satellite coverage to provide this service, the weekly movements of 18,000 merchant vessels were recorded for the year 1972. The method of recording and the applications of the dynamic traffic generator is described in Volume I: Summary Documentation. The processor program is designed to move these vessels along standard routes to their destination and keep statistical records of the ports visited, the five degree squares passed through and the occurence of casualties. Volume II: Electronic Data Processing Program describes this processor. One of the most useful forms of the data output is a weekly plot, on a world map, of the average, daily vessel density per five degree square. This output is applicable to many related programs in the maritime area and is the subject of Volume III: Density Data on World Maps.

DOT-TSC-OST-74-29. II
MARITIME DYNAMIC TRAFFIC GENERATOR VOLUME II: ELECTRONIC DATA PROCESSING PROGRAM
Transportation Systems Center.
Franklin D. MacKenzie.
AD-A012-222
Final Report. June 1975. 58p.

Maritime Communication-Satellite

DOT-TSC-OST-74-29. III
MARITIME DYNAMIC TRAFFIC GENERATOR VOLUME III: DENSITY DATA ON WORLD MAPS
Transportation Systems Center.
Franklin D. MacKenzie.
AD-A012-498
Final Report. June 1975. 70p.

Maritime Communication-Satellite

DOT-TSC-OST-74-33
ROLLING RESISTANCE OF PNEUMATIC TIRES
Michigan University.
S. K. Clarke, R. N. Dodge, R. J. Ganter, J. R. Luchini.
PB-242-985
DOT-TSC-316
Interim Report. May 1975. 76p.

Fuel Consumption-Motor Vehicles; Tire Rolling Resistance

Potential improvements in tire power transmission efficiency are worth seeking for gaining improved automotive fuel economy. Summaries herein of tire rolling resistance as influenced by tire construction and design, tire materials, and tire operating conditions indicate clearly that current trends towards smaller, lighter automobiles and increasing usage of radial tires, in addition to reduced speed levels are positive contributions in their effort. Difficulties in obtaining accurate and relevant data are discussed, including the capabilities existing and new testing machinery, and the necessity for adopting standardized testing methods for tire rolling resistance.

DOT-TSC-OST-74-30
MARITIME CASUALTY TABULATION (1972)
Transportation Systems Center.
Franklin D. MacKenzie.
PB-239-456
Final Report. January 1975. 52p.

Maritime Accidents

This report creates a data base of the maritime casualties during 1972 which would have been candidates for a distress channel in a satellite communications service.

There are 1546 casualties recorded in this report for the calendar year 1972; of these casualties 79% were large ocean crossing vessels. The ocean crossing casualty list includes 54 vessels sunk, 158 collisions, 289 emergencies, 118 run aground and 177 suffering weather damage. These 796 vessels represent 13% of the total casualties, 500 gross ton or over, occuring during this time period. This percentage could use a satellite communication service for distress alerting and search and rescue. The remaining 87% of the casualties happened close to shore, in harbors, on lakes, canals or rivers and would use conventional communication service.

DOT-TSC-OST-74-32
IMPLICATIONS OF AUTOMATION FOR OPERATING AND STAFFING AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM
Planar Corporation
Larry L. Jenney, Kenneth A. Lawrence
PB-238-423/AS
TS-7989 & TS-8402
Final Report. August 1974. 82p.

AATMS; Air Traffic Control-Automation

The role of the air traffic controller in future system operations will be substantially affected by the introduction of new automated features. The number of human operators needed to man the system will almost certainly decrease as machines assume a greater share of the workload. Equally important, the delegation of more tasks to automated devices will also bring about a fundamental change in the nature of man's participation in air traffic control.

The Advanced Air Traffic Management System (AATMS) study conducted by DOT/TSC in 1971-73 advanced a system concept in which most surveillance, control and communication tasks are assigned to machine elements. This report, in support of the study, examines the implications of a high level of automation in terms of manpower requirements and operational procedures. Specifically, three topics are discussed: 1) a new concept of manpower utilization called a traffic-centered approach to air traffic management; 2) qualitative and quantitative requirements for operational and managerial personnel to staff the system; and 3) a typical flight to illustrate the workings of AATMS and the program of services available to future users of the system.

DOT-TSC-OST-74-35
***NOISE EMISSIONS* AND BUILDING STRUCTURAL VIBRATION LEVELS FROM THE SUPERSONIC CONCORDE AND SUBSONIC TURBOJET AIRCRAFT**
Transportation Systems Center.
E. J. Rickley, R. W. Quinn, N. R. Sussan.
PB-241 384
Final Report. March 1975. 260p.

Supersonic Aircraft-Noise; Noise-Aircraft

Noise emissions and building structural vibration levels were measured during landing and take off operations of the Anglo/French supersonic aircraft (Concorde) and from some conventional subsonic turbojet aircraft. Measurements were made at both the Fairbanks International Airport, Fairbanks, Alaska and at the Logan International Airport, Boston, Massachusetts.

This report contains graphic level time history recordings, tabulated peak RMS noise and vibration levels measured, EPNL/PNLT history data, and 1/3 octave frequency spectra of selected events.

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DOT-TSC-OST-74-39. I
TECHNOLOGICAL IMPROVEMENTS TO AUTOMOBILE FUEL CONSUMPTION.
VOLUME I: EXECUTIVE SUMMARY
Southwest Research Institute, Department of Automotive Research
C. W. Coon et al.
PB-238-677
DOT-TSC-628
Final Report. December 1974. 14p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

This report is a preliminary survey of the technological feasibility of reducing the fuel consumption of automobiles. The study uses as a reference information derived from literature, automobile industry contacts, and testing conducted as part of the program requirements. The design changes, which are recommended for the purpose of maximizing fuel economy, have been derived after lengthy review against a series of constraints including regulatory requirements, technical feasibility, and cost effectiveness.

Several possible technological improvements are identified, documented, and evaluated with respect to fuel economy. Results are reported as percentage improvement in fuel economy by comparison with 1973 model year vehicles. The effect of vehicle emission control systems is considered in the evaluation procedure.

The most promising individual improvements are incorporated into three synthesized vehicle designs, and the projected fuel economy improvement for these vehicles is reported.

The status of the technology reported is that available in the time period of July 1973 to January 1974.

DOT-TSC-OST-74-39. IIA
TECHNOLOGICAL IMPROVEMENTS TO AUTOMOBILE FUEL CONSUMPTION
VOLUME IIA: SECTIONS 1 THROUGH 23
Southwest Research Institute, Department of Automotive Research
C. W. Coon et al.
PB-238-678
DOT-TSC-628
Final Report. December 1974. 232p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

DOT-TSC-OST-74-39. IIB
TECHNOLOGICAL IMPROVEMENTS TO AUTOMOBILE FUEL CONSUMPTION
VOLUME IIB: SECTIONS 24 AND 25 AND APPENDIXES A THROUGH I
Southwest Research Institute, Department of Automotive Research
C. W. Coon et al.
PB-238-679
DOT-TSC-628
Final Report. December 1974. 198p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

DOT-TSC-OST-74-40. I
A STUDY OF TECHNOLOGICAL IMPROVEMENTS IN AUTOMOBILE FUEL CONSUMPTION
VOLUME I: EXECUTIVE SUMMARY
Arthur D. Little, Inc.
Donald A. Hurter et al.
PB-238-693
DOT-TSC-627
Final Report. December 1974. 52p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

A study was conducted to determine potential improvements in automobile fuel consumption based on innovative design and components. Standard and compact-size reference vehicles were selected, and a study of how power is used was conducted. Obvious technological innovations (e.g., powerplants (such as spark-ignited, turbocharged, stratified charge, electronic fuel injected, and diesel), transmissions and drive train systems, tires, accessories and auxiliaries, aerodynamics, and weight) that would save on fuel consumption were identified and evaluated, and then screened against program constraints. Operation of reference vehicles equipped with innovative components or redesigned was computer-simulated to predict fuel usage and performance. Techniques to measure fuel economy performance were also developed, and a statistical evaluation of published driving modes was performed. Compliance of innovative components with constraints (such as emissions and safety) and user requirements were determined. Optimized synthesized standard and compact-size vehicles were simulated and total systems evaluation of each vehicle was performed on the basis of fuel usage, performance, technical compatibility, compliance with constraints, user acceptability, and manufacturer adaptability. Synthesized vehicles were ranked in accordance with study objectives, and conclusions and recommendations on designs were drawn. Program plans for synthesized vehicles were also selected.

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DOT-TSC-OST-74-40. II
A STUDY OF TECHNOLOGICAL IMPROVEMENTS IN AUTOMOBILE FUEL CONSUMPTION.
VOLUME II: COMPREHENSIVE DISCUSSION
Arthur D. Little, Inc.
Donald A. Hurter et al.
PB-238-694
DOT-TSC-627
Final Report. December 1974. 238p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

DOT-TSC-OST-74-40. IIIA
A STUDY OF TECHNOLOGICAL IMPROVEMENTS IN AUTOMOBILE FUEL CONSUMPTION.
VOLUME IIIA: APPENDIXES I THROUGH III
Arthur D. Little, Inc.
Donald A. Hurter et al.
PB-238-695
DOT-TSC-627
Final Report. December 1974. 220p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

DOT-TSC-OST-74-40. IIIB
A STUDY OF TECHNOLOGICAL IMPROVEMENTS IN AUTOMOBILE FUEL CONSUMPTION.
VOLUME IIIB: APPENDIXES IV THROUGH VII
Arthur D. Little, Inc.
Donald A. Hurter et al
PB-238-696
DOT-TSC-627
Final Report. December 1974. 236p.

Motor Vehicles-Design; Fuel Consumption-Motor Vehicles

DOT-TSC-OST-74-41
A REVIEW OF PROPOSED AUTOMOTIVE CARBURETOR CONCEPTS FOR IMPROVED FUEL ECONOMY
Aerospace Corporation.
M. G. Hinton, J. Meltzer, T. Iura, L. Forrest, W. Smalley, K. Swan
AD-A009-214
F04701-74-C0075
Interim Report. March 1975. 98p.

Carburetors; Fuel Consumption-Motor Vehicles

This report presents a brief summarization of available information pertaining to proposed concepts for improved automotive carburetors.

In particular, information is provided which depicts the development and performance characteristics of a selected number of advanced, novel, or new carburetors which have been brought to the attention of the Department of Transportation as having the potential to improve automotive fuel economy. To provide a basis of perspective, a discussion of the basic requirements, construction, method of operation, and inherent limitations of conventional carburetors and induction systems is also included.

DOT-TSC-OST-74-42. I
EVALUATION OF DIESEL ENGINE PERFORMANCE WITH INTAKE AND EXHAUST SYSTEM THROTTLING
VOLUME I: TEXT AND APPENDIXES A THROUGH H
Bartlesville Energy Research Center.
R. Hern, B. Eccleston and W. Marshall.
PB-247-752/AS
RA-73-2
Final Report. November 1975. 148p.

Noise-Trucks; Noise-Diesel Engines; Exhaust Emissions-Diesel Engines

The diesel engine itself is an important source of diesel powered vehicle noise, and becomes dominant after proper treatment of intake/exhaust and cooling system noise at vehicle speeds below fifty miles per hour. An investigation was conducted to quantify the effects of intake and exhaust restrictions, and load-speed scheduling on the radiated noise from four diesel truck engines, produced by different manufacturers. Sound power measurements were made in an accoustically modified engine performance test cell. The noise associated with intake, exhaust, cooling and their respective ducting systems were appropriately abated to permit quantification of engine radiated noise. Exhaust emission data including temperature and performance data were also monitored. Engine radiated noise was not significantly affected by intake pressure restrictions up to 60 inches H_2O or exhaust restrictions up to 90 inches H_2O. The precomposition chamber turbocharged engine exhibited lower sound output than the naturally aspirated engine with respect to the mechanical power available under various load-speed conditions. Calculated engine sound pressure levels projected to fifty feet, gave noise levels ranging from 77 to 83 dB (A) at rated engine speed.

DOT-TSC-OST-74-42. II
EVALUATION OF DIESEL ENGINE PERFORMANCE WITH INTAKE AND EXHAUST SYSTEM THROTTLING VOLUME II: APPENDIX I
Bartlesville Energy Research Center.
R. Hern, B. Eccleston and W. Marshall.
PB-247-753/AS
RA-73-2
Final Report. November 1975. 190p.

Noise-Trucks; Noise-Diesel Engines; Exhaust Emissions-Diesel Engines

DOT-TSC-OST-74-43
REVIEW AND ANALYSIS OF GASOLINE CONSUMPTION IN THE UNITED STATES FROM 1960 TO THE PRESENT
Transportation Systems Center.
Helen Condell and Rita Folan.
PB-246-129/AS
Final Report. September 1975. 54p.

Fuel Consumption-Statistics

This report is a presentation and analysis of the monthly gas consumption data for each of the 50 states and the District of Columbia.

The data, obtained from the Federal Highway Administration, covers the period from January 1960 through April 1974. Included is a series of charts containing a regression analysis performed on the selected data for each state, growth rates for each state, and a ranking of the states with respect to different parameters. Also included is a series of graphs depicting monthly gas consumption for each state.

DOT-TSC-OST-75-1
ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM STUDY, EXECUTIVE SUMMARY
Transportation Systems Center.
PB-238-779/AS
Final Report. January 1975. 18p.

AATMS; Radar Beacon Systems; Air Traffic Control-Satellite

This report summarizes the U. S. Department of Transportation study and development plans for the air traffic management system of the late 1980's and beyond. The plans are presented in the framework of an evolutionary system concept of traffic management, building upon the Upgraded Third Generation Air Traffic Control System, and defined to meet the projected demands for service, safety, and flexibility in a cost effective manner. In order to provide the information needed for planning future system developments, a program of research and development is described for the system concept presented in the report.

DOT-TSC-OST-75-2
A THEORETICAL COMPARISON OF FIXED ROUTE BUS AND FLEXIBLE ROUTE SUBSCRIPTION BUS FEEDER SERVICE IN LOW DENSITY AREAS
Transportation Systems Center.
Donald B. Ward.
PB-240-808
Final Report. March 1975. 74p.

Demand Responsive Systems; Bus Transit

A parametric variation of demand density was used to compare service level and cost of two alternative systems for providing low density feeder service. Supply models for fixed route and flexible route service were developed and applied to determine ranges of relative efficiency. It was found that flexible route bus exhibited a lower sensitivity of cost to level of service provided than did fixed route bus. Flexible route bus can provide better service at the same or higher level of productivity at all demand levels below about 100 passengers per square mile per hour, except when minimal service only is to be provided.

DOT-TSC-OST-75-3
FUEL CONSUMPTION OF TRACTOR-TRAILER TRUCKS AS AFFECTED BY SPEED LIMIT AND PAYLOAD WEIGHT
Transportation Systems Center.
Anthony J. Broderick.
PB-248-953/AS
Final Report. November 1975. 36p.

Fuel Consumption-Trucks

The effect of speed limit and payload weight on fuel consumption was determined in tests of tractor-trailer rigs. Two virtually identical vehicles were used, one loaded with a 28,000 lb. payload and the other carrying 42,000 lbs.; each was driven over two different sets of terrain on the Massachusetts Turnpike at simulated speed limits of 50, 55 and 60 mph. Onboard TSC observers recorded data on tank-measured fuel consumption, trip average speed, etc. An analysis of the data led to the following conclusions: (1) Increased fuel consumption results from higher speed limits in the range of 50 - 60 mph; (2) Terrain is an important factor in determining the effect of speed limit on fuel consumption; (3) A payload increase from 28,000 lbs. to 42,000 lbs. is

carried at no detectable increase in fuel consumption for the "hilly" route, and less than a 7 percent increase in fuel consumption for the route including a crossing of the Berkshire Mountains.

DOT-TSC-OST-75-4
EFFECT OF VARIATION OF SPEED LIMITS ON INTERCITY BUS FUEL CONSUMPTION, COACH AND DRIVER UTILIZATION, AND CORPORATE PROFITABILITY
Transportation Systems Center.
A. J. Brockerick, P. Davis, L. Leist, H. Miller, and E. Klaubert
PB-247-761/AS
Final Report. November 1975. 142p.

Fuel Consumption-Buses

The effect of speed limit and passenger load on fuel consumption was determined using actual intercity buses with simulated passenger loads over different types of terrain. In addition to road tests, laboratory type measurements were made on four intercity buses. Studies were also made to ascertain the effect of reduced speed limits on maintenance and operations. Principal conclusions were: 1) Increased fuel consumption results from higher speeds in the 50-60 mph range; 2) Terrain is an important factor in determining the effect of speed limit on fuel consumption; 3) No significant fuel savings are expected for intercity buses if speed limits are reduced in the 50-60 mph range over mountainous terrain; and 4) Reducing speed limits should reduce maintenance costs but increase direct operating costs.

DOT-TSC-OST-75-5
TARIFF COMPUTERIZATION, STANDARDIZATION AND SIMPLIFICATION: THE STATE OF THE ART AND ITS POLICY IMPLICATIONS FOR THE DEPARTMENT OF TRANSPORTATION
Transportation Systems Center.
Robert E. Thibodeau.
PB-241-049/AS
Final Report. March 1975. 68p.

Tariffs

The state of the art of tariff simplification/computerization/standardization is reviewed. Emphasis is placed on rail and motor tariffs for domestic freight. Sources of difficulty in the present tariffs and their application to freight bills are examined. Methods of coping with these difficulties are described, especially those using computerized rating systems. Recommendations are made for future DOT activities in this area. These include development of a formula rate tariff, feasibility studies of rate "utilities" and shipper-carrier networks, tariff standardization studies, and coordination of government tariff research.

DOT-TSC-OST-75-6
ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM STUDY—TECHNICAL SUMMARY
Transportation Systems Center.
PB-241-223/AS
Final Report. March 1975. 216p.

AATMS; Air Traffic Control-Satellite; Radar Beacon Systems

This report summarizes the U. S. Department of Transportation study and development plans for the air traffic management system of the late 1980's and beyond. The plans are presented in the framework of an evolutionary system concept of traffic management, building upon the Upgraded Third Generation Air Traffic Control System, and defined to meet the projected demands for service, safety, and flexibility in a cost effective manner. In order to provide the information needed for planning future system developments, a program of research and development is described for the system concept presented in the report.

DOT-TSC-OST-75-7
PROVIDING INCREASED TRANSIT CAPACITY DURING PEAK PERIODS: EXAMINATION OF TWO TECHNIQUES
Transportation Systems Center.
Donald E. Ward, Donald C. Kendall.
PB-240-679/AS
Final Report. February 1975. 66p.

Bus Transit; Carpools; Staggered Work Hours

Two techniques for increasing transit capacity without fleet expansion are examined: reducing the extents of bus routes and staggering work hours. Reduction of bus route lengths increased the number of round trips per bus possible in a given time period. For bus routes accessed mainly by auto, it is shown that significant savings in energy due to reduced auto miles travelled are possible by decreasing the lengths of multistop bus routes. Little or no savings are achieved with express bus routes.

Staggering work hours has the effect of greatly increasing the fraction of new transit demand that can be satisfied. It is shown that both the length of the peak period and the percentage travel in the peak hour affect potential transit utilization. Since staggering work hours has detrimental effects on carpooling potential, these effects are also

examined. It is found that the benefits to transit of staggering work hours probably exceed the disadvantages to carpooling.

DOT-TSC-OST-75-8. I
SYSTEMS ANALYSIS OF RAPID TRANSIT UNDERGROUND CONSTRUCTION, VOLUME I: SECTIONS 1-5
Bechtel, Incorporated and Arthur D. Little, Inc.
A. J. Birkmyer, D. L. Richardson.
DOT-TST-75-72. I
DOT-TSC-601
Final Report. December 1974. 173p.

Tunnels-Construction

Planning and implementing an urban rapid transit system involves many governmental, private, and public groups. The relationships and responsibilities of these groups and the planning/implementation process are discussed.

The techniques and processes of cut-and-cover and tunnel construction are described in detail. Environmental impacts of this construction as well as safety and insurance aspects are also presented.

Identification of physical and institutional controls (sensitivities) on construction is made. Physical controls include such factors as utility density, traffic conditions, maintaining existing structure integrity, ground conditions, and weather. Institutional controls include among others, the project schedule, right-of-way acquisition, material and equipment supply, and labor agreements and productivity.

Three San Francisco Bay Area Rapid Transit (BART) projects and two Washington Metropolitan Area Transit Authority (WMATA) projects were studied with respect to time schedules, costs, and sensitivity to physical and institutional controls. These data were utilized in developing generalized models of four specific types of underground construction: cut-and-cover station, cut-and-cover line, and free-air-driven tunnel and compressed-air-driven tunnel. The models are a planning tool for evaluation of the alternative types of underground construction in a transit system with respect to local costs and physical and institutional controls.

Possible future tunneling cost-reduction techniques and recommendations for further research are made.

Volume I includes sections 1 through 5; and Volume II, sections 6 through 9, and Appendixes A through F.

DOT-TSC-OST-75-8. II
SYSTEMS ANALYSIS OF RAPID TRANSIT UNDERGROUND CONSTRUCTION
VOLUME II: SECTIONS 6-9 AND APPENDIXES
Bechtel, Incorporated and Arthur D. Little, Inc.
A. J. Birkmyer, D. L. Richardson.
DOT-TST-75-72. II
DOT-TSC-601
Final Report. December 1974. 299p.

Tunnels-Construction Methods

DOT-TSC-OST-75-17
SMALL TRANSIT VEHICLE SURVEY
ECI Systems Inc. and Transportation Systems Center.
Martin Flusberg, Brian Kullman and Robert Casey.
PB-243-228/AS
TS-7769
Final Report. June 1975. 140p.

Bus Transit; Demand Responsive Systems

Small transit vehicles, defined as those vehicles seating 7-25 passengers and intended for public transportation use, are available in a variety of makes and models with markedly different characteristics affecting both operators and users.

Although the demand for small transit vehicles has only recently begun to grow there are many more manufacturers of these vehicles than there are of full size transit vehicles. This report provides a summary of the availability, specifications, and operational experience of small transit vehicles in the United States.

Vehicles are divided into three main categories: vans and van conversions, small buses, and converted motor homes. Operating experience was obtained by sampling from manufacturer provided user lists. Vehicle specifications were obtained directly from the manufacturer.

No vehicle has been completely free of problems; no one vehicle is clearly superior to all others, nor is any one category of vehicle clearly superior to any other. A vehicle operator must weigh a number of variables before determining which vehicle is best for a particular application.

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DOT-TSC-OST-75-18
SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
William F. Gay.
PB-242-410
Final Report. June 1975. 160p.

Transportation-Statistics

This report is a compendium of selected national-level transportation statistics. Included are cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water, and oil pipeline. The report includes basic descriptors of U. S. transportation, such as operating revenues and expenses, number of vehicles and employees, vehicle-miles and passenger miles, etc.

At its name implies, the report is a summary of a larger data base, consisting of time-series collected from a variety of government and private statistical handbooks. In this edition, the selected data cover the period 1963 through 1973.

DOT-TSC-OST-75-19
AUTOMATION OF PERIODIC REPORTS
Transportation Systems Center.
Alan S. Kaprelian, Rita Folan and Helen Condell.
PB-243-444
Preliminary User's Manual. June 1975. 62p.

Transportation-Statistics-Data Processing

This manual is a user's guide to the automation of the *"Summary of National Transportation Statistics."* The system is stored on the in-house PDP-10 computer to provide ready access and retrieval of the data. The information stored in the system includes cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water and oil pipeline, as well as supplementary data on transportation and the economy.

Included in the user's guide is: an explanation of the coding system developed for the different transportation modes; sample outputs and instruction on the use of the reports and plots developed; a listing of the information contained in the system.

DOT-TSC-OST-75-20
SYSTEM CONCEPT STUDY FOR A CARGO DATA INTERCHANGE SYSTEM (CARDIS)
Computer Sciences Corporation.
F. D.Alessandro, M. Wall.
PB-245-865/AS
DOT-TSC-851
Final Report. April 1975. 98p.

Freight Transportation-Computer Systems

This report presents the analysis of functional and operational requirements of CARDIS. From these requirements, system sizing estimates are derived. Three potential CARDIS concepts are introduced for consideration in subsequent analysis. Their characteristics are described and interface considerations with users and foreign systems developed. Functional flows of typical CARDIS transactions are presented with flow charts. The CARDIS alternatives are compared and a plan presented for CARDIS development.

DOT-TSC-OST-75-21
ANALYSIS OF THE FUTURE EFFECTS OF THE FUEL SHORTAGE AND INCREASED SMALL CAR USAGE UPON TRAFFIC DEATHS AND INJURIES
Center for the Environment and Man, Inc.
Hans C. Joksch.
PB-251-892
DOT-TSC-839
Final Report. January 1976. 194p.

Motor Vehicles-Accidents

The literature was reviewed and accident data were analyzed to establish relations between automobile size and the frequency of occupant death and injury. On the assumption of four future scenarios for the size of automobiles, the consequences for car occupant deaths were calculated. The present effects of the 55 mph speed limit and results that may be achieved by strict enforcement were estimated. The effects of the potential reduction of commuter traffic on vehicle deaths were estimated. The question of how the elimination of Sunday travel would affect motor vehicle deaths was addressed.

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DOT-TSC-OST-75-21A
ANALYSIS OF THE FUTURE EFFECTS OF THE FUEL SHORTAGE AND INCREASED SMALL CAR USAGE UPON TRAFFIC DEATHS AND INJURIES, EXECUTIVE SUMMARY
Center for the Environment and Man, Inc.
Hans C. Joksch
PB-251-893
DOT-TSC-839
Final Report. January 1976. 21p.

Motor Vehicles-Accidents

DOT-TSC-OST-75-22
A SUMMARY OF OPPORTUNITIES TO CONSERVE TRANSPORTATION ENERGY
Transportation Systems Center.
John Pollard, David Hiatt and David Rubin.
PB-247-790/AS
Final Report. August 1975. 110p.

Fuel Consumption-Transportation

This report surveys the near term opportunities for energy conservation in passenger and freight transportation. The present (1972) transportation energy flows and modal efficiencies are characterized. A total of 35 possible conservation measures are discussed and ranked for effectiveness. Their potential fuel savings are projected for 1980 and 1990.

For the more important measures, discussions of costs, timing constraints and side effects are included. Improving the efficiency of motor vehicles is shown to be the single most important approach to transportation energy conservation, but significant savings in other areas, such as load-factor improvement, are possible.

DOT-TSC-OST-75-23
CARPOOLING: STATUS AND POTENTIAL
Transportation Systems Center.
Donald C. Kendall.
PB-244-609/AS
Final Report. June 1975. 122p.

Carpools

This report contains the findings of studies conducted to analyze the status and potential of work-trip carpooling as a means of achieving more efficient use of the automobile. Current and estimated maximum potential levels of carpooling are presented together with analyses revealing characteristics of carpool trips, incentives, impacts of increased carpooling and issues related to carpool matching services. National survey results indicate the average auto occupancy for urban work-trip is 1.2 passengers per auto. This value, and average carpool occupancy of 2.5, have been relatively stable over the last five years. An increase in work-trip occupancy from 1.2 to 1.8 would require a 100% increase in the number of carpoolers. A model was developed to predict the maximum potential level of carpooling in an urban area. Results from applying the model to the Boston region were extrapolated to estimate a maximum nationwide potential between 47 and 71% of peak period auto commuters. Maximum benefits of increased carpooling include up to 10% savings in auto fuel consumption. A technique was developed for estimating the number of participants required in a carpool matching service to achieve a chosen level of matching among respondents, providing insight into tradeoffs between employer and regional or centralized matching services. Issues recommended for future study include incentive policies and their impacts on other modes, and the evaluation of new and ongoing carpool matching services.

DOT-TSC-OST-75-24
RAPID TRANSIT TUNNEL DIMENSIONS IN THE UNITED STATES: A BRIEF SUMMARY
Transportation Systems Center.
Gerald Saulnier.
PB-244-585
Final Report. July 1975. 36p.

Tunnels-Dimensions

Inside dimensions and shapes of existing and planned rapid transit tunnels in the United States are identified. Included is a discussion of those factors involved in deriving the inside dimensions of a tunnel and methods of calculation of circular tunnel diameters. Background information is provided for use in discussions concerning the need for standardization of tunnel dimensions.

DOT-TSC-OST-75-28
A STUDY OF AUTOMOTIVE AERODYANMIC DRAG
Jet Propulsion Laboratory, California Institute of Technology.
Jack E. Marte, Robert W. Weaver, Donald W. Kurtz and Bain Dayman, Jr.
PB-251-710
RA 74-35-PR612-0248
Final Report. September 1975. 92p.

Motor Vehicles-Aerodynamics

Reductions of aerodynamic drag in the 20-25% range through the use of several established drag-reduction devices and minor design changes have been demonstrated on three large sales-volume 1974 and 1975 model American automobiles. Comparisons of test techniques were made by testing one automobile both fullscale and as a 0.4-scale model in two different wind tunnels. Another vehicle was tested both full-scale in a wind tunnel and by the coast-down technique. Good comparative results were obtained.

DOT-TSC-OST-75-30
ENGINE PERFORMANCE TEST OF THE HONDA CVCC
Bartlesville Energy Research Center.
W. F. Marshall.
PB-246-157
RA-75-10
Interim Report. September 1975. 48p.

Fuel Consumption-Motor Vehicles;
Motor Vehicles-Engines;
Exhaust Emissions-Motor Vehicles

An engine test of a prototype Honda CVCC, 90.8-cubic-inch displacement, 4-cylinder engine was performed to determine its steady-state fuel consumption and emissions (HC, CO, NO_x) maps, and the data which were obtained are summarized.

DOT-TSC-OST-75-31
AUTOMOTIVE ENERGY EFFICIENCY PROGRAM—PRESENTED PAPERS AT THE CONTRACTORS COORDINATION MEETING, JANUARY 15-17, 1975
Transportation Systems Center.
Harold G. Miller, Chairman.
PB-245-808
Conference Papers. June 1975. 280p.

Exhaust Emissions-Motor Vehicles;
Motor Vehicles-Aerodynamics;
Motor Vehicles- Engines;
Motor Vehicles-Design;
Fuel Consumption-Motor Vehicles

This volume contains working papers presented at the Contractors Coordination Meeting of the Automotive Energy Efficiency Program held at the DOT Transportation Systems Center, January 15-17, 1975. This program is the Federal Government's major effort to assess the capability of the automotive industry to significantly improve the fuel economy of production vehicles and assess the related socio-economic effects.

The primary objective of the conference was to report on progress to date and future plans of the Automotive Energy Efficiency Program and to promote the exchange of information between government, industry and university investigators.

Twenty-two papers and illustrated lectures were presented at the conference, 20 of which are included in this volume. Some are copies of visual material and others are more formal technical papers.

DOT-TSC-OST-75-32
ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM STUDY OVERVIEW
Transportation Systems Center.
PB-243-460
Final Report. June 1975. 58p.

AATMS; Air Traffic Control-Satellite; Radar Beacon Systems

This report summarizes the U. S. Department of Transportation study and development plans for the air traffic management system of the late 1980's and beyond. The plans are presented in the framework of an evolutionary system concept of traffic management, building upon the Upgraded Third Generation Air Traffic Control System, and defined to meet the projected demands for service, safety, and flexibility in a cost effective manner. In order to provide the information needed for planning future system developments, a program of research and development is described for the system concept presented in this report.

DOT-TSC-OST-75-33
ENERGY STATISTICS, A SUPPLEMENT TO THE SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
William F. Gay.
GPO Stock No. 050-000-00-1024
Final Report. August 1975. 168p.

Fuel Consumption-Statistics

This annual report is a compendium of selected time-series data describing the transportation, production, processing, and consumption of energy. The statistics have been assembled from a wide variety of sources, including the U. S. Department of the Interior, the Interstate Commerce Commission, and the American Petroleum Institute.

The report is divided into three main sections. The first, entitled "Energy Transport", contains such items as the revenues and expenses of oil pipeline companies, number and capacities of U. S. tank ships, and the total crude oil transported in the U. S. by method of transportation.

The second section, entitled "Reserves, Production, and Refining," reveals the growth over time of the U. S. oil and natural gas reserves, refinery capacity, and yields.

Trends in the demand for fuel and power are displayed in the third section, entitled "Energy Consumption". Throughout this part, the transportation sector is emphasized. Included are the gasoline and oil costs of automobiles of different sizes, the consumption of petroleum by type of product, the electrical energy consumed by the local transit industry, and other important statistics describing the supply and demand for energy.

DOT-TSC-OST-75-36
THE SOCIAL IMPACTS OF THE ENERGY SHORTAGE: BEHAVIORAL AND ATTITUDE SHIFTS
Transportation Systems Center.
Mary D. Stearns.
PB-246-818
Final Report. September 1975. 128p.

Fuel Shortages-Public Opinion

An analysis of the social impacts of the energy shortage; specifically, an analysis of shifts in social behavior, or trip-making characteristics, and shifts in social attitudes towards the energy shortage and conservation policies. Data were obtained from the November and December, 1973 and February, 1974 administrations of the Continuous National Survey, a full probability National Opinion Research Center random sample survey.

The findings suggest, first, that energy shortage impacts need to be disaggregated by selected social characteristics such as income level and, second, that the relationship between attitudes towards the energy shortage and trip-making behavior is very complex.

DOT-TSC-OST-75-38
PROCEEDINGS OF THE FOURTH CONFERENCE ON THE CLIMATIC IMPACT ASSESSMENT PROGRAM
Transportation Systems Center.
Thomas M. Hard and Anthony J. Broderick.
Conference Proceedings. August 1976. 564p.

Supersonic Aircraft-Emissions

This volume contains the proceedings of the final, Fourth Conference on the Climatic Impact Assessment Program, held at the DOT Transportation Systems Center February 4 through 7, 1975. It includes 55 papers, a panel discussion, and edited question-and-answer exchanges following some of the sessions. Reports on work relevant to CIAP, though not sponsored by it, are included. Among the topics addressed are the related programs in the United Kingdom, France, Canada, and Japan; biological effects of ultraviolet irradiation and climate change; consequences of NO_x restrictions for the aviation industry; theoretical models of atmospheric composition, radiation, and climate and their response to stratospheric pollution; measurements of the concentrations of trace species in the stratosphere and their reaction rates in the laboratory; and chemistry and optics of stratospheric aerosols.

DOT-TSC-OST-75-40
1975 RIDE QUALITY SYMPOSIUM
NASA Langley Research Center.
N-76-16754
NASA-TM-X-3295
Technical Memorandum. November 1975. 648p.

Rapid Transit-Ride Quality

The report consists of a compilation of papers presented at the 1975 Ride Quality Symposium held in Williamsburg, Virginia, August 11-12, 1975. The symposium, jointly sponsored by NASA and the United States Department of Transportation, was held to provide a forum for determining the current state of the art relative to the technology base of ride quality information applicable to current and proposed transportation systems. Emphasis focused on passenger reactions to ride environment and on implications of these reactions to the design and operation of air, land, and water transportation systems acceptable to the traveling public. Papers are grouped in the following five categories:

The Needs and Uses for Ride Quality Technology
Vehicle Environments and Dynamics
Investigative Approaches and Testing Procedures
Experimental Ride Quality Studies
Ride Quality Modeling and Criteria

DOT-TSC-OST-75-41
A STUDY OF FUEL ECONOMY AND EMISSION REDUCTION METHODS FOR MARINE AND LOCOMOTIVE DIESEL ENGINES
Southwest Research Institute, Department of Engine and Vehicle Research.
J. O. Storment, C. D. Wood, R. J. Mathis.
AD-A009-214
DOT-TSC-920
Interim Report. September 1975. 118p.

Exhaust Emissions-Locomotives; Fuel Consumption-Diesel Engines; Exhaust Emissions-Diesel Engines

This interim report presents the results of the first phase of a two-part program to investigate methods of improving fuel consumption and reducing exhaust emissions of in-service diesel engines used as prime movers in locomotives and several classes of Coast Guard vessels. The engines are large, medium-speed units with individual cylinder displacements in excess of 150 in^3 and power ratings from 2000 to 4000 brake horsepower. The study that is the subject of this report utilizes information that was obtained from the technical literature and from interviews of engine manufacturers, railroads, and engineering staffs of Coast Guard vessels.

Several methods were investigated for their potential to reduce fuel consumption and emissions, within the constraint of maintaining adequate locomotive and vessel operating flexibility and engine life. These methods included the retrofit of engines with existing state-of-the-art components (e.g., injectors, governor, turbocharger) of improved design, the adjustment of injection timing, and changes in engine operating modes (speed-power points). The effects of engine wear and maintenance on fuel consumption and emissions were investigated, as were the effects of ambient air properties (temperature, pressure, humidity).

The conclusions reached at the end of Phase I of the program resulted in several recommendations for additional investigation or evaluation by actual testing in Phase II.

DOT-TSC-OST-75-42
AN ESTIMATION OF RIVER TOWBOAT AIR POLLUTION IN SAINT LOUIS, MISSOURI
Transportation Systems Center.
Joseph C. Sturm.
PB-251-711
Final Report. February 1976. 64p.

Exhaust Emissions-River Towboats

This study gives an estimate of river towboat air pollution emissions for the St. Louis Air Pollution Study area. No emissions from secondary sources or from recreational boating on the river of other areas are considered. The emission estimate is based primarily on river traffic data taken by the Corps of Engineers at Lock 27 near St. Louis and on exhaust emission factors of similar engines of the Coast Guard fleet and railroad locomotives.

The emissions are given for each grid of the Environmental Protection Agency (EPA) St. Louis Grid Plan so that these results can be utilized for the St. Louis Regional Air Pollution Study.

The total annual emissions in the SLAPS region from towboats operating on the 135 miles of the Mississippi river and the 95 miles on the Missouri river are estimated to be:

Oxides of nitrogen	3,297	tons/year
Total hydrocarbons	939	" / "
Carbon monoxide	2,101	" / "
Oxides of sulphur	462	" / "
Particulates	198	" / "

DOT-TSC-OST-75-43
MIDLATITUDE MEASUREMENTS OF L-BAND IONOSPHERIC SCINTILLATION WITH THE ATS-5 SPACECRAFT
Transportation Systems Center.
W. E. Brown III, G. G. Haroules, and W. I. Thompson III
PB-246-286
Final Report. September 1975. 192p.

Applications Technology Satellite; Ionosphere-Measurement

This report presents some results of L-band signal level measurements taken from the ATS-5 spacecraft operating in the narrow-band frequency translation mode. The uplink signal was sent from the DOT/TSC/Westford Propagation Facility in Westford, Massachusetts, which has geographic coordinates of latitude: 42.60 deg. N and longitude: 71:50 deg. W and is thus a midlatitude site. The uplink signal was transponded by the NASA ATS-5 spacecraft and re-radiated back to earth. The signal was received by several L-band receiving systems located at the Westford facility.

The data are presented weekly, monthly and seasonal plots of the root-mean-square of the probability density function and the 90th percentile level of the probability distribution function of the received signal amplitude. Sample analog recordings of the signal are also presented along with the corresponding computer calculated statistics.

Brief equipment descriptions are included along with a description of an automatic data collection platform which was used during some of the measurements.

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DOT-TSC-OST-75-44
ENGINE PERFORMANCE TEST OF THE 1975 CHRYSLER-NISSAN MODEL CN633 DIESEL ENGINE
Bartlesville Energy Research Center.
W. F. Marshall and K. R. Stamper.
PB-246-742
RA-75-10
Interim Report. September 1975. 36p.

Fuel Consumption-Diesel Engines;
Exhaust Emissions-Diesel Engines;
Motor Vehicles-Engines

An engine test of the Chrysler-Nissan Model CN633 diesel engine was performed to determine its steady-state fuel consumption and emissions (HC, CO, NO_x) maps. The data acquired are summarized in this report.

DOT-TSC-OST-75-45. I
URBAN DATA BOOK, VOLUME I: URBAN DATA: ATLANTA – MIAMI
Transportation Systems Center.
L. Bronitsky, M. Costello, C. Haaland and S. Schiff.
PB-248-601
Final Report. November 1975. 174p.

Population-Statistics; Modal Split

A quick reference compilation of certain population, socio-economic, employment, and modal split characteristics of the 35 largest Standard Metropolitan Statistical Areas (SMSA) in the United States is presented.

The three basic groups or urban data presented are population, socio-economic, and employment. The population data include population totals and densities for the various segments of each of the individual SMSA's (CBD, Central City, Urbanized Area, and SMSA). Also included are population totals by concentric urban rings and population density plots (dot, contour, and isometric views). The urban ring data combined with population density plots can be used for identifying existing urban corridors. The socio-economic data compiled by concentric urban rings include: median female and male age, proportion of population 65 years and older, median family income, number of households and families, number of home-owners and renters, average home value and average rent paid, and auto ownership. The employment data found in this report include home-to-work flows, employment and worker densities, and a modal split distribution for each of the 35 SMSA's.

Volume I includes introductory material and the urban data, arranged alphabetically, for the SMSA's Atlanta-Miami.

Volume II includes data for the remaining SMSA's, Milwaukee-Washington, technical notes on individual tables and figures contained in both volumes, and two appendixes: Appendix A, a glossary of terms and concepts; and Appendix B, sample calculations which explain how the journey to work data were calculated.

DOT-TSC-OST-75-45. II
URBAN DATA BOOK, VOLUME II: URBAN DATA: MILWAUKEE-WASHINGTON, NOTES AND TECHNICAL APPENDIXES
Transportation Systems Center.
L. Bronitsky, M. Costello, C. Haaland and S. Schiff.
PB-248-601
Final Report. November 1975. 176p.

Population-Statistics; Modal Split

DOT-TSC-OST-75-46
A STUDY OF TECHNOLOGICAL IMPROVEMENTS TO OPTIMIZE TRUCK CONFIGURATIONS FOR FUEL ECONOMY
Arthur D. Little, Inc.
Donald A. Hurter, W. David Lee.
PB-246-681
DOT-TSC-627
Final Report. September 1975. 168p.

Fuel Consumption-Trucks

A study of truck fuel economy was undertaken for the U. S. Department of Transportation as a continuation of the Study of Technological Improvements in Automobile Fuel Consumption, report number DOT-TSC-OST-74-40. I-IV. The truck types that accounted for most of the fuel consumed were identified and modeled by computer analysis. Baseline fuel consumption was calculated for the major truck types over specific duty cycles. Design improvements in the truck were then modeled, and the effect on fuel economy was estimated. Those improvements considered cost effective and capable of meeting manufacturing and performance criteria were examined further for their economic impact. Total life cycle costs for the incorporation of improvements were developed for single improvements and combinations of improvements.

The study results indicated that fuel economy gains of up to 40% could be made in Classes I and II, 70-80% in Class IV van-type local delivery trucks, 15-30% in Class VIII depending on the type of truck and use. These four classes account for over 85% of the fuel consumed by the entire truck fleet.

It appears that the technological changes required to mass produce these more fuel efficient vehicles could be accomplished in the 1980's.

DOT-TSC-OST-75-48. I
HIGHWAY VEHICLE RETROFIT EVALUATION – PHASE I: ANALYSIS AND PRELIMINARY EVALUATION RESULTS
VOLUME I: SECTIONS 1 THROUGH 3
Aerospace Corporation.
M. G. Hinton, J. Meltzer, T. Iura, L. Forrest, A. Burke, R. Kopa, W. Lee, K. Swan, F. Augustine, W. Smalley.
PB-252 554
F04701-74-C0075-1
Interim Report. November 1975. 232p.

Fuel Consumption-Motor Vehicles

This report in two volumes presents an analysis and preliminary evaluation of selected used-car and light-truck fuel economy retrofit devices.

In particular, information is provided that depicts the performance characteristics of retrofit devices that have been brought to the attention of the Department of Transportation as having the potential to improve automotive fuel economy. The spectrum of devices includes carburetors, acoustic and mechanical atomizers, lean-bleed devices, vapor injectors, fuel modifications, inlet manifolds, drivetrain components, drag reduction techniques, driver aids, cooling fans, valve timing, tuneups, exhaust-related systems, engine oils, oil additives, and filters.

Included where possible, are analyses of the general operational principles of a given device and its possible effects on spark ignition engine operation in order to substantiate or explain the available test data.

DOT-TSC-OST-75-48. II
HIGHWAY VEHICLE RETROFIT EVALUATION – PHASE I: ANALYSIS AND PRELIMINARY EVALUATION RESULTS
VOLUME II: SECTIONS 4 THROUGH 13 AND APPENDIX
Aerospace Corporation, Environmental and Urban Division.
M. G. Hinton, J. Meltzer, T. Iura, L. Forrest, A. Burke, R. Kopa, W. Lee, K. Swan, F. Augustine, W. Smalley.
PB-252 555
F04701-74-C0075-2
Interim Report. November 1975. 196p.

Fuel Consumption-Motor Vehicles

DOT-TSC-OST-75-49
A COMPUTER MODEL FOR SIZING RAPID TRANSIT TUNNEL DIAMETERS
Bechtel Incorporated
F. P. Wyman and H. J. Hefland
DOT-TSC-601
Final Report. January 1976. 104p.

Tunnels-Dimensions

A computer program was developed to assist the determination of minimum tunnel diameters for electrified rapid transit systems. Inputs include vehicle shape, walkway location, clearances, and track geometrics. The program written in FORTRAN IV calculates the locations of six critical points with respect to the top of the low rail. Twenty triplets of points are considered, each triplet defining a possible circle. Circles not containing all six points are discarded and the minimum-diameter circle is selected. An additional plotting option is available to provide a visual presentation of tunnel, vehicle envelope, and walkway envelope.

DOT-TSC-OST-75-50
COMBINED UTILITY/TRANSPORTATION TUNNEL SYSTEMS – ECONOMIC, TECHNICAL AND INSTITUTIONAL FEASIBILITY
IIT Research Institute.
P. J. Huck, M. N. Iyengar, K. S. Makeig and J. Chipps.
DOT-TSC-794
Final Report. July 1976. 242p.

Tunnels-Construction

Although utility tunnels are common in Europe and Asia, United States use is largely confined to institutions where all utilities are under single ownership. Cut-and-cover transportation projects appear to display nearly ideal conditions for the use of utility tunnels. This project evaluated the economic, technical and institutional feasibility of incorporating utility tunnels into cut-and-cover transportation tunnel projects. Direct construction costs for the utility tunnel and conventional utility treatment options were projected and found to be comparable. In addition, significant reductions in urban disruption result when the construction of the utility tunnel and transportation tunnel is properly integrated. The combined tunnel system is the recommended option. The treatment of each utility, the structure of the tunnel operating entity and recommendations for implementation are included.

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DOT-TSC-OST-75-51
TRUCK NOISE VIII
THE DETERMINATION OF THE PRACTICAL NOISE CONTROL RETROFITTING OF PRE-1970 TRUCK AND COACH MODELS
General Motors Corporation, GMC Truck & Coach Division
Orison J. Bullard and Gayle M. Shaffer.
PB-256 287
DOT-TSC-699
Final Report. June 1976. 120p.

Noise-Buses; Noise-Diesel Engines; Noise-Trucks

A retrofit noise package was selected for four representative GMC vehicles; i.e. two Heavy Duty Conventionals, one cab-over engine Heavy Duty Astro, and one 53 passenger transit coach, to achieve optimum noise reduction. The selection of this material came from commercially available items submitted by various component suppliers.

A new system of noise-source isolation was developed in order to evaluate the vendor-supplied material. The best one of these components was then selected for the final Retrofit Noise Package.

DOT-TSC-OST-75-52
POTENTIAL FOR FLEXICAB SERVICES: INNOVATIVE USES OF TAXIS AND JITNEYS FOR PUBLIC TRANSPORTATION
INTERPLAN Corporation.
Roberta Remak.
PB-248 783
DOT-TSC-748
Final Report. December 1975 162p.

Demand Responsive Systems; Taxis; Jitneys

Taxis and jitneys can be significant urban transportation resources. Used innovatively to provide public transit services, they can offer mobility in low density areas where mass transit is not feasible, supplement mass transit economically to improve the overall level of service, and promote ridership of regional rapid rail and commuter rail systems and express bus services to reduce the use of private vehicles.

The term flexicab has been coined to refer to the range of demand-responsive and fixed-route services that can be offered as extensions of existing taxi/jitney operations. The taxi industry, with its experience in small vehicles, dispatching and flexible routing is particularly suited to flexicab operations. Opportunities for profit exist, particularly when several types of flexicab services are offered by the same operator, permitting him to make maximum use of his labor force and equipment.

Three examples of multi-service flexicab systems are presented in the form of scenarios set in hypothetical urban areas (small, medium, and large). The examples include the calculation of revenues, operating costs, and net earnings.

The report also reviews the present status of the taxi and jitney industry and makes policy and research recommendations. A bibliography and a list of contracts are included in appendixes.

DOT-TSC-OST-75-53
DIESEL-POWERED HEAVY-DUTY REFRIGERATION UNIT NOISE
Donaldson Company, Inc., Conrad Division.
Thomas J. Retka.
PB-250 554/AS
DOT-TSC-532
Final Report. January 1976. 52p.

Noise-Diesel Engines

A series of noise measurements were performed on a diesel-powered heavy-duty refrigeration unit. Noise survey information collected included: (1) polar plots of the "A Weighted" noise levels of the unit under maximum and minimum load conditions; (2) a linear and "A" weighted acoustical time history of the refrigeration unit noise operating from start-up to load conditions representing both minimum (unloaded) and maximum (loaded) cooling capacity; (3) the determination of the unmuffled refrigeration unit engine exhaust noise level under maximum and minimum load conditions; (4) the determination of the noise contribution, under maximum load conditions, from the refrigeration unit engine exhaust and engine cooling system fan to the overall system noise.

DOT-TSC-OST-75-54
WORKSHOP/SEMINAR REQUIREMENTS STUDY
Dynatrend Inc.
Rudolph G. DiLuzio.
DOT-TSC-774
Final Report. February 1976. 109p.

Transportation-Information Needs

The feasibility of using the workshop/seminar technique as an effective communication tool for technology sharing was affirmed by the use of a national survey of potential users of Federal DOT Research and Development products. The survey encompassed on-site interviews at numerous government and academic organizations. A diversity of geographic, institutional, and professional perspectives was obtained.

A total of over 100 transportation related areas of interest was refined to provide 10 workshop/seminar subject candidates. The survey results articulate state, local, and regional government transportation information needs and attitudes.

DOT-TSC-OST-75-56
STRATIFIED CHARGE ENGINES
Transportation Systems Center.
Eric M. Withjack.
PB-251 479
Final Report. January 1976. 114p.

Motor Vehicles-Engines

This report reviews stratified charge concepts and engines, with emphasis on the important issues of exhaust emissions, fuel economy, and performance. Divided and open chamber designs are discussed. Potential improvements in exhaust emissions and fuel economy are considered in detail.

Significant engine programs discussed include those of the Ford, Texaco, and Honda companies. Other variations are described as information is available. Results of programs for the test and evaluation of newly developed and modified conventional engines, particularly engines in test vehicles, are provided.

A special addendum provides additional information current to March 1975, gleaned primarily from "Requests for Suspension of 1977 Emission Standards," filed by several of the automobile manufacturers.

DOT-TSC-OST-76-1
AUTOMOTIVE ENERGY EFFICIENCY PROGRAM – PAPERS PRESENTED AT THE PROJECT COORDINATION MEETING, NOVEMBER 4-6, 1975
Transportation Systems Center.
Harold G. Miller.
Conference Papers. May 1976. 336p.

Fuel Consumption-Motor Vehicles; Tire Rolling Resistance; Motor Vehicles-Aerodynamics; Motor Vehicles-Engines

This volume contains working papers presented at the Project Coordination Meeting of the Automotive Energy Efficiency Program held at the DOT Transportation Systems Center, November 4-6, 1975. This program is the Federal Government's major effort to assess the capability of the automotive industry to significantly improve the fuel economy of production vehicles and assess the related socio-economic effects.

The primary objective of the conference was to report on progress to date and future plans of the AEEP as well as to promote the exchange of information between government, industry, and university investigators.

DOT-TSC-OST-76-4
AN ASSESSMENT OF RAILROAD LOCOMOTIVE NOISE
Bolt Beranek and Newman Inc.
Paul J. Remington and Michael J. Rudd.
PB-260 410
DOT-TSC-1016
Final Report. August 1976. 168p.

Noise-Railroads

Measurements of the noise generated by an SD40-2 diesel electric locomotive are described. The noise was measured in three types of moving tests: the first with the locomotive passing a 6-microphone array while under maximum power acceleration, the second with the locomotive simulating the pulling of a train, and the third with the locomotive coasting by unpowered. Stationary noise measurements were made at 16-microphone positions around the locomotive while it was attached to a load cell. The moving tests show that at the lower throttle settings, wheel/rail noise may be an important contributor to the overall locomotive noise signature even at modest speeds (20 mph and above at throttle 1 and 30 mph and above at throttle 4). At throttle 8, wheel/rail noise does not become a significant source until speeds in excess of 50 mph are reached. At throttle 8 and at speeds below 50 mph, noise spectra measured opposite the moving locomotive are comparable to noise spectra measured opposite the stationary locomotive. Diagnostic tests to determine how much the various sources contributed to the overall noise were performed at seven positions on one side of the locomotive. The engine exhaust and intake, the engine/generator, the radiator cooling fans, the dynamic brake fans, the traction motor blowers, the dust bi.. blower compressor, and structure-borne noise have all been identified. At high throttle settings the exhaust and radiator cooling fans dominate. At low throttle settings the engine/generator, the exhaust and the cooling fans all contribute to the overall noise.

DOT-TSC-OST-76-5
SOUND ATTENUATION KIT FOR DIESEL-POWERED BUSES
Rohr Industries, Inc.
James C. Berry and David L. Overgard.
PB-256 828
DOT-TSC-714
Final Report. June 1976. 240p.

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Noise-Diesel Engines; Noise-Buses

TheTransportation Systems Center (TSC), on behalf of the U. S. Department of Transportation (DOT), initiated a project to assess, demonstrate and document the noise reduction potential of optimized commercially-available exhaust, intake, and fan subsystems on a typical diesel-powered city bus. These subsystems were to be retrofitable designs in current vehicle fleets while maintaining public safety and established vehicle exhaust emission regulations.

This report, in response to this effort, is intended to provide a reference for manufacturers, owners, and operators to consult for recommendations or instructions on installing a proven noise-reduction kit. It provides an insight into the causes of diesel-powered bus noise and demonstrates an effective means for its reduction.

Appendixes give standard noise measurement procedures, acoustic and performance test data on the various design configurations, and service information on sound attenuation kits.

DOT-TSC-OST-76-7
TERRESTRIAL RADIODETERMINATION POTENTIAL USERS AND THEIR REQUIREMENTS
Transportation Systems Center.
S. Cantor, E. Farr, and R. Kodis.
PB-255 839
Interim Report. July 1976. 40p.

Navigation Systems; Automatic Vehicle Monitoring

This interim report summarizes information gathered during a preliminary study of the application of electronic techniques to geographical position determination on land and on inland waterways. Systems incorporating such techniques have been called terrestrial radiodetermination (TRD) systems. Their most common application has been to locate and track a large number of vehicles in real time. These and other potential uses and requirements are identified and discussed.

The final portions of this report describe the design and operation of a number of TRD and TRD-related systems that have been or soon will be deployed for demonstration. Most of these systems are associated with the computer-aided dispatching and monitoring of either municipal police car or bus fleets.

The benefits and limitations of these systems, as determined by their users, are presented for consideration.

DOT-TSC-OST-76-9
ROLLING RESISTANCE OF TIRES MEASURED UNDER TRANSIENT AND EQUILIBRIUM CONDITIONS ON CALSPAN'S TIRE RESEARCH
Calspan Corporation.
D. J. Schuring.
PB-251 932
DOT-HS-4-00923, AMEND. 2
Final Report. March 1976. 244p.

Tire Rolling Resistance

Rolling loss tests were performed on 31 different passenger and 4 light truck tires on Calspan's Tire Research Facility (TIRF) under transient and equilibrium conditions. The tests were designed to determine the effects of load, speed, inflation pressure, tire temperature, slip angle, torque, tire construction, aspect ratio and wheel diameter. In addition, the influences of road curvature (flat roadway, drum) and trip length on rolling resistance were investigated. The results are presented in tables and graphs. They are expressed in terms of 12 power loss descriptors (for each tire), stating initial values, equilibrium values, and distances required to achieve equilibrium, for rolling resistance, contained air temperature, tread surface temperature, and inflation pressure.

DOT-TSC-OST-76-10
ESTIMATING THE EFFECTS OF URBAN TRAVEL POLICIES
Charles River Associates.
Frederick C. Dunbar.
PB-253 208
DOT-TSC-964
Final Report. April 1976. 196p.

Travel Demand-Forecasts

This report presents models and procedures for quick evaluation of transportation policy options on urban travel behavior. The methods described in this report can be used to estimate the travel demand effects of a wide variety of transportation policy instruments with currently available data in a matter of hours, or minutes, with the aid of a calculator.

To evaluate the effects of a transportation policy, travel is separated into work and nonwork purposes. The work travel section of the report describes procedures for applying disaggregate logit models to generally available grouped data. To analyze the effects of policies on nonwork travel, a disaggregate travel demand model is estimated which is designed to be broadly applicable to a variety of planning and data contexts.

Both the work and nonwork trip demand models and procedures are exercised on sets of policy issues which are of current interest, including gasoline taxes, parking restrictions, transit service improvements and the introduction of new modes. Where appropriate, travel demand elasticities with respect to level of service changes are computed.

DOT-TSC-OST-76-11
SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
William F. Gay.
Annual Report. June 1976. 120p.

Transportation-Statistics

This report is a compendium of selected national-level transportation statistics. Included are cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water, oil pipeline, and gas pipeline. The report includes basic descriptors of U. S. transportation, such as operating revenues and expenses, number of vehicles and employees, vehicle-miles and passenger miles, etc.

As its name implies, the report is a summary of a larger data base, consisting of time-series collected from a variety of government and private statistical handbooks. In this edition, the selected data cover the period 1964 through 1974.

DOT-TSC-OST-76-12. I
SYSTEMS MODELS FOR TRANSPORTATION PROBLEMS, VOLUME I: INTRODUCING A SYSTEMS SCIENCE FOR TRANSPORTATION PLANNING
General Technical Services, Inc.
A. S. Iberall and S. Z. Cardon.
DOT-TSC-946
Final Report. March 1976. 84p.

Transportation Systems-Models;
Urban Transportation-Planning

In this introductory portion of a systems science for transportation planning, which is based on the statistical physics of ensembles, a foundation is laid on how statistical mechanics, equilibrium thermodynamics, and near equilibrium thermodynamics can be used for systems other than the atoms and molecules of its standard application. Its relevance to living systems is indicated. To provide some insight to its application, three example systems are briefly discussed – rivers, the vascular system in mammals, and the development of the nervous system and the evolution of intelligence in the living system. The study then considers social nets. The likely problems of the social net, particularly as they bear on transportation research and development, are discussed.

DOT-TSC-OST-76-12. II
SYSTEMS MODELS FOR TRANSPORTATION PROBLEMS, VOLUME II: AN INTRODUCTION TO URBAN CENTER MODELING
General Technical Services, Inc.
A. S. Iberall and S. Z. Cardon
DOT-TSC-946
Final Report. March 1976. 46p.

Transportation Systems-Models;
Urban Transportation-Planning

Our thermodynamic theory considers the problem of attempting to formalize in a modeling sense what might be done in an urban economy, wherein transportation planning and other institutionalized requirements of the domain are also to be satisfied, and to build technical notions toward a model that lead towards experimental testing within the real system and by means of the model. To that end we have developed some primitives for an urban system information flow policy model based on a Ziebolz two time scale controller. Policy is open to the existing ideology of the society.

DOT-TSC-OST-76-12. III
SYSTEMS MODELS FOR TRANSPORTATION PROBLEMS VOLUME III: A COMPUTABLE COMMAND-CONTROL SYSTEM FOR A SOCIAL SYSTEM
General Technical Services, Inc.
A. S. Iberall and S. Z. Cardon.
DOT-TSC-946
Final Report. March 1976. 90p.

Transportation Systems-Models;
Urban Transportation-Planning

In this report, the spectral characteristics of the urban center – at the level of the family, the functional organized units of society, and the essential compartment balances of the urban center – are spelled out in greater detail. These compartments are food, materials, energetics, manpower, productive function, economic balance, and technology governing the system. Ideal 'Carnot cycle' efficiencies are characterized for the basic cyclic processes in each compartment.

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DOT-TSC-OST-76-12. IV
SYSTEMS MODELS FOR TRANSPORTATION PROBLEMS, VOLUME IV: THE DEVELOPMENT OF URBAN DYNAMICS AND ITS POSSIBLE REGULATION
General Technical Services, Inc.
A. S. Iberall and S. Z. Cardon.
DOT-TSC-946
Final Report. March 1976. 132p.

Transportation Systems-Models;
Urban Transportation-Planning

In this final volume, the kinds of extant modeling are reviewed; a hard social physics is outlined; a theory is developed for the thermostatic state of complex systems (here, the social system); using the United States and some American cities, a first round estimate is made of the thermostatic state; the underlying potentials that govern the spatial character of a settlement are outlined; a theory of technological growth is proposed; and the means by which the transport fluxes are related to the potentials are suggested. This closes an introduction to the physics of society and how it may be used for regulation and control; e.g., transportation design.

It appears that man, like all other systems—e.g., rivers, plants, animals--is tied intimately to the earth and the earth's potential.

DOT-TSC-OST-76-13
STUDY OF AERODYNAMIC DRAG REDUCTION ON A FULL-SCALE TRACTOR-TRAILER
NASA Dryden Flight Research Center.
L. L. Steers and L. C. Montoya.
PB-254 571
RA-74-31
Final Report. April 1976. 58p.

Fuel Consumption-Trucks

Aerodynamic drag tests were performed on a tractor-trailer combination using the coast-down method on a smooth, nearly level runway. The tests included an investigation of drag reduction obtained with add-on devices that are commercially available or under development. The tests covered tractor-trailer speeds ranging from approximately 35 to 65 miles per hour and included fuel consumption measurements. The study shows the effects of the various add-on devices on the aerodynamic drag, and for some devices on the fuel consumption. Results from a simulation of fuel consumption tests using a computer program are also included.

DOT-TSC-OST-76-15
AUTOMOTIVE ENERGY EFFICIENCY PROGRAM—PAPERS PRESENTED AT THE AUTOMOBILE ENGINE CONTROL SYMPOSIUM, JULY 8 AND 9, 1975
Transportation Systems Center.
Wolfgang V. Roessler.
Conference Papers. April 1976. 390p.

Fuel Consumption-Motor Vehicles

This volume contains papers presented at the Automobile Engine Control Symposium conducted at the U. S. Department of Transportation, Transportation Systems Center, Cambridge, Massachusetts, on July 8 and 9, 1975, as part of the Department's Automotive Energy Efficiency Program (AEEP).

The primary objective of the symposium was to provide a forum of technical interchange between investigators from industry, government agencies, and universities, with regard to potential benefits in fuel economy and emissions resulting from the use of improved engine control techniques and systems.

Nineteen papers were presented at the conference, 17 of which are included in this volume. Some are abstracts or copies of visual material, while others are formal technical papers.

DOT-TSC-OST-76-18
MONITORING REPORT – AUTOMOBILE VOLUNTARY FUEL ECONOMY IMPROVEMENT PROGRAM
Transportation Systems Center.
W. M. Basham, S. Powel, H. H. Gould.
PB-258 442
Final Report. April 1976. 24p.

Fuel Consumption-Motor Vehicles

On October 8, 1974, President Ford announced the goal of a 40% improvement in fuel economy of automobiles to be achieved in the 1980 new car fleet compared to 14.0 MPH for 1974. The Secretary of Transportation was given the lead in developing the program to evaluate manufacturers' progress to achieve their fuel economy goals, to make periodic analyses of future plans of each manufacturer, and to report findings to the Energy Resource Council. This report discusses the domestic manufacturers' progress to date, reviews the manufacturers' future plans in general, and assesses the likelihood of their meeting the goals.

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DOT-TSC-OST-76-20
AEROSAT ACCESS CONTROL SUMMARY

See DOT-TSC-FAA-76-18 for complete documentation.

DOT-TSC-OST-76-21
TRUCK NOISE XI, EVALUATION AND REDUCTION OF HEAVY-DUTY TRUCK NOISE
PACCAR Inc., Truck R&D Center.
V. Alan Werner, William Boyce.
PB-260 676
DOT-TSC-708
Final Report. September 1976. 192p.

Noise-Trucks; Noise-Diesel Engines

This report describes the work performed to examine the noise sources on two common truck configurations manufactured by this company, and to evaluate the noise reduction effectiveness of retrofit hardware. The two trucks selected were Cab-Over-Engine (COE) models with engines most often ordered with these models. One was a Kenworth K-123 with a Cummins NTC-350 engine, the other a Peterbilt 352A with a Detroit Diesel 8V-71T engine.

The major noise source on both trucks was the cooling fan which led to modifications involving fan changes and fan speed decreases which resulted in decreased overall noise levels. The Kenworth's interior and exterior levels were reduced from 92 dB(A) to 89 dB(A) and from 91 dB(A) to 86.5 dB(A), respectively. The Peterbilt interior noise level was reduced from 95 dB(A) to 88.5 dB(A) and from 89 dB(A) to 84.5 dB(A) for the exterior.

Further reduction of noise levels from these trucks would require additional cooling fan changes and some form of engine treatment, the engine being the second major noise source.

DOT-TSC-OST-76-22
ENGINE PERFORMANCE TEST OF THE 1975 GM 140-CID
Bartlesville Energy Research Center.
W. F. Marshall and K. R. Stamper.
PB-254 686
RA-75-10
Interim Report. June 1976. 30p.

Fuel Consumption-Motor Vehicles;
Motor Vehicles-Engines;
Exhaust Emissions-Motor Vehicles

An engine test of the 1975 GM 140 cubic-inch-displacement, 4-cylinder engine has been performed to determine its steady-state fuel consumption and emissions (HC, CO, and NO_x) maps. The data acquired are summarized in this report.

DOT-TSC-OST-76-23
CASE STUDY EVALUATION OF THE BOSTON AREA CARPOOLING PROGRAM
Transportation Systems Center.
Carla Heaton.
PB-255 976
Final Report. May 1976. 280p.

Carpools

This report is a case study evaluation of an areawide carpooling program in operation in the Boston, Massachusetts area from August, 1973 through August, 1974. The program, entitled the WBZ/ALA Commuter Computer Campaign, was the first program in the nation to promote and organize carpooling on a regional scale. It consisted of a free computer matching service for prospective carpoolers supported by an intensive multi-media promotional effort.

The central objective of the present evaluation was to assess the effectiveness of the WBZ/ALA effort in generating interest in carpooling and in encouraging carpool formation. The evaluation was structured around a two-pronged survey effort. The WBZ/ALA Follow-Up Survey was administered to a sample of program participants to determine participant demographic and travel characteristics; their reasons for wanting to carpool; the extent of carpool formation as a result of, or independent of, the WBZ/ALA program; and participant experiences and attitudes toward the program.

In order to understand the regional significance of the WBZ/ALA Program, a second survey, the Eastern Massachusetts Survey, was administered to a sample of auto commuters in the region. The second survey was specifically designed to measure the penetration of the WBZ/ALA Program as well as provide benchmark data on the level of carpooling in the region and the characteristics and attitudes of carpoolers, noncarpoolers, and potential carpoolers.

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DOT-TSC-OST-76-25, I
EXPERIMENTAL TEST CONCEPT FOR A CARGO DATA INTERCHANGE SYSTEM (CARDIS), VOLUME I: TEXT
Computer Sciences Corporation.
C. Ruthling, W. Penrose, M. Wall
PB-256 822
DOT-TSC-1026
Final Report. May 1976. 62p.

Freight Transportation-Computer Systems

This report includes the recommended CARDIS experimental test system functional capabilities. It identifies the CARDIS functions that are inherent to an information exchange capability and optional systems which are required by the transportation related industries.

The criteria to evaluate the various system functions selected for implementation by test participants are included as are the CARDIS test objectives.

Volume I contains the CARDIS test concept, functional analysis, and test objectives.

Volume II contains the details on CARDIS functional modules.

DOT-TSC-OST-76-25, II
EXPERIMENTAL TEST CONCEPT FOR A CARGO DATA INTERCHANGE SYSTEM (CARDIS) VOLUME II: APPENDIXES
Computer Sciences Corporation.
C. Ruthling, W. Penrose, M. Wall.
PB-256 823
DOT-TSC-1026
Final Report. May 1976. 146p.

Freight Transportation-Computer Systems

DOT-TSC-OST-76-26
THE APPLICATION OF DECOMPOSITION TO TRANSPORTATION NETWORK ANALYSIS
Control Analysis Corporation.
G. B. Dantzig, S. F. Maier, Z. F. Lansdowne.
PB-251 766
DOT-TSC-1059
Interim Report. October 1976. 126p.

Transportation-Systems Analysis

This document reports preliminary results of five potential applications of the decomposition techniques from mathematical programming to transportation network problems. The five application areas are 1) the traffic assignment problem with fixed demands, 2) the traffic assignment problem with elastic demand, 3) the transportation network improvement problem, 4) the optimal staging of transportation investments over time, and 5) the geographic decomposition of the traffic assignment problem. For all five, proposed solution techniques are presented and compared with previous work.

DOT-TSC-OST-76-27
1975 AUTOMOTIVE CHARACTERISTICS DATA BASE
Transportation Systems Center.
Moses Rouse and William Basham.
PB-262 015
Final Report. October 1976. 140p.

Fuel Consumption-Motor Vehicles

A study of automobile characteristics as a supportive tool for auto energy consumption, fuel economy monitoring, and fleet analysis studies is presented. This report emphasizes the utility of efficient data retrieval methods in fuel economy analysis, statistical data reporting, and fleet mix analysis. The methods of vehicle sample selection, computation methods for statistical reports, illustrative output examples, and instructions for operating the data base are presented in order to fully represent the 1975 automobile fleet characteristics. A statistics section in this report contains information that is useful in econometric modeling and the determination of automobile design characteristics.

DOT-TSC-OST-76-29
TUNNELING: THE STATE OF THE INDUSTRY
Cresheim Company, Inc.
R. S. Mayo, J. E. Barrett and R. J. Jenny.
PB-256 817
DOT-TSC-1091
Final Report. June 1976. 282p.

Tunnels-Construction

Tunneling is examined as an industry. The demand for its services, the makeup of the industry, some history and its problems and prospects are analyzed. Industry participants are listed: owners, engineer firms, tunnel builders and specialized suppliers. How business is obtained, an estimate prepared, and a project conducted are described. Decision

making and risk management with private, public and multi-industry tunnel building firms, is described and analyzed. Manpower, technology and research and development needs are reviewed. The report covers transport, water and sewer tunnels, with emphasis on rapid transit.

DOT-TSC-OST-76-30
ENERGY STATISTICS, A SUPPLEMENT TO THE SUMMARY OF NATIONAL TRANSPORTATION STATISTICS
Transportation Systems Center.
William F. Gay.
Annual Report. August 1976. 144p.

Fuel Consumption-Statistics

This annual report is a compendium of selected time-series data describing the transportation, production, processing, and consumption of energy. The statistics have been assembled from a wide variety of sources, including the U.S. Department of the Interior, the Interstate Commerce Commission, and the American Petroleum Institute.

The report is divided into three main sections. The first, entitled "Energy Transport," contains such items as the revenues and expenses of oil pipeline companies, number and capacities of U. S. tank ships, and the total crude oil transported in the U. S. by method of transportation.

The second section, entitled "Reserves, Production, and Refining," reveals the growth over time of the U. S. oil and natural gas reserves, refinery capacity, and yields.

Trends in the demand for fuel and power are displayed in the third section, entitled "Energy Consumption." Throughout this part, the transportation sector is emphasized. Included are the gasoline and oil costs of automobiles of different sizes, the consumption of petroleum by type of product, the electrical energy consumed by the local transit industry, and other important statistics describing the supply and demand for energy.

DOT-TSC-OST-76-31
POTENTIAL ECONOMIC IMPACTS OF NON-MARKET CARGO ALLOCATION IN U.S. FOREIGN TRADE: WITH SPECIAL ANALYSIS OF THE UNCTAD CODE OF CONDUCT FOR LINER CONFERENCES
Transportation Systems Center.
Robert W. Schuessler and David Spiller.
PB-255 972
Final Report. July 1976. 144p.

Freight Transportation-Management; Freight Allocation

The objective of the report is to analyze the impacts of the non-market allocation of cargo in the U. S.-International liner trades, with a special emphasis on analyzing the impacts of cargo allocation as prescribed by the United Nations Code of Conduct for Liner Conferences. The report analyzes the effects of the non-market allocation of cargo on U. S. carriers, U. S. shippers, the consuming public and U. S. regulatory policy. A trade-route analysis has been made of the UNCTAD code's cargo-allocation provision on the basis of 1973 U. S.-foreign trade flows, and additions to U. S. shipping capacity have been indicated using four possible implementation scenarios. A specific methodology was developed to treat military cargos, as well as to account for cargo allocation by volume as well as value.

DOT-TSC-OST-76-36
FUEL CONSUMPTION, EMISSIONS AND POWER CHARACTERISTICS OF THE 1975 CHEVROLET 350-CID 2V AUTOMOTIVE ENGINE—EXPERIMENTAL DATA
Bartlesville Energy Research Center.
W. F. Marshall and K. R. Stamper.
PB-259 330
RA-75-10
Interim Report. September 1976. 40p.

Fuel Consumption-Motor Vehicles

Experimental data were obtained in dynamometer tests of the 1975 Chevrolet, 350 cubic-inch displacement, 2-bbl engine, to determine the steady-state fuel consumption and emissions of hydrocarbon, carbon monoxide and oxides of nitrogen. These data were obtained in detail adequate to construct performance maps for the entire speed/load operating range of the engine.

The objective of the test work was to obtain data that describe engine performance characteristics in engineering terms; the data are so presented. The comparative or judgmental assessment of engine performance was not an objective and such assessment is avoided.

DOT-TSC-OST-76-37
THE ADVISABILITY OF REGULATING ELECTRIC VEHICLES FOR ENERGY CONSERVATION
Transportation Systems Center.
S. F. Powel III and N. Rosenberg.
PB-260 667
Report to Congress. August 1976. 238p.

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Electric Vehicles

Vehicles that do not consume fuel are examined to determine if they should be included under the provisions of the Motor Vehicle Information and Cost Savings Act, as amended by Title III of the Energy Policy and Conservation Act. The manner of comparing energy requirements of these vehicles with energy requirements of fuel-consuming vehicles is considered, as is the application of the Act to vehicles that do not consume fuel, their market potential, and the effects of regulations on their production and their introduction into commerce.

DOT-TSC-OST-76-38
THE EFFECTIVENESS OF MILES-PER-GALLON METERS AS A MEANS TO CONSERVE GASOLINE IN AUTOMOBILES
Transportation Systems Center.
M. Stephen Huntley, Jr., William Z. Leavitt.
PB-260 541
Report to Congress. October 1976. 78p.

Fuel Consumption-Motor Vehicles

This report is the response of the U. S. Department of Transportation to a requirement of the Energy Policy and Conservation Act (PL-163) for an assessment of fuel flow instruments reading directly in miles per gallon (mpg). The report describes currently available mpg meters, their installation, utility, and safety and presents an analysis of potential cost savings. It discusses means of encouraging purchase and the use of mpg meters as add-on equipment and considers issues associated with the mandatory installation of mpg meters in new cars. It concludes that it has not yet been demonstrated that the use of available mpg meters will improve fuel economy for typical drivers. It recommends that the Congress not require that each new automobile be equipped with an mpg meter and that no action be taken to promote the use of mpg meters in used cars at this time. Appendix A discusses other driver aids for conserving gasoline. Appendix B contains a summary to the request for information and public comment on fuel flow meters. Appendix C lists thirteen references.

DOT-TSC-OST-76-42
FUEL CONSUMPTION, EMISSIONS, AND POWER CHARACTERISTICS OF THE 1975 DATSUN 119-CID AUTOMOTIVE ENGINE—EXPERIMENTAL DATA
Bartlesville Energy Research Center.
W. F. Marshall and K. R. Stamper.
PB-261 308
RA-75-10
Interim Report. November 1976. 42p.

Motor Vehicles-Engines; Fuel Consumption-Motor Vehicles; Exhaust Emissions-Motor Vehicles

Experimental data were obtained in dynamometer tests of the 1975 Datsun, 119 cubic-inch displacement, 2-bbl engine to determine steady-state fuel consumption and emissions of hydrocarbon, carbon monoxide, and oxides of nitrogen. These data were obtained in detail adequate to construct performance maps for the entire speed/load operating range of the engine.

The objective of the test work was to obtain data the describe engine performance characteristics in engineering terms; the data are so presented. The comparative or judgmental assessment of engine performance was not an objective and such assessment is avoided.

DOT-TSC-OST-76-43
FUEL CONSUMPTION, EMISSIONS, AND POWER CHARACTERISTICS OF THE 1975 FORD 140-CID AUTOMOTIVE ENGINE—EXPERIMENTAL DATA
Bartlesville Energy Research Center.
W. F. Marshall and K. R. Stamper.
PB-261 771
RA-75-10
Interim Report. November 1976. 40p.

Exhaust Emissions-Motor Vehicles; Fuel Consumption-Motor Vehicles; Motor Vehicles-Engines

Experimental data were obtained in dynamometer tests of the 1975 Ford, 140 cubic-inch displacement, 2-bbl engine to determine steady-state fuel consumption and emissions of hydrocarbon, carbon monoxide, and oxides of nitrogen. These data were obtained in detail adequate to construct performance maps for the entire speed/load operating range of the engine.

The objective of the test work was to obtain data that describe engine performance characteristics in engineering terms; the data are so presented. The comparison or judgment of engine performance was not an objective and such assessments are avoided.

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DOT-TSC-OST-76-51
AGGREGATE AUTO TRAVEL FORECASTING: STATE OF THE ART AND SUGGESTIONS FOR FUTURE RESEARCH
Transportation Systems Center.
Robert E. Mellman.
Final Report. December 1976. 46p.

Travel Demand-Forecasts

This report reviews existing forecasting models of auto vehicle miles of travel (VMT), and presents evidence that such models incorrectly omit time cost and spatial form variables. The omission of these variables biases parameter estimates in existing VMT models. More accurate parameter estimates are made, and suggestions are made for improving VMT models.

Accurate VMT models are important because VMT is a primary determinant of auto fuel use, pollution, and traffic fatalities; because the federal government is considering regulations to lower the levels of these externalities; and because future levels of the externalities must be measured in order to calculate the benefits to be derived from such federal regulation.

UNITED STATES COAST GUARD

DOT-TSC-CG-71-1
SURVEY OF METEOROLOGICAL REMOTE SENSORS
Transportation Systems Center.
A. E Barrington.
PB-204 793
May 1971. 18p.

Remote Sensing

The preliminary results of a survey are presented which identify techniques for determining meteorological data by remote sensing, applicable to automatic data buoy platforms. Both passive and active techniques are reviewed with emphasis on the former, in view of their more advanced development status. The principal references listed in the bibliography section of the memorandum indicate that experimental data to date have been obtained using only stable instrument platforms in a clean environment. Operation on unstable instrument platforms in the severe ocean environment requires further study.

DOT-TSC CG-71-3
TWO CANDIDATE SYSTEMS FOR UNMANNED FOG BANK DETECTION
Transportation Systems Center.
Jack R. Lifsitz and Hector C. Ingrao.
PB-204 805
June 1971. 132p.

Remote Sensing; LIDAR

The detection of coastal fog banks by remote sensing methods is discussed. The feasibility of laser backscattering (LIDAR) and infrared radiometry is explored in detail. These techniques are analyzed theoretically and experimental data are presented supporting the analysis. A design study is carried out for several laser systems, considering safety, reliability, cost, convenience, efficiency and maximum range. A fog bank detector utilizing a GaAs laser array is described which best satisfies these criteria. Before the prototype design is selected, a brief in situ test program is recommended, using apparatus designed at the Transportation Systems Center under Contract No. GC-02/99-712104, with the U. S. Coast Guard. In addition to clarifying several critical questions underlying the LIDAR design, the proposed test program would allow further evaluation of the infrared radiometric method. The latter technique, if its reliability can be verified, offers the advantages of being simpler and less expensive for fog bank detection than the LIDAR method.

TSC-USCG-71-7
AN INVESTIGATION OF OIL FLUORESCENCE AS A TECHNIQUE FOR THE REMOTE SENSING OF OIL SPILLS
Transportation Systems Center.
John F. Fantasia, Thomas M. Hard and Hector C. Ingrao
PB-203 585
Final Report. June 1971. 126p.

Remote Sensing; Oil Spills-Detection

The flexibility of remote sensing of oil spills by laser-excited oil fluorescence is investigated. The required parameters are fed into a physical model to predict signal and background levels; and the predictions are verified by field experiments. Airborne detection, identification, and quantification of oil spills at sea are shown to be feasible with existing equipment, day or night.

DOT-TSC-CG-72-1
A TECHNIQUE FOR MEASURING THE BEHAVIOR OF A NAVIGATIONAL BUOY
Transportation Systems Center.
L. V. Babb, R. W. Wilmarth.
PB-211 975
Sept. 1971. 118p.

Buoys

A prototype instrumentation system has been developed and fabricated to furnish stability information about a moored navigational buoy. The parameters necessary to define this stability are listed and the electro-mechanical transducers selected to measure these parameters are discussed. By utilizing a command and data transmission telemetry system, analog data were recorded and used to determine the types of instrumentation best suited to this application. A discussion of the results of testing and project recommendations conclude the report.

DOT-TSC-USCG-72-2
FOG BANK DETECTOR FIELD TESTS: A TECHNICAL SUMMARY
Transportation Systems Center.
Jack R. Lifsitz, Melvin Y. Yaffee.
December 1971. 36p.

Remote Sensing; LIDAR

This report summarizes the results of field experiments performed at Pt. Bonita, California, under the auspices of the U. S. Coast Guard, to test certain technical and opera-

tional assumptions underlying the design of a fog bank detector. The system under study, a laser LIDAR and a vertical-scanning infrared radiometer, have been discussed in detail in Report No. DOT-TSC-CG-71-3. Measurements of the peak power and shape of the return LIDAR pulse, and of the background levels, support the assumptions made in that report. The largest value of background spectral radiance measured, when a sunlit cloud fills the LIDAR receiver field-of-view, is 2 pw/cm^2/Å/sr (at 6943 Å). The infrared radiometer was found to be susceptible to ambiguities serious enough to eliminate this method from use as a reliable fog detector at the present time. Based on the laser backscatter results, a LIDAR fog bank detector, using a GaAlAs laser diode array as the transmitting source, is recommended and conclusions regarding its technical performance are presented.

DOT-TSC-USCG-72-3
USCG POLLUTION ABATEMENT PROGRAM: A PRELIMINARY STUDY OF THE VESSEL AND BOAT EXHAUST EMISSIONS
Transportation Systems Center.
R. A. Walter, A. J. Broderick, J. C. Sturm, E. C. Klaubert.
PB-210 417
November 1971. 129p.

Exhaust Emissions-Vessels

A preliminary study of exhaust emissions from Coast Guard vessels and boats indicates that the Coast Guard fleet is an insignificant contributor to air pollution on a national and regional basis. Based upon fuel usage data, emission estimates by vessel class were made for the entire Coast Guard fleet and compared to other sources of marine and land air pollution. No estimates of the effects on air quality of the two-stroke cycle outboard engine could be made due to the lack of reliable data on their emissions.

A general review of the existing air quality legislation pointed up the scarcity and contradictory nature of present laws as related to vessel emissions.

Existing monitoring instrumentation and emission control techniques were evaluated with consideration to their usefulness in a ship-board environment.

DOT-TSC-CG-72-4
SHAPE CODING FOR DAYMARKS
Transportation Systems Center.
J. H. Hill & C. N. Abernethy.
AD-778 686
CG-D-78-74
Final Report. March 1974. 46p.

Human Factors-Navigation; Buoys

Three experiments were conducted on form discrimination to select and evaluate forms for shape coding of daymarks. The discriminability of the forms was measured by the frequency with which each form was identified correctly and the frequency with which each form was confused with the other forms under evaluation. The form, in addition to the presently used can and nun, that was found sufficiently discriminable for use as a shape code for daymarks is the hourglass or a cylinder of equal aspect ratio.

DOT-TSC-USCG-72-5-I
VESSEL SAFETY MODEL, VOLUME I – ANALYTIC DEVELOPMENT
Transportation Systems Center.
D. Kahn, T. Talbot, J. Woodard.
AD-772-726-1
CG-D-40-74
Final Report. January 1974. 158p.

Maritime Safety-Models

A computer model which mathematically simulates the ship's movement in defined waterways is described. Volume I presents the capabilities and usefulness for ship traffic lane selection, alternate route selection, and safety analysis. The analytic development of the equations of motion and the collision and grounding probability analysis used in the computer program are also presented. Volume II of the report consists of a complete Users' Manual. Volume III is a self-contained Programmers' Manual.

DOT-TSC-USCG-72-5-II
VESSEL SAFETY MODEL, VOLUME II – USERS' MANUAL
Transportation Systems Center.
D. Kahn, T. Talbot, J. Woodard.
AD-772-726-2
CG-D-41-74
Final Report. January 1974. 74p.

Maritime Safety-Models

UNITED STATES COAST GUARD

DOT-TSC-USCG-72-5-III
VESSEL SAFETY MODEL,
VOLUME III – PROGRAMMERS' MANUAL
Transportation Systems Center.
D. Kahn, T. Talbot, J. Woodard.
AD-772-726-3
CG-D-42-74
Final Report. January 1974. 148p.

Maritime Safety-Models

DOT-TSC-USCG-73-1
A STUDY OF STACK EMISSIONS FROM COAST GUARD CUTTERS
Scott Research Laboratories, Inc.
Anthony F. Souza.
CG-D-13-73
DOT-TSC-429
Final Report. September 1973. 174p.

Exhaust Emissions-Vessels

The gaseous and particulate emissions from 14 cutters and boats in the First Coast Guard District have been measured under typical operating conditions. These measurements were performed on 57 diesel engines and boilers configured as main propulsion units, ship-service generators and hotel-service boilers. The diesel engines varied in size from two-cylinder naturally aspirated, 35 h.p. units to 3600 h.p. turbo-charged units. The gaseous emission concentrations measured were carbon monoxide, carbon dioxide, total hydrocarbons, and oxides of nitrogen. Particulate emission rates by the gravimetric technique as well as smoke levels were also documented. These measured concentrations were reduced to mass emission notes by appropriate computer programs.

DOT-TSC-USCG-73-2
U. S. COAST GUARD POLLUTION ABATEMENT PROGRAM: A PRELIMINARY REPORT ON THE EMISSIONS TESTING OF BOAT DIESEL ENGINES
Transportation Systems Center.
Robert A. Walter.
AD-769-455/7
CG-D-21-74
Interim Report. November 1973. 42p.

Exhaust Emissions-Vessels

The exhaust emission concentrations from three GM6-71's and a Cummins VT-350 diesel engines were measured on a dynamometer as a function of engine load. The GM6-71 engines were newly rebuilt by the Coast Guard; the Cummins Engine was in used condition. These engines are used as main power units in Coast Guard boats. The exhaust emission concentrations were reduced to mass emissions by the carbon balance technique. Similar emission levels were obtained from the three rebuilt GM6-71 engines with type HV injectors.

DOT-TSC-USCG-74-2
MARINE ENGINE-EXHAUST EMISSIONS TEST CELL
Transportation Systems Center.
Earl C. Klaubert, Robert A. Walter.
AD/A001 874
CG-D-27-75
Interim Report. November 1974. 68p.

Exhaust Emissions-Vessels

A marine engine-exhaust emissions test cell for boat-size diesel engines (approx. 200 hp) and outboard engines was constructed as part of a project sponsored by the United States Coast Guard for the monitoring and control of emissions from marine sources. This report describes the salient features of the cell including its structural aspects and noise attenuating capabilities. The engine types to be tested are briefly outlined. The power train for testing outboard motors along with the instrumentation assembled for monitoring and controlling the various test engine operating parameters are discussed in detail. Techniques for handling the outboard engine-exhaust emission gas sample and the instrumentation for emission measurements are described.

DOT-TSC-USCG-74-3
MEASUREMENT AND ANALYSIS OF L-BAND (1535-1660 MHz) ELECTROMAGNETIC (EM) NOISE ON SHIPS
Transportation Systems Center.
J. M. Clarke, S. R. Cantor, J. J. Winchus, A. L. Caporale
AD/A005 653
CG-D-50-75
Final Report. December 1974. 84p.

Maritime Communication-Satellite;
Radio Frequency Interference

A program of L-band (1535-1660 MHz) electromagnetic (EM) noise measurements conducted on ships is described in this report. The magnitude and duration of EM noise on ships is of particular significance in terms of potential radio frequency interference (RFI) to future Marine Satellite

(MARSAT) receiving systems on ships. The program involved the measurement and identification of EM noise levels originating at internal sources on the ships selected, and external sources at coastal locations within radio line-of-sight. The instrumentation and measurement procedures employed are described and illustrated. The predominant EM noise sources identified are discussed and illustrated graphically, and the potential RFI signal amplitude and bandwidth parameters are related to a typical MARSAT receiver sensitivity, and the communications link quality ratio C/N_0. The predominant sources of L-band noise were found to originate at ports and the adjacent cities. These sources are continuously present when the ships are docked, and can be characterized as a combination of continuous city ambient noise and intermittent broadband impulsive ignition noise from dockside unloading apparatus, automobiles and trucks. Some RFI levels 20 to 30 dB above receiver thermal noise were evident which would result in unacceptable degradation to the satellite-to-ship link C/N_0.

DOT-TSC-USCG-74-5
THE DEVELOPMENT OF AN EXPERIMENTAL AIRBORNE LASER REMOTE SENSOR FOR OIL DETECTION AND CLASSIFICATION IN SPILLS
Transportation Systems Center.
John F. Fantasia, Hector C. Ingrao.
AD/A013/580
CG-D-86-75
Final Report. February 1975. 166p.

Oil Spills-Detection; Remote Sensing

A study and measurements program to determine the feasibility of using laser-excited oil fluorescence as a means of detecting and classifying oils in spills and the marine environment was undertaken at the DOT/Transportation Systems Center. The study consisted of an analysis of the fluorescence properties of oils and oil slicks on the sea surface, and a theoretical analysis of the remote fluorometry of oil spills. As a result of this study a laboratory and field measurements program was undertaken. Laboratory measurements were made of 29 crude and refined oils commonly transported in the marine environment. These measurements included API gravity, fluorescence and reflectance spectra, fluorescence coefficient and fluorescence lifetimes. Similar measurements were made with a laboratory model of an N_2 laser oil spill remote sensor that was designed and built at TSC and installed at Point Allerton, Hull, Massachusetts. Results of these measurements showed that, under certain conditions, oil spill detection and classification can be made in the marine environment. A program was undertaken for further development of this technique. As part of the program the Experimental Remote Oil Detection and Classification (ERODAC) system was developed. After laboratory tests the ERODAC was field tested onboard a helicopter. The field tests showed that the ERODAC, under certain conditions, is capable of remotely detecting and classifying oils in spills.

DOT-TSC-USCG-74-6
LUBRICATING OIL BURN-OFF IN COAST GUARD POWER PLANTS
Transportation Systems Center.
J. R. Hobbs and R. A. Walter.
AD-A007 313
CG-D-80-75
February 1975. 98p.

Oil-Waste-Disposal

The results of a feasibility study for the burn-off of waste oils in Coast Guard power plants are presented. Among the factors considered in this evaluation were: simplicity, cost, engine manufacturers' recommendations, mixing ratios, engine emissions, and effects on engine performance. As a result of this study it is recommended that waste oil be treated by procedures outlined in this study, blended at a mix ratio of 1% or less waste oil to diesel fuel oil, and burned off in Coast Guard power plants.

DOT-TSC-USCG-74-7. I-III
MARITIME DYNAMIC TRAFFIC GENERATOR
CG-D-37-75. I-III

See DOT-TSC-OST-74-29. I-III for complete documentation.

DOT-TSC-USCG-75-1
TRANSPORTATION SYSTEMS CENTER/U. S. COAST GUARD L-BAND MARITIME SATELLITE TEST PROGRAM: TEST SUMMARY: SEPTEMBER-NOVEMBER 1974
Transportation Systems Center.
C. B. Duncombe, P. D. Engels, A. E. Foley, J. H. Kraemer, and P. G. Mauro
AD-A012 352
CG-D-104-75
Interim Report. June 1975. 48p.

Maritime Communication-Satellite; Applications Technology Satellite; Multipath Transmission

Several L-band satellite communications tests with the NASA ATS-6 spacecraft and the U. S. Coast Guard Cutter SHERMAN are described. The tests included 1200 bit per

second digital data, voice, simultaneous data and voice, ranging, multipath and antenna tracking. Preliminary results are discussed.

DOT-TSC-USCG-75-2
A STUDY OF FUEL ECONOMY AND EMISSION REDUCTION METHODS FOR MARINE AND LOCOMOTIVE DIESEL ENGINES
CG-D-124-75

See DOT-TSC-OST-75-41 for complete documentation.

DOT-TSC-USCG-75-3
U. S. COAST GUARD POLLUTION ABATEMENT PROGRAM: CUTTER ESTIMATED EXHAUST EMISSIONS
Transportation Systems Center.
R. A. Walter.
AD/A019/783
CG-D-123-75
Final Report. September 1975. 44p.

Exhaust Emissions-Vessels

The gaseous and particulate emissions of the Coast Guard cutter fleet are estimated by using measured emission factors and derived operational duty cycles. These data are derived operational duty cycles. These data are compared to previous estimates by using emission factors found in the literature and the EPA estimates of total national vessel emissions and the total national emissions from all transportation sources. The U. S. Coast Guard fleet emissions for all categories of pollutants are less than 1% of the national transportation totals.

DOT-TSC-USCG-75-4
U. S. COAST GUARD POLLUTION ABATEMENT PROGRAM – TWO-STROKE CYCLE OUTBOARD ENGINE EMISSIONS
Transportation Systems Center.
R. A. Walter.
AD/A019/783
CG-D-122-75
Final Report. September 1975. 136p.

Exhaust Emissions-Outboard Engines

This report documents the results of emissions tests performed on three old and two new outboard engines. Tests of the emissions were made before and after water contact. Older engines were tested in as-received condition, tuned to factory specifications and retested. After being tuned, these engines showed improvements in emissions and fuel consumption. The new engines with improved ignition and combustion chamber design and crankcase drainage recycling showed less emission and better fuel consumption characteristics than the older engines. The results of these tests were used to calculate the emissions impact of the United States Coast Guard outboard fleet for comparison with the emissions impact of other Coast Guard vessels and vessels in general.

DOT-TSC-USCG-76-1
WASTE OIL BURN-OFF IN COAST GUARD POWERPLANTS; WASTE OIL FILTERING SYSTEMS AND DIESEL ENGINE PERFORMANCE
Transportation Systems Center.
J. R. Hobbs, R. A. Walter.
AD-A031 064
CG-D-78-76
Final Report. June 1976. 58p.

Oil-Waste-Disposal; Exhaust Emissions-Diesel Engines

This report documents two tasks of a continuing study to determine the feasibility of burning waste lubricating oils in Coast Guard powerplants. The first task evaluated the effectiveness of two treatment devices for the clean-up of waste lubricating oil. It was found that a commercially available diesel filter pack is more effective than an oily-water separator. In the second task, exhaust emissions and performance were measured with a GM6-71 diesel engine when mixtures of lube oil in fuel oil up to 10 percent were burned. No short-term degradation in emissions or performance were observed.

DOT-TSC-USCG-76-2
RISK ANALYSIS METHODS FOR DEEPWATER PORT OIL TRANSFER SYSTEMS
Transportation Systems Center.
L. Frenkel and W. T. Hathaway.
AD-A029 329
CG-D-69-76
Final Report. June 1976. 146p.

Oil Spills-Risk Analysis;
Deepwater Ports

This report deals with the risk analysis methodology for oil spills from the oil transfer systems in deepwater ports. Failure mode and effect analysis in combination with fault tree analysis are identified as the methods best suited for the assessment of comparative risk from different technical alternatives.

The necessary methodology and analytical expressions are developed and their application is demonstrated in some general sample calculations.

Basic data sources are listed, and the quality of the data is discussed. It is shown that the available data are not sufficiently complete for quantitative calculations of the risk for the entire system. Comparative calculations, however, can be made, and a systematic quantitative examination of the system is possible.

DOT-TSC-USCG-76-3
WASTE OIL BURN-OFF IN COAST GUARD POWERPLANTS: DIESEL PISTON RING WEAR STUDY BY RADIOACTIVE TRACER TECHNIQUES
Southwest Research Institute, Department of Engine and Vehicle Research.
J. O. Storment and J. R. Sherrard.
CG-D-84-76
DOT-TSC-920
Interim Report. July 1976. 43p.

Fuel Consumption-Diesel Engines;
Oil-Waste-Disposal

The work reported here is the final effort in a study to determine the feasibility of burning waste crankcase lubricating oils in Coast Guard powerplants. Specifically, the program reported here was to determine if burning a mixture of used lube oil and diesel fuel in a two-stroke cycle diesel engine resulted in increased rates of ring wear relative to that observed with standard fuel. Piston ring wear rates were measured by the radioactive tracer technique. Four top compression rings of a Detroit Diesel 6-71 engine were made radioactive, and the wear particles present in the crankcase oil from these rings were measured by gamma ray spectrometry. In 210 hours of operation, using diesel fuel with used lube oil up to 10% by volume, no increased wear rates were measured. The engine was disassembled upon test completion, and the wear and deposit build-up on critical engine components were nominal for this type of engine and total operating hours.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-71-1
EN-ROUTE AIR TRAFFIC FLOW SIMULATION
Transportation Systems Center.
M. F. Medeiros, Jr.
AD-751 929
January 1971. 66p.

Air Traffic Control-Models

This report covers the concept, design, development, and initial implementation of an advanced simulation technique applied to a study of national air-traffic flow and its control by En-Route Air Route Traffic-Control Centers (ARTCC). It is intended to be the first step in gaining an insight into the nature of the national flow-control problem and the utility and limitations of digital simulation to that end.

A flexible digital computer-implemented simulation has been developed which provides a family of model configurations and simulated environments for the U. S. air-traffic system, restricted to positive-controlled high-altitude airspace. Exploitation, validation, and verification of this simulation model are just beginning. Detailed information on the design and program structure is presented in the appendixes.

DOT-TSC-FAA-71-3
CONCEPTUAL NETWORK MODEL OF THE AIR TRANSPORTATION SYSTEM. THE BASIC, LEVEL 1 MODEL
Transportation Systems Center.
Aurel N. de Hollan, Arthur S. Priver.
AD-733-752
April 1971. 44p.

Air Transportation Systems-Models

A basic conceptual model of the entire Air Transportation System is being developed to serve as an analytical tool for studying the interactions among the System elements. The model is being designed to function in an interactive computer graphics environment which permits rapid alteration of rules and parameters, as well as continuous real-time graphical monitoring of system operations. The model described here is the first member in an evolving hierarchy of increasingly complex models, progressing in the direction of closer approximation to the real-world Air Transportation System.

DOT-TSC-FAA-71-4
A FUNCTIONAL DESCRIPTION OF AIR TRAFFIC CONTROL
Transportation Systems Center.
J. R. Coonan and P. Mpontsikaris.
March 1971. 81p.

Air Traffic Control

This document contains a description of air traffic control in terms of generic operational functions. The functions are grouped by flight phase and by major system function (navigation, surveillance, control, and communication). More detailed descriptions of these functions, and estimates of related parameters are contained in the appendix. A diagram is shown of the sequence of events for a typical IFR flight through the current ATC system. Also, certain aspects of ATC which cannot be described in terms of operational functions (e.g., legal responsibilities) are discussed.

DOT-TSC-FAA-71-5
THE IMPACT OF INERTIAL NAVIGATION ON AIR SAFETY
Transportation Systems Center.
R. M. Hershkowitz, D. O'Mathuna and K. R. *Britting*
AD-733-753
May 1971. 25p.

Aircraft-Collision Risk-Models

An analysis of inertial navigation system performance data was carried out to assess the probable impact of inertial navigation on the aircraft collision risk in the North Atlantic region. These data were used to calculate the collision risk between two aircraft flying at the same nominal flight level on adjacent tracks. The inertial system's error sources are treated in a statistical sense to infer the en route error behavior from the terminal error data. Collision risk estimates are derived for easterly and westerly transatlantic flights. The results of this relatively conservative analysis show that there is strong evidence to support the concept that the widespread use of impartial navigators will lead to reduced separation standards in the North Atlantic region while maintaining present safety standards.

DOT-TSC-FAA-71-6
COLLISION RISK MODEL FOR NAT REGION
Transportation Systems Center.
Ronald Hershkowitz.
AD-733-754
May 1971. 55p.

FEDERAL AVIATION ADMINISTRATION

Aircraft-Collision Risk-Models

This paper reviews and summarizes the essential features of the collision risk model used to analyze the effects of separation standards on safety for the parallel tracking system employed in the North Atlantic. The derivation of the model is traced from a set of basic assumptions to formulation of various philosophies and a brief set of conclusions and recommendations for future work. Section VII contains a complete reference list.

DOT-TSC-FAA-71-7
EVALUATION OF AIR TRAFFIC CONTROL MODELS AND SIMULATIONS
Transportation Systems Center.
L. O. Higgins, P. Mpontsikaris.
AD-733-755
DOT-TSC-77
June 1971.

Air Traffic Control-Models

Approximately two hundred reports were identified as describing Air Traffic Control (ATC) modeling and simulation efforts. Of these, about ninety analytical and simulation models dealing with virtually all aspects of ATC were formally evaluated. The bibliography lists all the reports identified. There is an introduction to, and a summary of the evaluation effort as of this publication. The summary also contains a preliminary indication of which models may be of value for ATC concept evaluation; specifically traffic flow, safety and system loading aspects of proposed concepts. The remainder of the document is a catalog of the written evaluation of the ATC models. The models are divided into seven categories: (A) Airport Surface Traffic, (B) Runway, Departure/Arrivals, (C) Terminal Area, (D) Enroute, (E) ATC Systems (and miscellaneous), (F) Cost-Effectiveness Models, and (G) Safety Related Models. The catalog will be updated periodically.

DOT-TSC-FAA-71-8
LINEARIZED MATHEMATICAL MODELS FOR DEHAVILLAND CANADA "BUFFALO & TWIN OTTER" STOL TRANSPORTS
Transportation Systems Center.
R. A. MacDonald, Mel Garelick, and J. O'Grady
AD-733-756
112p.

STOL Aircraft

Linearized six degree of freedom rigid body aircraft equations of motion are presented in a stability axes system.

Values of stability derivatives are estimated for two representative STOL aircraft – the DeHavilland of Canada "Buffalo" and "Twin Otter." These estimates are based on analytical expressions included in the report. The combination of the equations of motion and the estimated stability derivatives provides an aircraft model which is useful for Navigation, Guidance and ATC Studies.

Resulting transient responses to control inputs are presented.

DOT-TSC-FAA-71-9
PRELIMINARY SURVEY OF POTENTIAL STOL TERMINAL AREA OPERATIONAL REQUIREMENTS
Transportation Systems Center.
Lloyd E. Stevenson.
AD-744-719
Interim Report. June 1971. 38p.

STOL Aircraft

A preliminary survey of potential operational requirements for STOL in the terminal area has been made. The presentation of this survey is in three sections. The first section presents the motivation for the survey, which can be summarized as the necessity for the federal government to have a knowledge of the potential operational requirements of STOL. The second section discusses the markets in which STOL may be found viable. This discussion is limited to those aspects which are necessary to determine the effects of these markets on shaping future STOL operations. The final section consists of a description of terminal area operations as they currently exist, of possible operational changes that may occur exclusive of the introduction of STOL, and then of potential operational requirements of STOL in the terminal area.

DOT-TSC-FAA-71-11
SIMULATION MODEL FOR THE PIPER PA-30 LIGHT MANEUVERABLE AIRCRAFT IN THE FINAL APPROACH
Transportation Systems Center.
Joseph S. Koziol, Jr.
AD-733-757
June, 1971. 21p.

Automatic Pilot; Aircraft-Landing Systems

This report describes the Piper PA-30 "Twin Comanche" aircraft and a representative autopilot during the final

approach configuration for simulation purposes. The aircraft is modeled by linearized six-degree-of-freedom perturbation equations referenced to the aircraft stability axis. Other equations are presented which derive the body axis rates, velocities and accelerations, and ground referenced velocities (translation equations).

The autopilot is a representative system for automatic ILS approaches from initial localizer track down to decision height. The glideslope system is engaged by approaching the glidepath at constant altitude (usually in the altitude hold mode) on the localizer beam. The pilot must take over manually at the decision height since light aircraft are not normally equipped with automatic flare capability.

The aircraft autopilot model described herein has been used extensively in simulation studies at TSC and exhibits the expected behavior.

DOT-TSC-FAA-71-13
FINAL REPORT: OCEANIC SURVEILLANCE AND NAVIGATION ANALYSIS, FY 71
Transportation Systems Center.
Ronald M. Hershkowitz.
AD-733-758
Final Report. June 1971. 94p.

Aircraft-Collision Risk-Models;
Air Traffic Control-Satellite

This report summarizes the oceanic surveillance and navigation analysis performed at Transportation Systems Center under PPA FA-04 for FY 71. Three major efforts are reviewed and discussed herein: (1) a tutorial summary of the NAT/SPG collision risk model; (2) a study of the impact of inertial navigation on air safety; and (3) an investigation of the modeling techniques required to assess the effect of ATC satellite surveillance on separation standards in the North Atlantic region.

DOT-TSC-FAA-71-14
REAL-TIME SIMULATION PROGRAM FOR DE-HAVILLAND (CANADA) "BUFFALO" AND "TWIN OTTER" STOL TRANSPORTS
Transportation Systems Center.
R. A. MacDonald, Mel Garelick, & J. Haas.
AD-744-720
June 1971. 52p.

STOL Aircraft

Simulation models of two representative STOL aircraft – the DeHavilland (Canada) "Buffalo" and "Twin Otter" transports – have been generated.

The aircraft are described by means of non-linear equations that will accomodate gross changes in angle of attack, pitch angle, flight path angle, velocity, and power setting. Aircraft motions in response to control inputs and external disturbances are related to Earth-fixed coordinates. The equations are programmed to run in "real time" so that they can be used in conjunction with a manned cockpit simulator. Provisions are made for pilot control inputs to the simulation, and conventional panel display parameters are generated.

The report includes representative simulation results which demonstrate that the simulation is an adequate representation of the two STOL aircraft being modeled.

DOT-TSC-FAA-71-15
LARGE SCALE SYSTEMS–A STUDY OF COMPUTER ORGANIZATIONS FOR AIR TRAFFIC CONTROL APPLICATIONS
Transportation Systems Center.
John Dumanian & David Clapp.
AD-733-759
June 1971. 152p.

Air Traffic Control - Computer Systems

Based on current sizing estimates and tracking algorithms, some computer organizations applicable to future air traffic control computing systems are described and assessed. Hardware and software problem areas are defined and solutions are outlined. System evaluation criteria are presented.

Section 1: delineates the objectives and approach, and furnishes definitions of computer hardware and software.
Section 2: presents the ATC data processing requirements: the anticipated traffic, the computer processing rates, and the methods for analyzing computer performance;
Section 3: describes current computing systems with capabilities for usage in near future ATC applications;
Section 4: denotes the algorithms which are to be used in the projected ATC programs;
Section 5: sums up the future prospects in ATC data processing, assesses the risks and points out some future work efforts.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-71-16
SYSTEM RELIABILITY AND RECOVERY
Transportation Systems Center.
Charles A. Dancy, III.
AD-733-760
June 1971. 61p.

Air Traffic Control - Computer Systems

This study exhibits a variety of reliability techniques applicable to future ATC data processing systems. Presently envisioned schemes for error detection, error interrupt and error analysis are considered, along with methods of retry, reconfiguration, task rescheduling and system restart. Reliability data are accumulated on present and planned ATC data processing systems and on certain commercial, military, and experimental computers having features applicable to future ATC tasks.

Included as well are discussions of reliability concepts, methods of reliability determination and criteria for judging system reliability and capability for recovery.

This work is connected with FA-03-1, Large Scale Systems.

DOT-TSC-FAA-71-17
TIME/FREQUENCY SYSTEMS
Transportation Systems Center.
E. H. Farr, L. A. Frasco, H. D. Goldfein, R. M. Snow.
AD-733-761
June 1971. 82p.

Air Traffic Control-Time Frequency Systems; Multipath Transmission

This report summarizes the work performed at DOT/TSC on the Time/Frequency ATC System study project. Principal emphasis in this report is given to the evaluation and analysis of the technological risk areas. A survey and description of proposed T/F system is included. The technical risk areas include the effects of multipath on signalling over radio links. Material is presented which bears on the comparative analysis of T/F with alternative technologies, including satellite and beacon-based system concepts. It is concluded that the most critical problem areas requiring further study are (a) multipath effects on T/F systems, and (b) systems operability under non-ideal conditions leading to graceful degradability.

DOT-TSC-FAA-71-18
PROPOSED CONTROL TOWER AND COCKPIT VISIBILITY READOUTS BASED ON AN AIRPORT-AIRCRAFT INFORMATION FLOW SYSTEM
Transportation Systems Center.
Hector C. Ingrao, J. R. Lifsitz.
AD-744-718
July 1971. 43p.

Air Traffic Control; Visibility

The problem of displaying visibility information to both controller and pilot is discussed in the context of visibility information flow in the airport-aircraft system.

The optimum amount of visibility information, as well as its rate of flow and display, depends both on the needs of the pilot during landing and on the air traffic control philosophy (tactical or strategic) chosen.

A rationale is provided to assist in the selection of flow rates and readouts. The relationship of visibility information to the magnitude of terminal information handled by the pilot is discussed. Several display formats are proposed, including one for the traffic controller and three different options for the pilot.

DOT-TSC-FAA-71-19
CLEAR AIR TURBULENCE RADIOMETRIC DETECTION PROGRAM
Transportation Systems Center.
George W. Wagner, G. G. Haroules, W. E. Brown
AD-733-762
Annual Report. July 1971. 47p.

Remote Sensing; Clear Air Turbulence-Detection

This report presents a review of accomplishments for the Clear Air Turbulence Detection Program. The objectives, instrumentation, supporting hardware and interfaces leading up to and including the test flights for the reporting period are given.

The ultimate goal of this program is the development of a remote method for detecting and thereby alerting high-altitude, high-speed aircraft in sufficient time to avoid the hazards associated with Clear Air Turbulence, CAT.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-71-20
DISPERSED PROCESSING FOR ATC
Transportation Systems Center.
Grant G. Paul & Robert M. Snow.
AD-733-763
Interim Report. June 1971. 16p.

Air Traffic Control-Computer Systems;
Digital Data Link

An analysis has been made of the potentialities and problems involved in assigning some computer processing and control functions to the remote sites in an upgraded third generation air traffic control system. Interrogator sites offer the most fruitful opportunities for remote processing. The minimal remote processing configuration consists of extraction, compaction, and encoding of locally derived data. With concurrent remote tracking, additional tasks may be added, including roll call generation, data link management, ground communications management, and IPC service. Phased-array management is considered to be the function of a separate dedicated controller. Attention is directed to the need for an "orderwire" net to avoid problems of floating control.

DOT-TSC-FAA-71-21
KEYBOARD AND MESSAGE EVALUATION FOR COCKPIT INPUT TO DATA LINK
Transportation Systems Center.
Edwin H. Hilborn.
AD-744-721
November 1971. 38p.

Air Traffic Control; Digital Data Link

The project reported herein studied some methods for implementation of the man-machine interface of Digital Data Link for Air Traffic Control. An analysis of information transfer requirements indicated that a vocabulary of less than 200 words could yield meaningful messages for all routine ATC transactions. Keyboard configurations suitable for one-handed operation to yield alphanumeric outputs were studied and a ten-key character selection layout based upon sequential keying of the first two letters of the phonetic alphabet was developed. Tests with experimental subjects indicated that training time was no longer and keying proficiency at least as good as that achieved with the larger keyset suggested by ARINC.

A second-order mnemonic coding scheme based upon key letters of the words of messages was proposed as a means for reducing the number of required keystrokes to generate such messages.

DOT-TSC-FAA-71-23
COMPUTER SYSTEMS PERFORMANCE MEASUREMENT TECHNIQUES
Transportation Systems Center.
Judith Gertler, Herbert Glynn, Vivian Hobbs, Frederick Woolfall.
AD-733-764
June 1971. 71p.

Air Traffic Control-Computer Systems

Computer system performance measurement techniques, tools, and approaches are presented as a function for future recommendations regarding the instrumentation of the ARTS ATC data processing subsystem for purposes of measurement and evaluation.

Section 1: Introduces the subject of computer system performance measurement and states objectives.
Section 2: Defines several computer system measurement approaches, describes the event-monitoring and statistical sampling software techniques, and discusses the various phases of a measurement process.
Appendix A: Defines the role of an Executive System in diverse computing environments and its effect on the design of a measurement package, discusses fundamental operational concepts of Executive Systems, and reviews ARTS III in terms of those concepts.
Appendix B: Surveys the state-of-the-art of available simulation languages and packages, summarizes their salient characteristics and provides guidelines for evaluation and selection of a simulation capability.

DOT-TSC-FAA-71-24
AN INVESTIGATION OF MICROWAVE LANDING GUIDANCE SYSTEM SIGNAL REQUIREMENTS FOR CONVENTIONALLY EQUIPPED CIVILIAN AIRCRAFT
Transportation Systems Center.
Maurice H. Lanman III.
AD-737-339
June 1971. 171p.

Aircraft-Landing Systems-Microwave

This report describes efforts leading to the determination of minimum suitable scan rates for the azimuth and Elevation #1 functions of the microwave Landing Guidance System (LGS) proposed by RTCA SC-117, based on performance requirements of two conventionally equipped civilian aircraft. Two complementary methods are used; one involving a full nonlinear digital simulation, the other involving direct covariance matrix propagation. Wind and

turbulence models, aircraft models and LGS models are described in detail. Safety and pilot acceptability criteria for performance evaluation are developed. Results are presented in terms of minimum scan rate maximum beam noise constraints. Limitations of the methods and data are also discussed and required further work outlined.

DOT TSC-FAA-71-25
VISIBILITY CONCEPTS AND MEASUREMENT TECHNIQUES FOR AVIATION PURPOSES
Transportation Systems Center.
G. T. Schappert.
AD-744-688
Final Report. July 1971. 104p.

Visibility

This is the final report #1 of the Visibility Measuring Devices project, PPA-FA-15-Q, carried out for the Federal Aviation Administration at the Transportation Systems Center, both under the Department of Transportation.

The report reviews present techniques for measuring atmospheric transmittance and its conversion to runway visual range. The response of the pilot to visual cues used in determining the visibility is discussed as a function of his cockpit environment. The lights utilized by the FAA as targets for visibility determinations are discussed and used in the computations.

New techniques for visibility measurements and new concepts and definitions are discussed and analyzed. The emphasis is on techniques for measuring slant visual range by means of optical remote sensing devices. Various problems relating to atmospheric modeling, signal processing, and eye safety aspects are discussed.

DOT-TSC FAA-71-26
ACCURATE SURVEILLANCE IN THE TERMINAL AREA
Transportation Systems Center.
B. Kulke, R. T. Minkoff, C. G. Haroules.
Final Report. September 1971. 43p.

Digital Data Link; Discrete Address Beacon System; Aircraft-Landing Systems-Microwave

The problem of deriving surveillance information from the MLS has been analyzed in terms of the available air-to-ground communication links. The results of this study indicate that the use of this approach is feasible and it is recommended that the configuration based on the DABS data link be included in the upgraded third-generation design to meet the high-density terminal-area surveillance requirements.

DOT-TSC-FAA-71-27
THE CALCULATION OF AIRCRAFT COLLISION PROBABILITIES
Transportation Systems Center.
Juan F. Bellantoni.
AD-744-722
October 1971. 41p.

Aircraft-Collision Risk-Models; Air Traffic Control

The basic limitation of air traffic compression, from the safety point of view, is the increased risk of collision due to reduced separations. In order to evolve new procedures, and eventually a fully automatic system, it is desirable to have a means of calculating the collision probability for any prescribed flight paths. This paper extends the statistical-probabilistic method of collision probability calculation, which has been limited to parallel, straight line flight paths, to arbitrary flight paths and vehicle shapes. The general formula is specialized to the cases of large relative velocity, non-zero relative velocity, zero relative velocity, and spherical collision surface. The formulas are applied to independent curved landing approaches to parallel runways.

DOT-TSC-FAA-71-29
MICROWAVE SCANNING BEAM APPROACH AND LANDING SYSTEM PHASED ARRAY ANTENNA
Transportation Systems Center.
R. M. Kalafus, G. J. Bishop, G. G. Haroules, P. Harris, F. J. LaRussa, P. J. Pantano, B. Rubinger, R. S. Vatsko.
AD-737-511
Annual Report. September 1971. 312p.

Aircraft-Antennas; Phased Arrays; Air Traffic Control; Aircraft-Landing Systems-Microwave

The feasibility of the use of phased arrays for the proposed microwave landing guidance system (MLGS) is discussed. The effects of the use of planar and conical beam guidance on the choice of system configurations is investigated. The design of an experimental antenna to demonstrate feasibility is given.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-71-30
MULTIBEAM AERONAUTICAL SATELLITE SYSTEM DESIGN
Transportation Systems Center.
L. M. Keane.
AD-744-861
December 1971. 76p.

Satellites-Aeronautical

A method is described which allows the identification of favored beam distributions for multiple beam aeronautical satellites. It is used to synthesize beam designs and compare the capacities of two satellite system configurations which cover the major Pacific routes. The first configuration has two satellites with eclipse capability adequate for housekeeping and independent aircraft surveillance; the second has additional battery capacity to provide 50% of the daylight communications capability in each satellite during eclipse. In this case, each satellite covers a limited portion of the full coverage area.

DOT-TSC-FAA-72-1
CHARACTERISTICS OF A SIGNAL DATA CONVERTER FOR A MULTI-RUNWAY VISIBILITY MEASURING SYSTEM
Transportation Systems Center.
H. C. Ingrao, J. R. Lifsitz.
AD-744-873
October 1971. 30p.

Visibility; Air Traffic Control

The characteristics of a signal data converter (SDC) are developed with application to airport visibility measuring systems. The SDC is discussed in the context of an evolutionary growth of the visibility measuring system stemming from the present FAA RVR measuring technique. A new SDC will be employed which will use state-of-the-art concepts and will be capable of handling future visibility measuring systems outputs to provide more comprehensive visibility information and display. Included in these outputs will be simultaneous signals from as many as nine transmissometers distributed three each along three runways. In addition, ground illuminance sensors will provide more background discrimination than the present day-night switch. Finally, the system will be expected to handle inputs from several kinds of target lights and to calculate and output for display several specialized visibility values (RVR,SVR,TVR). The SDC will be capable of modular expansion such that the capability for such future tasks will be available.

DOT-TSC-FAA-72-2
VORTEX SENSING TESTS AT NAFEC
Transportation Systems Center.
D. Burnham, J. Hallock, R. Kodis, T. Sullivan.
AD-749-908
January 1972. 72p.

Aircraft-Wake Vortices; Remote Sensing

This report describes the results of a series of tests conducted for the FAA at NAFEC by the DOT/Transportation Systems Center. The test objectives were to determine and evaluate some of the characteristics of three experimental techniques for the remote sensing of the wing-tip vortices generated by heavy commercial and military aircraft. These techniques involved (1) a pulsed, bistatic acoustic detection and ranging system (referred to as an acoustic radar); (2) a ground level pressure sensor; and (3) a ground level hot-wire anemometer. The tests were conducted both in conjunction with the instrumented tower and at the end of runway 13. Data were obtained and analyzed for a variety of aircraft including the DC-7, B-747, C-141, and C-5A. Results in the form of altitudes and times of tower hits and vortex tracks are presented and compared to the tower data wherever possible.

DOT-TSC-FAA-72-5
PATH CHANGING METHODS APPLIED TO THE 4-D GUIDANCE OF STOL AIRCRAFT
Transportation Systems Center.
Robert J. Hynes, Edward B. Capen and Lloyd E. Stevenson.
AD-744-874
November 1971. 42p.

STOL Aircraft

Prior to the advent of large-scale commercial STOL service, some challenging navigation and guidance problems must be solved. Proposed terminal area operations may require that these aircraft be capable of accurately flying complex flight paths, and in some situations, maintaining a time of arrival envelope at waypoints along these paths (4-D guidance capability). This report discusses problems that arise in performing 4-D guidance and presents the results of an initial investigation of two candidate 4-D guidance schemes that are based on the aircraft having a limited amount of protected airspace for maneuvering. Preliminary analysis and simulation results are presented and future work on the 4-D guidance of STOLS is outlined. The results although presented for STOLS are applicable also to the 4-D guidance of any RNAV equipped aircraft.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-72-6
MONOPULSE AZIMUTH MEASUREMENT IN THE ATC RADAR BEACON SYSTEM
Transportation Systems Center.
Bernhard Kulke, Bruce Rubinger, George G. Haroules.
AD-746-943
December 1971. 121p.

Radar Beacon Systems; Air Traffic Control; Monopulse Radar

A review is made of the application of sum-difference beam techniques to the ATC Radar Beacon System. A detailed error analysis is presented for the case of a monopulse azimuth measurement based on the existing beacon antenna with a modified feed network. A comparison of the total expected monopulse error with the azimuth error of the existing ATCRBS indicates that there is little to be gained by a monopulse modification. Without beam sharpening, the single-reply monopulse accuracy is less than that of the existing system. With beam sharpening and/or by using multiple reply information, the azimuth error is estimated to be as little as 1 or 2 Azimuth Change Pulses (ACP's), compared to 3 ACP's measured error for the Common Digitizer. However, the monopulse modification implies a considerable increase in system cost and complexity, and the estimated accuracy has not so far been demonstrated in the field. A monopulse modification for azimuth measurement in ATCRBS therefore is not recommended. In terms of fruit reduction, an advantage is obtainable by utilizing sum-difference techniques for artificial beam sharpening, but other solutions may be preferable.

DOT-TSC-FAA-72-7
THE ILS SCATTERING PROBLEM AND SIGNAL DETECTION MODEL
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin.
AD-746-944
February 1972. 105p.

Multipath Transmission; Aircraft-Landing Systems

The construction of a mathematical model of the Instrument Landing System (ILS) multipath problem has been undertaken. This report presents the theoretical basis for any such model, a critique of previous models and newly achieved developments in ILS model construction.

DOT-TSC-FAA-72-8
EVALUATION OF THE FAA ADVANCED FLOW CONTROL PROCEDURES
Transportation Systems Center.
J. F. Bellantoni, J. R. Coonan, M. F. Medeiros.
AD-744-862
January 1972. 215p.

Air Traffic Control

This report is an evaluation of the present FAA Advanced Flow Control Procedures (AFCP), based on data gathered from its implementation on February 5, 1971 and on a fast-time digital simulation of traffic feeding into the N.Y. airports on that day. The report discusses the effectiveness of AFCP in theory, in the February 5 case study, and as modelled in the simulation. Recommendations are made 1) to retain the concept, 2) to modify the procedures, 3) to modify the computer program, and 4) to conduct further research.

DOT-TSC-FAA-72-9
CONSIDERATIONS ON THE RELATIONSHIP BETWEEN WHITE AND RED CENTERLINE RUNWAY LIGHTS AND RVR
Transportation Systems Center.
J. L. Horner.
AD-761-119
Final Report. January 1972. 26p.

Visibility

The runway visual range (RVR) for a Type L-850 bidirectional centerline runway light has been calculated for the red and white output ports at three different current settings for both day and night illuminance thresholds. The calculations are based on certain parameters measured in our laboratory on a sample light. The resulting RVRs are compared to the standard RVRs based on the High Intensity Runway Light (HIRL). An analysis is also included on the error introduced by ignoring the spectral transmittance of the atmosphere.

DOT-TSC-FAA-72-10
A SURVEY TO DETERMINE FLIGHT PLAN DATA AND FLIGHT SCHEDULE ACCURACY
Transportation Systems Center.
John R. Coonan
AD-744-876
January 1972. 125p.

FEDERAL AVIATION ADMINISTRATION

Air Traffic Control

This survey determined Operational Flight Plan Data and Flight scheduling accuracy vs. published schedules and/or stored flight plan data. This accuracy was determined by sampling tracer flights of varying lengths, selected terminals, and high altitude sectors; then comparing this data with stored computer data, thus, revealing average delay areas. This information will aid operational analysts and programmers to construct flow control software programs.

DOT-TSC-FAA-72-12
MODULATION AND CODING FOR A COMPATIBLE DISCRETE ADDRESS BEACON SYSTEM
Transportation Systems Center.
H. D Goldfein, L. A. Frasco.
February 1972. 45p.

Air Traffic Control; Discrete Address Beacon System; Radar Beacon Systems

One of several possible candidate configurations for the Discrete Address System is described. The configuration presented is compatible with the Air Traffic Control Radar Beacon System, and it provides for gradual transition from one system to the other. A discussion of the effects of modulation and coding on the performance of the candidate DABS system is presented, and an experimental design is described. Some studies which will be required for detailed design are described.

DOT-TSC-FAA-72-13
AIRCRAFT WAKE VORTEX SENSING SYSTEMS
Transportation Systems Center.
D. Burnham, M. Gorstein, J. Hallock, R. Kodis, I. McWilliams, T. Sullivan.
AD-744-864
June 1971. 65p.

Aircraft-Wake Vortices; Remote Sensing

This report summarizes and analyzes techniques, both active and passive that could be used to detect and measure air movements associated with wingtip vortex generation within an area or throughout a volume of terminal airspace. This study also indicates one or more usable techniques with an appraisal of expected performance and inherent limitations. Results of preliminary feasibility tests employing available technology are presented.

This report also discusses the Systems Studies to be performed on the wake vortex sensing problem. The major effort is directed toward the location of wake vortex hazard, and the generation of monitoring requirements for safe operation in the airport terminal environment.

DOT-TSC-FAA-72-15
ILS LOCALIZER PERFORMANCE STUDY, PART I DALLAS/FORT WORTH REGIONAL AIRPORT AND MODEL VALIDATION—SYRACUSE HANCOCK AIRPORT
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin and D. Newsom.
AD-749-293
FAA-RD-72-96
Final Report. July 1972. 100p.

Aircraft-Landing Systems

The TSC electromagnetic scattering model has been used to predict the course deviation indications (CDI) at the planned Dallas Fort Worth Regional Airport. The results show that the CDI due to scattering from the modeled airport structures are within Category I requirements on all four modeled runways when the capture effect localizer (Alford 1B) is used but only marginally acceptable when the standard V-Ring localizer is used. Category II requirements for the designated Category II runway are met only by the capture effect antenna.

The report also presents the results of the TSC validation test in which Syracuse Hancock Airport was modeled. Theoretical and flight recorded data were compared and good agreement was obtained.

DOT-TSC-FAA-72-16
ASDE-2 TRANSMITTER MODIFICATIONS
Transportation Systems Center.
Henry R. Guarino.
AD-751-927
FAA-RD-72-82
Final Report. September, 1972. 29p.

Airport Surface Detection Equipment.

In October 1971, TSC was assigned the task of assessing the current ASDE-2 maintenance problems. After studying the available statistics, obtained from various airports, it was quickly concluded that the preponderance of ASDE-2 radar failures originated in the modulator-transmitter section where the low mean time between failures was controlled by the following inter-related factors: 1) An undersized hydrogen thyratron driver for the power amplifier; 2) An inadequate trigger pulse amplifier output; 3) Poor operating conditions for the power amplifier tubes.

The report analyzes these and bther engineering inadequacies and then describes in detail the modification of one channel of an ASDE radar, at TSC. To date the system has been operating for several months without any modulator failures. This is nearly fifty times longer than previous mean time between failures.

DOT-TSC-FAA-72-19
ALL-WEATHER LANDING OPERATIONS BIBLIOGRAPHY
Transportation Systems Center.
James M. Morris.
AD-754-267
FAA-RD-72-102
June 1972. 52p.

Aircraft-Landing Systems

The bibliography provides a selected coverage of several topic areas within the general subject of all-weather landing. The period covers the recent years of 1966 through 1971. The areas are: Approach and Landing, Human Factors, Navigation and Display Systems, Requirements and Standards, and Safety, Reliability and Maintenance.

DOT-TSC-FAA-72-20
PRELIMINARY EVALUATION OF SYNTHETIC SPEECH
Transportation Systems Center.
Edwin H. Hilborn.
AD-752-156
FAA-RD-72-109
Interim Report. August 1972. 22p.

Air Traffic Control; Digital Data Link; Synthetic Speech

This report briefly discusses the methods for storing and generating synthetic speech and a preliminary evaluation of the intelligibility of a speech synthesizer having a 75-word vocabulary selected for air traffic control messages. A program is suggested for additional testing based upon a vocabulary expanded to 128 words.

DOT-TSC-FAA-72-21
ADVANCED COMPUTER ARCHITECTURE FOR LARGE-SCALE REAL-TIME APPLICATIONS
Transportation Systems Center.
Gary Y. Wang.
AD-758-697
FAA-RD-72-101
Final Report. April 1973. 186p.

Air Traffic Control-Computer Systems

In this study the air traffic control automation is identified as a crucial problem which provides a complex, real-time computer application environment. A novel computer architecture in the form of a pipeline associative processor is conceived to achieve greater performance improvement over the present air traffic control system by parallel processing. This new processor is structured into a multiprocessor configuration for reliability enhancement. Problems associated with multiprocessors are identified with special emphasis on execution time anomalies and memory conflict. A direct graph model is used for analysis from which simple heuristics are established for memory allocation and dynamic task scheduling to achieve optimal performance with minimal system overhead. These schemes are simulated and the results obtained follow closely the predicted system behavior.

DOT-TSC-FAA-72-25
VORTEX SENSING TESTS AT LOGAN AND KENNEDY AIRPORTS
Transportation Systems Center.
T. Sullivan, D. Burnham, R. Kodis.
AD-753-849
FAA-RD-72-141
Final Report. December 1972. 136p.

Aircraft-Wake Vortices; Remote Sensing

This report describes a series of tests of wake vortex sensing systems at Logan and Kennedy Airports. Two systems, a pulsed acoustic radar (acdar) and an array of ground level pressure sensors, were tested. Site restrictions limited the Logan work to preliminary evaluation. The tests at Kennedy Airport established the general operating characteristics of both tracking systems. It was found that the acoustic sensor can detect and track the vortices of all commonly used commercial aircraft, though with varying degrees of sensitivity. The pressure sensors generally behaved best during conditions of low to moderate winds when the vortices could often be tracked laterally up to several hundred feet from the aircraft flight path.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-72-26
OCEANIC SURVEILLANCE AND NAVIGATION ANALYSIS, FY72
Transportation Systems Center.
Gilbert A. Gagne, Ronald M. Hershkowitz
AD-757-274
FAA-RD-72-142
Final Report. August 1972. 76p.

Aircraft-Collision Risk-Models; Air Traffic Control

This report summarizes the Oceanic Surveillance and Navigation Analysis performed, at or under the direction of, the Transportation Systems Center under PPA-FA-204 for FY72. A methodology has been developed by Systems Control, Inc. for relating the safety (collision risk) of the North Atlantic organized Track System in the lateral dimension to the general characteristics of the on-board navigation system, the independent satellite surveillance system and the ATC procedures. The initiation of this effort by TSC was reported in TR-DOT-TSC-FAA-71-13. The analysis and results are detailed herein. Extensions of this methodology to the latitude and vertical dimensions are also discussed and preliminary results are presented. A study has also been initiated to investigate and evaluate various configurations of aided inertial navigation system in the NAT region. The requirements, goals and contract award for this study are reviewed.

DOT-TSC-FAA-72-27
EVALUATION OF ILS LOCALIZER SIGNAL SPECIFICATION DURING GROUND ROLLOUT
Transportation Systems Center.
Joseph S. Koziol, Jr.
AD-765-761/2
FAA-RD-73-31
Final Report. August 1973. 102p.

Aircraft-Landing Systems

The International Civil Aviation Organization (ICAO) has developed a specification for localizer information on the runway surface appropriate for rollout guidance during Category III B operations. The suitability of this specification was evaluated by systems analysis and simulation and is reported herein. The results of the performance evaluation for a representative rollout guidance system indicate that the specification is too stringent especially for higher frequency type localizer disturbances and therefore should consider the spectral characteristics of the localizer disburbance. A more relaxed specification was therefore developed by taking additional advantage of the sensitivity effect of the localizer receiver and the attenuating effect of the rollout guidance system on localizer disturbances. The revised specification is recommended for future localizer signal specification since it could allow Category III B certification, without degradation of overall rollout system performance or safety, that the current specification might otherwise preclude. Practical means for applying the revised localizer signal specification are discussed but other more simple and practical means should be examined.

DOT-TSC-FAA-72-28
INSTRUMENT LANDING SYSTEM SCATTERING
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin.
AD-754-517
FAA-RD-72-137
Final Report. December 1972. 148p.

Aircraft-Landing Systems; Multipath Transmission

The construction of a mathematical model of the Instrument Landing System (ILS) multipath problem has been undertaken. This report presents the theoretical basis for such a model, and newly achieved developments in ILS model construction.

DOT-TSC-FAA-72-29
SIGNAL ANALYSIS FOR AEROSAT
Transportation Systems Center.
L. A. Frasco.
AD-758-407
FAA-RD-73-24
Final Report. August 1972. 80p.

Satellites-Aeronautical; Multipath Transmission

This report addresses signal design for the AEROSAT system. Candidate data and surveillance modems are analyzed for L-Band avionics. Detailed theoretical analyses are presented of the effects of the oceanic satellite-aircraft channel on data modem performance. In addition, an L-Band avionics transceiver is proposed to meet the requirements of the Experimentation and Evaluation Phase of AEROSAT. The proposed avionics is flexible and easily adaptable to a variety of operational and access control concepts. A task plan outline is presented for an improved modem taks for the following year.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-72-30
MICROWAVE LANDING SYSTEM SIGNAL REQUIREMENTS FOR CONVENTIONAL AIRCRAFT
Transportation Systems Center.
Maurice H. Lanman, III.
AD-754-892
FAA-RD-72-86
Final Report. July 1972. 146p.

Aircraft-Landing Systems-Microwave

The results of analysis directed towards determining Microwave Landing System (MLS) signal requirements for conventional aircraft are discussed. The phases of flight considered include straight-in final approach, flareout, and rollout. A limited number of detailed problems in performance analysis are studied. Data from computer simulation, covariance propagation and system optimization, with a careful selection of variables provides a means for generalizing from the results of specific experiments to more comprehensive functional, data rate, beam noise, and control system requirements for automatic landing in turbulence.

Conclusions point toward the requirements for a reevaluation of the MLS as sole primary landing aid; the problem arises during flareout in turbulence, when elevation information is inadequate to maintain precise sink rate control. Minimum suitable data rate and maximum allowable noise for final approach are also recommended.

DOT-TSC-FAA-72-31
A SYSTEM OF SIXTEEN SYNCHRONOUS SATELLITES FOR WORLDWIDE NAVIGATION AND SURVEILLANCE
Transportation Systems Center.
John J. Morrison.
AD-757-807
FAA-RD-73-30
Interim Report. March 1973. 62p.

Navigation Systems-Satellite

This report considers the orbital mechanics aspects of a system of satellites to be used for position determination of any point on or near the surface of the earth. Only satellites having a period of twenty-four hours are examined. No perturbing forces are taken into account. Three and four satellites are required to be visible at twenty and ten degrees elevation angles respectively. A system of sixteen satellites is described which has the required properties.

DOT-TSC-FAA-72-32
O'HARE ASDE-2 RADOME PERFORMANCE IN RAIN; ANALYSIS AND IMPROVEMENT
Transportation Systems Center.
Robert M. Weigand.
AD-757-744
FAA-RD-73-22
Final Report. March 1973. 80p.

Airport Surface Detection Equipment

The operational performance of the ASDE-2 radar at O'Hare Airport is severely limited during periods of moderate to heavy rainfall. Using the system performance specifications, an estimate has been made of the ASDE-2's tolerance to power loss and degradation of its circular polarization produced by a radome. Three aspects of the O'Hare radome have been examined as potential sources of excessive loss. These are (a) the metal space frame, (b) the dielectric constant and loss tangent of the membrane material, and (c) the membrane surface properties. It has been concluded that the membrane surface properties permit a water film buildup during rain which will cause severe losses. Hydrophobic coatings were tested in the laboratory before and after exposure to the environment. Two coating materials were found to retain their water shedding properties for several months. One of these coating materials was applied to the O'Hare ASDE-2 radome. Since coating the radome, very substantial improvement in operation has been noted during periods of rainfall.

DOT-TSC-FAA-72-33
ELECTROCARDIOGRAM SCANNER-SYSTEM REQUIREMENTS
Transportation Systems Center.
P. W. Davis, D. Ofsevit, J. Lutz.
AD-759-082
Final Report. March 1973. 40p.

Electrocardiograms

An experimental and analytical study has been conducted to establish the feasibility for scanning and digitizing electrocardiogram records. The technical requirements and relative costs for two systems are discussed herein. One is designed to automate the analysis of current electrocardiograms submitted in accordance with the FAA Aeromedical certification regulations. The other is designed for retrieval and scanning of the FAA file of microfilmed electrocardiogram records.

A cost-benefit analysis of the two systems is also presented.

FEDERAL AVAIATION ADMINISTRATION

DOT-TSC-FAA-72-34
AIRCRAFT L-BAND BALLOON-SIMULATED SATELLITE EXPERIMENTS, VOLUME II: CW MULTIPATH TEST RESULTS AND ANALYSES
Transportation Systems Center.
J. Liu, J. Kraemer, S. Karp.
AD-A005-649
FAA-RD-73-172
Final Report. November 1973. 196p.

Applications Technology Satellite; Multipath Transmission; Satellites-Aeronautical; Air Traffic Control-Satellite

Volume II contains the CW test results of an experiment run to simulate a satellite-to-aircraft channel at L-band. The program was initiated when the ATS-5 Satellite failed to achieve a wholly successful synchronous orbit and started to tumble. Using balloons to simulate the satellite, tests were run with the FAA CV880 aircraft. Although the geometry restricted the tests to low elevation angles and tangential paths, they were sufficient to obtain representative results.

The data reduction focused primarily on satisfactorily characterizing the combined direct and multipath returns. The results of this characterization indicated that, for the narrow bandwidth considered, the diffuse reflection from the surface appears Gaussian with independent in-phase and quadrature-phase components as attested to by a Ricean-distributed combined envelope return. The absence of a specular return was noted at elevation angles as low as 5 degrees and for Sea State I. Komolgorov-Smirnov tests were used to check for homogeneity and to test for a Ricean Distribution. Further analysis indicated a negative correlation between the envelope returns of the vertically and horizontally polarized signals.

DOT-TSC-FAA-72-35
A METHOD FOR THE STUDY OF CATEGORY III AIRBORNE PROCEDURE RELIABILITY
Transportation Systems Center.
Carl E. Feehrer.
AD-758-698
FAA-RD-73-39
Final Report. March 1973. 40p.

Aircraft-Landing Systems; Visibility

A method for the study of Category III airborne-procedure reliability is presented. The method, based on PERT concepts, is considered to have utility at the outset of a procedure-design cycle and during the early accumulation of actual performance data. For purposes of illustration, the method is exercised on a procedural set drawn from an earlier study of all-weather-system reliability.

DOT-TSC-FAA-72-37
HUMAN FACTORS EXPERIMENTS FOR DATA LINK: INTERIM REPORT I
Transportation Systems Center.
Edwin H. Hilborn.
AD-754-273
FAA-RD-72-150
Interim Report. November 1972. 72p.

Digital Data Link; Human Factors-Air Traffic Control; Synthetic Speech

This report discusses three experiments aimed at providing information pertinent to the Data Link Operational Experiments Program. Section 1. describes the evaluation of the WIDCOM, a visual display, and a voice synthesizer for providing ATC information to pilots in a GAT-1 simulator. Section 2. is concerned with the evaluation of the intelligibility of the individual words in the vocabulary of the voice synthesizer. Section 3. describes an experiment to provide information as to possible coding formats for short message ATC commands and advisories.

The three sections of the report are independent in content, having as a common denominator their applicability to the Data Link Program.

DOT-TSC-FAA-72-38
CLEAR AIR TURBULENCE RADIOMETRIC DETECTION PROGRAM
Transportation Systems Center.
George W. Wagner, G. G. Haroules, W. E. Brown
AD-757-074
FAA-RD-73-20
Final Report. February 1973. 94p.

Clear Air Turbulence-Detection; Remote Sensing

The report presents the accomplishments of the Clear Air Turbulence Detection Program for the Period July 1, 1971 to June 30, 1972. The experimental effort during this time period was devoted mainly to the flight test program, acquisition of flight data and evaluation of flight data obtained. The program established the ability of the DOT/FAA detection system to sense turbulence and verify the encounter by means of other on-board atmospheric sensors. The total of 15 flights represents 31 flight hours and 26 hours of data tape. Eight of the turbulence encounters reported during these flights are considered significant and ranged from

moderate to severe. All test flights were conducted locally (within 350 miles) from NASA/Flight Research Center, Edwards, California.

Instrumentation, supporting hardware and interfaces are briefly reviewed. Improvements to the measurement technique are also presented.

Included are curves, tables and comments which support the events during particular flights where the data indicates changes in atmospheric conditions were sensed before and during turbulence encounters. The conclusions emphasize the need for additional flight tests that are coordinated with meteorological predictions of turbulence conditions in the moderate to severe classifications.

Operational experience gained with each flight allowed problems in equipment functions and data evaluation to be assessed and corrected so as to improve the "follow-on" flights that were conducted. Design improvements are recommended for existing and future sensor systems as well as use of more efficient methods of data reduction as a result of this experience.

A continuation of the flight test program is planned for the coming year by FAA.

DOT-TSC-FAA-72-40
CONTROLLER-REPORTED PERFORMANCE DEFECTS IN THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (1971 SURVEY)
Transportation Systems Center.
Bruce Rubinger.
AD-758-699
FAA-RD-73-16
Final Report. March 1973. 200p.

Radar Beacon Systems; Air Traffic Control

This report analyzes the returns from a recent ATC performance survey initiated by the Beacon System Interference Problem Subgroup. The survey began on 27 November 1971 and lasted for two weeks. Participation was limited to 37 facilities with problems considered representative of the entire system; included were enroute centers, civilian towers and military air traffic installations.

Examination of the deficiency data revealed that the most common nationwide problem was the loss of beacon coverage for a short period of time. This is followed by broken target slash, ring around, loss of coverage for long time, and false targets. The returns are sorted to identify the type of aircraft involved in the reported discrepancies. For each aircraft the data is further refined on the basis of error category, and the performance summarized by an error matrix. Attention is focused on the air carriers and the beacon discrepancies associated with this group are categorized. Air traffic statistics are derived and employed to normalize the discrepancy information. The resulting data reveals significant performance variation among the different air carriers, as well as between different aircraft. Finally, the manner in which the survey was conducted is discussed, and recommendations made for automating future performance tests.

DOT-TSC-FAA-72-41. I
MICROWAVE SCANNING BEAM APPROACH AND LANDING SYSTEM PHASED ARRAY ANTENNA. VOLUME I.
Transportation Systems Center.
R. M. Kalafus, G. J. Bishop, F. J. LaRussa, P. J. Pantano, W. R. Wade, R. S. Yatsko.
AD-755-682-1
FAA-RD-72-128 V.I
Annual Report. February 1973. 246p.

Air Traffic Control; Aircraft-Antennas; Aircraft-Landing Systems-Microwave; Phased Arrays

The use of phased arrays for the proposed landing system (MLS) is discussed. Studies relating to ground reflections, near field focusing, and phased-array errors are presented. Two experimental antennas which were fabricated and tested are described. Complete component specifications as well as test results are included.

The first annual report, having the same title, was published in September 1971 as report number FAA-RD-71-87 (TSC-FAA-71-29).

DOT-TSC-FAA-72-41. II
MICROWAVE SCANNING BEAM APPROACH AND LANDING SYSTEM PHASED ARRAY ANTENNA VOLUME II
Transportation Systems Center.
R. M. Kalafus, G. J. Bishop, F. J. LaRussa, P. J. Pantano, W. R. Wade, R. S. Yatsko
AD-755-682-2
FAA-RD-72-128 V.II
Annual Report. February 1973. 206p.

Air Traffic Control; Aircraft-Antennas; Aircraft-Landing Systems-Microwave; Phased Arrays

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-73-1
A PRELIMINARY REQUIREMENTS ANALYSIS FOR AIRPORT SURFACE TRAFFIC CONTROL SYSTEMS
MITRE Corporation.
G. Baran, R. A. Bales, J. F. Koetsch, R. E. LeVan.
AD-762-442
FAA-RD-73-6
DOT-TSC-378
Interim Report. January 1973. 194p.

Airport Surface Traffic Control

This report summarizes the results of a preliminary ASTC (Airport Surface Traffic Control) requirements analysis. The analysis was performed under a TSC/DOT contract and its scope was restricted. Consequently, the results shown are based on limited data and additional follow-on work by TSC is planned.

The study concentrated on the analysis of the ASTC requirements at three airports (Boston-Logan, Los Angeles and Chicago-O'Hare) to obtain baseline data, and extrapolated these results to an additional six airports (Seattle-Tacoma, Bradley, Cleveland, Detroit, Pittsburgh and Philadelphia) using data-of-record and the results of the baseline airport analysis.

The results of the study indicate a need for immediate improvement of the ASTC system in the 1970-1980 period at the baseline airports, with the need for improvements during peak periods at the Chicago-O'Hare Airport under all visibility conditions, and at Boston and Los Angeles in poor visibility conditions. Similar results are obtained by extrapolation for the other six airports surveyed in the course of this study, with the requirements for improvement being generally less critical with respect to the time of their implementation.

The primary measures that were used to determine the requirements for improvements are: controller communication workload and communication channel overloads, the controller capability to handle simultaneously the traffic required to achieve operational rates dictated by traffic demand, and controller capability to accept and release runway traffic with small headways, relative to the existing and/or projected traffic demand.

A preliminary evaluation of the value of potential ASTC improvements indicates that surveillance improvement, coupled with procedural changes, would result in the greatest capability increase. This is followed, in terms of potential payoff, by automation of the conflict-resolution function.

A requirement for improvement of the traffic flow networks (taxiway concrete) exists and may be the major factor determining the feasibility, costs, and payoff of ASTC improvements.

DOT-TSC-FAA-73-2
EVALUATION OF THE WATERTOWN ARSENAL BUILDING # 311 AS AN ILS MODEL RANGE
Transportation Systems Center.
Robert M. Weigand, Francis J. LaRussa.
AD-722-477
FAA-RD-73-193
Interim Report. December 1973. 44p.

Aircraft-Landing Systems

The Watertown Arsenal Building # 311 was evaluated for use as an indoor ILS model range using upward frequency scaling of 100 to 1. To model the effects of small buildings and aircraft in the vicinity of an airport ILS, any model range has to have very low background reflections. If background reflections are large, they will obscure the desired measurements. Sets of measurements designed to determine the amplitude and location of undesirable background reflections due to structural objects around the proposed model site show that it will be necessary to completely enclose the range with high quality absorber.

Using 200 square feet of inexpensive absorber to cover regions causing the largest background reflections and using antennas of narrow beamwidth, measurements of the effects of several large scattering objects were made. The scattered energy due to the largest target (3 feet x 3 feet) is in good agreement with calculations based on geometrical optics.

DOT-TSC-FAA-73-6
HUMAN FACTORS EXPERIMENTS FOR DATA LINK INTERIM REPORT NO. 2
Transportation Systems Center.
Edwin H. Hilborn, Leonard R. Devanna.
AD-760-401
FAA-RD-73-55
Interim Report. April 1973. 46p.

Digital Data Link; Human Factors-Air Traffic Control

Two experiments involving the coding of Air Traffic Control messages for Digital Data Link transmission are reported. Reaction times and error rates to slide presentations were recorded for both experiments as a means for assessing the relative meaningfulness of messages.

Experiment I studied the differences between long and short abbreviations with and without spaces. The need for the use of spaces was demonstrated. The experiment also indicated that with proper spacing, short and somewhat cryptic abbreviations were as useful as the longer and seemingly more meaningful abbreviations, even with only brief training of the experimental subjects.

Experiment II provided a procedural variation using the same stimulus material as that reported in Section III of Report FAA RD-72-150, with generally comparable results. It was again determined that for short ATC messages differences in type font were not significant, that arrows were generally better than words for altitude and heading commands, that a format of three short lines was better than one extended line, and the "L" and "R" as heading commands in messages such as "HDGL230" were extremely difficult to comprehend.

DOT-TSC-FAA-73-7
ANALOG RANGING MODEM CODE PROCESSOR AND GENERATOR
Transportation Systems Center.
P. G. Mauro.
AD-782-039
FAA-RD-74-55
Final Report. May 1974. 48p.

Modems; Satellites-Aeronautical

This report details technical development efforts to implement an analog ranging modem using recently developed linear integrated circuits where possible. The breadboard hardware is capable of acquiring frequency and phase of a weak signal in a high noise environment, i.e., a C/No ratio of 37 dB-Hz, as verified in laboratory noise tests.

The report includes a description of the system and of the hardware implementation. The ranging technique implemented and tested here has direct application to the AEROSAT system. It represents one possible approach to sidetone ranging. The test setup and test results are given along with a summary, recommendations and conclusions. Schematics of the circuitry, test data and analyses are included.

DOT-TSC-FAA-73-8
FEASIBILITY ANALYSIS OF AN AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS) BASED SURFACE TRILATERATION SURVEILLANCE SYSTEM
MITRE Corporation
John D. Vinatieri.
AD-763-328
FAA-RD-73-75
DOT-TSC 393
Final Report. June 1973. 238p.

Radar Beacons Systems; Air Traffic Control

Analysis indicated there are feasible methods for achieving surveillance of vehicles on the airport surface by means of time-of-arrival measurements of the vehicle's ATCRBS Transponder reply at three or more receiver sites. Some methods require modification to aircraft equipment while others do not. Performance will be superior with modification to aircraft equipment. On the other hand, the number of vehicles capable of participating in the system will be smaller. The principal problems to be overcome in system design are the potential garbling of replies through fruit responses, multipath responses, and responses from more than one vehicle to a single interrogation. The analysis indicates that techniques exist to overcome these effects with sufficient promise to warrant an austere implementation of a Data Acquisition Subsystem.

Contained herein is a definition of an ATCRBS Based Surface Surveillance System, analyses of various problems and techniques to achieve a satisfactory Data Acquisition Subsystem, and criteria for conducting a test program for further verification of feasibility and design.

DOT-TSC-FAA-73-13
USER'S MANUAL FOR ILSLOC: SIMULATION FOR DEROGATION EFFECTS ON THE LOCALIZER PORTION OF THE INSTRUMENT LANDING SYSTEM
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin, D. Newsom, A. Watson.
Transportation Systems Center.
AD-768-049
FAA-RD-73-76
Operational Handbook. August 1973. 92p.

Aircraft-Landing Systems

This manual presents the complete ILSLOC computer program package. In addition to including a thorough description of the program itself and a commented listing, the manual contains a brief description of the ILS system and

antenna patterns. To illustrate the program a test case was created and the figures of the case are incorporated in the report. Program DYNM and program ILSPLT are included as Appendices. The ILSPLT, complete with sample graphs, is a plotting routine for ILSLOC.

For a technical mathematical analysis of the system, the FAA report "Instrument Landing System Scattering" No. FAA-RD-72-137 should be consulted.

DOT-TSC-FAA-73-16
AIRPORT INFORMATION RETRIEVAL SYSTEM (AIRS) SYSTEM DESIGN
Transportation Systems Center.
Manuel F. Medeiros and Julie Sussman.
AD-764-202
FAA-RD-73-77
Final Report. July 1973. 188p.

Air Traffic Control-Computer Systems

This report presents the system design for a prototype air traffic flow control automation system developed for the FAA's Systems Command Center. The design was directed toward the immediate automation of airport data for use in traffic load predictions and flow control operational support. The system employed computer services offered by commercial time-sharing companies. The system was also designed to serve as a technology foundation and an experimental tool from which subsequent automation specifications could be derived. The report covers the design decisions associated with the data base, the user interface, the user language, the special processing and the numerous operational considerations. Also included are the supporting program designs for data base updating and integrity maintenance. Finally, the report presents several recommended improvements to the automation system.

DOT-TSC-FAA-73-17
HUMAN FACTORS EXPERIMENTS FOR DATA LINK INTERIM REPORT NO. 3
Transportation Systems Center.
Edwin H. Hilborn and Robert W. Wisleder.
AD-765-340/5
FAA-RD-73-69
Interim Report. August 1973. 124p.

Human Factors-Air Traffic Control;
Digital Data Link

The results of three experiments involving eight FAA NAFEC test pilots are reported. Section I describes the evaluation of four prototype Data Link displays in a GAT-1 simulator. While there was lack of agreement among the pilots as to the relative merits of the four displays, their opinions concerning Data Link as a concept were generally favorable.

Section 2 describes reaction time and error rate measurements made as 144 slides were presented containing a variety of short ATC messages. It was determined that differences in type font were not significant, that arrows were generally better than words for altitude and heading commands, and the "L" or "R' as heading commands in messages such as HDGL230 were extremely difficult to comprehend.

Section 3 describes a second laboratory experiment which studied the differences between long and short abbreviations with and without spaces. The need for the use of spaces was demonstrated.

The results of the experiments described in Sections 2 and 3 closely parallel those previously obtained using TSC engineers as experimental subjects.

DOT-TSC-FAA-73-19
SOLID STATE IMPATT AMPLIFIER PERFORMANCE DATA
Transportation Systems Center.
Philip J. Pantano.
AD-772-770
FAA-RD-73-177
DOT-TSC-158
Interim Report. December 1973. 36p.

Aircraft-Landing Systems-Microwave

Evaluation data on an 8-watt and a 16-watt Impatt Amplifier are presented to concisely describe the performance of these amplifiers. The data include component specifications and photographs, TSC test set-up configuration, amplitude and phase characteristics of the input and/or output, and noise data.

The amplifier development effort was pursued in the component development phase of the Microwave Landing System (MLS) Program, because solid state sources are considered a part of the critical technology ultimately required for the MLS systems.

The units performed satisfactorily and show promise for the implementation of this solid state source technology into future microwave landing systems.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-73-20
AIRCRAFT VORTEX WAKE DESCENT AND DECAY UNDER REAL ATMOSPHERIC EFFECTS
AeroVironment Inc.
P. B. S. Lissaman, S. C. Crow, P. B. MacCready, Jr., I. H. Tombach, & E. R. Bate Jr.
AD-771-311
FAA-RD-73-120
DOT-TSC-523
Final Report. October 1973. 222p.

Aircraft-Wake Vortices

Aircraft vortex wake descent and decay in a real atmosphere is studied analytically. Factors relating to encounter hazard, wake generation, wake descent and stability, and atmospheric dynamics are considered.

Operational equations for encounter hazard, wake generation, and atmospheric dynamics are given, including a brief description of a possible automatic meteorological system to provide atmospheric data for an airport wake forecasting program.

A new analysis for Crow Instability in ambient turbulence is given, expressing time-to-linkage as an explicit function of the turbulent dissipation. The analysis is well corroborated by flight tests although only limited data is available.

Wake descent in a stratified inviscid fluid is studied analytically providing new results for this problem. According to the present theory, the vortex span reduces upon descent into a stably stratified flow, causing the rate of descent to increase. Exact solutions are derived for vortex cell shapes in a uniformly sheared crosswind, showing that the upwind cell is greatly increased in size. It is believed that this may partly account for the observed unsymmetrical behavior (banking, etc.) in crosswinds.

A discussion of core bursting and turbulent wake entrainment during descent is given, with some tentative formulations for the latter. Full understanding of these two aspects must still be considered incomplete.

Finally, an assessment of the remaining problems is given, with recommendations for further analytical and flight test research.

DOT-TSC-FAA-73-21
INSTRUMENT LANDING SYSTEM PERFORMANCE PREDICTION
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin
AD-773-368
FAA-RD-73-200
Final Report. January 1974. 114p.

Aircraft-Landing Systems; Glide Paths

Further achievements made in fiscal year 1973 on the development of an Instrument Landing System (ILS) performance prediction model are reported. These include ILS localizer scattering from generalized slanted rectangular, triangular and cylindrical surfaces, a model of a parabolic localizer antenna system and an ILS glide slope terrain scattering theory. In addition, applications of this ILS performance prediction model are presented.

DOT-TSC-FAA-73-22
COMPUTER SYSTEM PERFORMANCE MEASUREMENT TECHNIQUES FOR ARTS III COMPUTER SYSTEMS
Transportation Systems Center.
V. J. Hobbs, J. G. Gertler.
AD-772-475
FAA-RD-73-195
Final Report. December 1973. 114p.

Computers

Direct measurement of computer systems is of vital importance in: a) developing an intelligent grasp of the variables which affect overall performance; b) tuning the system for optimum benefit; c) determining under what conditions saturation thresholds will be reached; d) understanding the effect of hardware or software alterations; and e) in establishing specifications for future systems.

The potential contribution of direct system measurement in the evolving ARTS III Program is discussed and software performance measurement techniques are comparatively assessed in terms of credibility of results, ease of implementation, volume of data, extent of useful information derived, and computer resource requirements. Hardware Monitors, Simulation and other measurement tools are also described. The applicability of these measurement tools and techniques to the ARTS III system is indicated.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-73-23, I
NORTH ATLANTIC (NAT) AIDED INERTIAL NAVIGATION SYSTEM SIMULATION.
VOLUME I: TECHNICAL RESULTS
Aerospace Systems, Inc.
William C. Hoffman, Walter M. Hollister, Kenneth R. Britting.
AD-770-072
FAA-RD-73-112, I
DOT-TSC-473
Final Report. July 1973. 204p.

Air Traffic Control-Models

Current air traffic operations over the North Atlantic (NAT) and the application of hybrid navigation systems to obtain more accurate performance on these NAT routes are reviewed. A digital computer simulation program (NATNAV —North ATlantic NAVigation) is developed to evaluate the performance of navigation systems for future commercial NAT aircraft operations. Error models are developed for aided-inertial navigation systems with external measurements from Doppler radar, Omega, satellite-ranging or air data. The covariance matrix error analysis method is used to simulate the navigation error histories, using the recursive navigation technique to incorporate measurements. A 34th-order error state vector is defined, requiring the numerical integration of up to 585 independent, first-order differential equations to propagate the covariance matrix. NATNAV has a highly modular structure for maximum flexibility to analyze a variety of likely hybrid navigation system configurations, to allow for contingencies such as subsystem failures and blunders, and to enable evaluation of variable update rates, suboptimal filtering schemes, aircraft maneuvers, etc. The program provides for an optimum initial alignment of the INS prior to taxi. A dead-reckoning option; i.e., no INS, is also available. Independent measurements using Doppler radar, Omega or satellite-ranging may be used to update the position and velocity estimates using the optimum recursive Kalman filter. As an alternative, suboptimum filter gains may be used instead. The outputs of the simulation are the standard deviations of the position and velocity errors, resolved into along-track, cross-track and vertical components. A number of computer results are presented for a typical eastbound North Atlantic flight. These results illustrate the performance of unaided-inertial systems; dead-reckoning; inertial systems with Omega, Doppler or satellite-ranging updates; sub filtering; and example malfunctions or blunders.

DOT-TSC-FAA-73-23, II
NORTH ATLANTIC (NAT) AIDED INERTIAL NAVIGATION SYSTEM SIMULATION
VOLUME II: COMPUTER PROGRAM NATNAV USER'S MANUAL
Aerospace Systems, Inc.
William C. Hoffman, Kathryn G. Bowie.
AD-770-073
FAA-RD-73-112, II
DOT-TSC-473
Final Report. July 1973. 158p.

Air Traffic Control-Models

A user's manual is provided for Program NATNAV (North ATlantic NAVigation), a digital computer simulation program developed to evaluate the performance of navigation systems for future commercial NAT aircraft operations. Error models for aided-inertial navigation systems with external measurements from Doppler radar, Omega, satellite-ranging or air data are simulated. The covariance matrix error analysis method is used to calculate the navigation error histories, using the recursive navigation technique to incorporate measurements. A 34th-order error state vector requires the numerical integration of up to 585 independent, first-order differential equations to propagate the covariance matrix. The program provides for an optimum initial alignment of the INS prior to taxi. The dead-reckoning option is also available. Independent measurements using Doppler radar, Omega or satellite-ranging may be used to update the position and velocity estimates using the optimum recursive Kalman filter. Optionally, suboptimum filter gains may be used instead. The outputs of the simulation are the standard deviations of the position and velocity errors, resolved into along-track, cross-track and vertical components. NATNAV is written entirely in Fortran IV for operation on the CDC-3800 digital computer of the Naval Research Laboratory. The program was developed with a highly modular structure for ease of program checkout, to simplify the user's understanding of the program, and to facilitate any modification which might be required for future applications. Programming details of the simulation describe functions of the various routines, flow charts, common storage and definition of Fortran variables. The usage of the program is illustrated with an example which presents typical input data and results. The hardware requirements, the deck setup, program options and operating procedures are all described. Certain restrictions and potential modifications are discussed, and a complete listing of the Fortran source program is included.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-73-24
AIRPORT INFORMATION RETRIEVAL SYSTEM (AIRS) USER'S GUIDE
Transportation Systems Center.
Manuel F. Medeiros and Julie Sussman.
AD-765-339/7
FAA-RD-73-121
Final Report. August 1973. 107p.

Air Traffic Control-Computer Systems

This handbook is a user's guide for a prototype air traffic flow control automation system developed for the FAA's System Command Center. The system is implemented on a time-sharing computer and is designed to provide airport traffic load predictions and flow control support. The User's Guide is a reference manual designed for use by the air traffic controllers and does not require any previous computer experience. The AIRS request (command) language is explained along with instructions on using remote teletype and graphical display terminals in working with the time-sharing computer. The manual tells the user how to obtain airport traffic demand data, flight listings, plots, arrival delay predictions and flow control assistance. It also describes how to enter operational data such as landing capacity estimates and how to add (or cancel) flight schedules to the AIRS centralized data base.

DOT-TSC-FAA-73-25
AIRPORT INFORMATION RETRIEVAL SYSTEM (AIRS) SYSTEM SUPPORT MANUAL
Transportation Systems Center.
Manuel F. Medeiros and Julie Sussman.
AD-770-251/9 GI
FAA-RD-73-122
Final Report. October 1973. 85p.

Air Traffic Control-Computer Systems

This handbook is a support manual for a prototype air traffic flow control automation system developed for the FAA's Systems Command Center. The system is implemented on a time-sharing computer and is designed to provide airport traffic load predictions and flow control support. The System Support Manual is designed for use by an experienced computer programmer. It contains instructions on performing the monthly AIRS data base updating including the Official Airline Guide data tape processing, the merging with the existing data base and the maintenance of the associated supporting data files. The manual describes the duties associated with monitoring nightly file checking and failsafe programs to assure data base integrity. The daily processing and troubleshooting of the system's usage records are also described. Other support functions involving data base maintenance are presented.

DOT-TSC-FAA-73-26
A BIBLIOGRAPHY ON METHODS OF ATMOSPHERIC VISIBILITY MEASUREMENTS RELEVANT TO AIR TRAFFIC CONTROL AND RELATED SUBJECTS
Transportation Systems Center.
Hector C. Ingrao.
AD-777-741
FAA-RD-73-128
Final Report. November 1973. 250p.

Visibility; Air Traffic Control

This bibliographical survey provides reference information and background material to assist in the selection of principles and measuring techniques which may be used in the development of future systems to measure Runway Visual Range (RVR), Slant Visual Range (SVR), Approach Light Contact High (ALCH), Taxi Visual Range (TVR), or any other parameter to be defined which will describe the photometric conditions of runways and/or taxiways under actual operational and atmospheric visibility conditions.

This survey gives much of the literature which has been published on the subject of visibility, the factors inherent to the target background, atmospheric optics, visibility-measuring instrumentation, photometric properties of the eye, visibility data-processing, landing, takeoff and taxiing problems which are imposed by reduced visibility. References on anatomy and physiology of the eye, pathological effects on vision, optometrical testing and visibility statistics of airports have been excluded with the exception of a few selected references.

The raw references and abstracts of this survey have been selected from automated information searches conducted by the National Aeronautics and Space Administration, The Defense Documentation Center, and the National Information Service at the request of TSC as well as from existing bibliographies on visibility and manual searches conducted by the Transportation Systems Center.

DOT-TSC-FAA-73-27
THE MEASUREMENT OF ATMOSPHERIC VISIBILITY WITH LIDAR: TSC FIELD TEST RESULTS
Transportation Systems Center.
J. R. Lifsitz.
AD-777-553
FAA-RD-74-29
Final Report. March 1974. 116p.

Visibility; LIDAR

This report represents a technical feasibility study of the use of lidar for determining the atmospheric extinction coefficient (σ) in low visibility. Measurements were made with

three laser sources: a Q-switched ruby laser, a GaAlAs diode laser array, and a modulated cw helium-neon laser. The work, sponsored by the FAA, is part of a program aimed at measuring and reporting slant visibility.

Results of lidar measurements made both in natural coastal fog and in artificial fog are analyzed. Extinction coefficients ($.01 < \sigma < .07 m^{-1}$) are obtained with the pulsed systems, using both the "slope" and "ratio" methods to analyze the backscatter signature. Corrections for finite laser pulse width are included in the data reduction. The analysis does not treat the effects of multiple scattering. In most cases the pulsed lidar values agree reasonably well with independent assessments of extinction. The relative merit of instantaneous versus time-averaged signatures is discussed. The cw technique did not show the predicted visibility-dependence, apparently due to inadequate system sensitivity.

DOT-TSC-FAA-73-28
CALCULATED AND SCALE MODEL EXPERIMENTALLY MEASURED SCATTERING FROM METALLIC STRUCTURES IN INSTRUMENT LANDING SYSTEM
Transportation Systems Center.
G. Chin, L. Jordan, D. Kahn, S. Morin.
AD-776-162/0
FAA-RD-74-25
Interim Report. March 1974. 34p.

Aircraft-Landing Systems

Comparison is made of theoretically calculated and experimentally determined scattering from metallic tilted rectangles and vertical cylindrical scatterers. The scattering was experimentally measured in a scale model range at the Watertown Arsenal, Watertown, MA. The theoretically calculated scattering effects were obtained from the Transportation Systems Center, (TSC), physical optics model for ILS scattering. Reasonably good agreement was found between theoretically calculated and experimentally measured received power patterns.

DOT-TSC-FAA-73-31
LETTER REPORT ON A STRAW-MAN MODIFICATION OF AN ATC TRANSPONDER FOR DISCRETE ADDRESS USE
Transportation Systems Center.
R. P. Rudis.
AD-782-353
FAA-EM-74-13
Interim Report. May 1974. 31p.

Radar Beacon Systems; Air Traffic Control; Discrete Address Beacon System

An experimental evaluation has been made of an RCA AVQ-65 air-traffic control transponder modified, in Mode D, so as to reply if and only if interrogated with its own preset reply code. Successful operation of the modified transponder was verified, and some key circuit limitations were explored and improved upon.

DOT-TSC-FAA-73-33
ILS LOCALIZER PERFORMANCE STUDY FOR DALLAS/FORT WORTH AIRPORT, PART 2
Transportation Systems Center.
L. Jordan, D. Kahn, S. Morin, R. Silva.
AD-775-259
FAA-RD-74-26
Interim Report. February 1974. 16p.

Aircraft-Landing Systems

The Transportation Systems Center electromagnetic scattering model was used to predict the course deviation indication (CDI) at the Dallas/Fort Worth Airport in the presence of several derogating structures in the report FAA-RD-72-96 "ILS Localizer Performance Study Part I Dallas/Fort Worth Regional Airport and Model Validation-Syracuse Hancock Airport." In this report the recommendation was made to use a capture effect system localizer.

In the present report several additional structures, the Braniff and Delta hangar buildings, are modeled. Using the recommended capture effect localizer, it is found that these two additional structures do not add significantly to the derogation, and the category 1 and category 2 operation is still possible on the four instrumented runways tested.

DOT-TSC-FAA-73-35
AIRPORT SURFACE TRAFFIC CONTROL SYSTEMS DEPLOYMENT ANALYSIS
MITRE Corporation
G. Baran, R. A. Bales, J. F. Koetsch.
AD-773-699/4
FAA-RD-74-6
DOT-TSC-378
Final Report. January 1974. 146p.

Airport Surface Traffic Control; Airport Surface Detection Equipment

This report summarizes the findings of an analysis of ASTC (Airport Surface Traffic Control) system requirements and

develops estimates of the deployment potential of proposed system alternatives. The tower control problem areas were investigated by a survey of 19 airports including: visual observations, interviews with tower personnel, collection of data of record and an analysis of tower communication tape recordings at selected airports. Data were also collected from regional FAA authorities and airport authorities on facility expansion and improvement plans aimed at meeting the projected air traffic demand.

A preliminary requirements analysis was performed for three baseline airports to quantify the control tower problems, establish the degree of relief achievable with alternate conceptual ASTC systems. and to establish physical limits on airports operational capacity.

This report summarizes the requirements analysis and extends the analysis to the remainder of the airports surveyed and establishes a tentative deployment schedule of system alternatives. The deployment schedule is established on the basis of a capacity/demand ratio criterion aimed at limiting the delays encountered by aircraft to reasonable levels when the required systems are available.

DOT-TSC-FAA-73-36
HORIZONTAL COLLISION AVOIDANCE SYSTEMS STUDY
Systems Control, Inc.
J. A. Sorensen, A. W. Merz, T. B. Cline, J. S. Karamarker, W. Heine, and M. D. Ciletti.
AD/A-004-536/9ST
FAA-RD-73-203
DOT-TSC-535
Final Report. December 1973. 262p.

Aircraft-Collision Avoidance Systems; Air Traffic Control

This report presents the results of an analytical study of the merits and mechanization requirements of horizontal collision avoidance systems (CAS). The horizontal and combined horizontal/vertical maneuvers which provide adequate miss distance with minimum initial range, minimum deviation off track, and acceptable turn rates are found. Horizontal maneuvers are compared with vertical maneuvers and speed control for collision avoidance in terms of initial range requirements, deviation off track and flight path time loss. Requirements for implementing an airborne horizontal CAS are outlined. Digital filtering is analyzed for estimating airspeed and relative heading from noisy range and bearing measurements between aircraft. An algorithm (suitable for airborne mechanization) is developed for computing appropriate collision avoidance maneuvers. The effects of dynamic and measurement errors on the CAS's ability to provide safe miss distance are examined. A digital computer program which simulates encounters between two aircraft with random measurement errors is used for conducting error and sensitivity analyses of various effects. Statistical quantities such as false alarm rate, missed alarm rate, collision rate, incorrect maneuvers, and near miss probability are computed. These data allow specification of sensor accuracy to achieve fixed levels of airspace safety. The results are applicable to both airborne and ground-based mechanizations.

DOT-TSC-FAA-74-1
IMPACT OF SATELLITE AERONAUTICAL CHANNEL ON MODEM SPECIFICATIONS
CNR, Inc.
Phillip A. Bello, Charles J. Boardman, David Chase, Joseph K. DeRosa.
AD-778-390
FAA-RD-74-54
DOT-TSC-516
Final Report-Phase I. March 1974. 310p.

Satellites-Aeronautical; Modems; Multipath Transmission

This report analyzes the effects of surface-scattered multipath on the performance of ranging and data modems such as might be used on the aircraft-satellite channel of an air-traffic control system. An exact analysis is carried out on the effects of noise and multipath on the one-way ranging errors of a single-sideband tone ranging modem. These results are shown to be applicable at high SNR and direct path/multipath ratios to a double-sideband tone ranging modem whose sideband separation equals the tone separation in the single sideband system. The conventional practice of calculating ambiguity error probabilities with an assumption of Gaussian ranging error distribution is shown to be inapplicable for many situations of practical interest. Computations of ranging and data modem performance for a candidate hemispherical coverage antenna are carried out which lead to the conclusion that there are critical cost trade-offs between modem advanced signal processing and antenna design. Consideration is given to the design trade-offs of a channel prober to collect information useful both for stored-channel playback and channel parameter extraction. The need for additional channel measurements is discussed.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-74-3
AIRBORNE WAKE VORTEX DETECTION
Raytheon Company, Equipment Development Laboratories.
J. D. Fridman.
AD-776-695
FAA-RD-74-46
DOT-TSC-522
Final Report. March 1974. 92p.

LIDAR; Remote Sensing; Aircraft-Wake Vortices

Active and passive remote sensing systems were assessed to determine the feasibility of detecting aircraft trailing vortices using instrumentation on-board an aircraft. It was found that a modification of the front-end receiver of a 10 GHz weather radar system or a change of frequency to 35 GHz may allow vortex identification over a range of several kilometers. The CO_2 laser coherent Doppler radar technique and passive radiometric techniques (8-14 microns) show considerable promise. Other airborne systems (incoherent Lidar, Raman shift techniques, fluorescence scattering, acoustic radar, ultraviolet emissions) were shown not to possess sufficient sensitivity.

DOT-TSC-FAA-74-4. I
ASDE-2 RELIABILITY IMPROVEMENT STUDY, VOLUME I: OPERATIONAL DATA AND MODIFICATION RECOMMENDATIONS
Texas Instruments, Inc.
David N. Grover, C. Norman Butler.
AD-A008-381
FAA-RD-74-195. I
DOT-TSC-445
Final Report. November 1974. 204p.

Airport Surface Detection Equipment;
Airport Surface Traffic Control

Eight airport sites and the FAA Oklahoma Depot were visited and surveys conducted to obtain reliability, maintainability and performance data on the ASDE-2 Radar System. The data was analyzed and recommendations for modification to the equipment made based on cost/benefit trade-offs. Three electronic modifications were recommended: modulator, local oscillator, and solid state duplexer modifications. (These modifications have since been accomplished.) To increase the operational utility of the ASDE-2 Radar, a bright display is recommended and, where space permits in the control tower, multiple displays.

The report contains detailed information on ASDE-2 reliability/maintainability, operational status, performance, and future ASDE system contributions as of March 1973.

DOT-TSC-FAA-74-4. II
ASDE-2 RELIABILITY IMPROVEMENT STUDY. VOLUME II: MODULATOR, RECEIVER AND INDICATOR INTERFACE RECOMMENDATIONS
Texas Instruments, Inc.
David N. Grover, C. Norman Butler.
AD-A008-382
FAA-RD-74-195. II
DOT-TSC-445
Final Report. November 1974. 76p.

Airport Surface Detection Equipment;
Airport Surface Traffic Control

DOT-TSC-FAA-74-5
HUMAN FACTORS EXPERIMENTS FOR DATA LINK INTERIM REPORT NO. 4
Transportation Systems Center.
Edwin H. Hilborn.
AD-779-084
FAA-RD-74-81
Interim Report. April 1974. 118p.

Human Factors-Air Traffic Control; Digital Data Link

Eight two-man crews of FAA/NAFEC test pilots made four runs each in a GAT-2 simulator to evaluate four displays presenting short-message ATC commands and advisories. The counterbalanced experimental design was later replicated with eight crews of airline and ALPA pilots; and a single crew of AOPA pilots provided further data.

Response-time measurements were taken with each display. This information was supplemented by a questionnaire administered to each crew member at the completion of his experimental runs.

The use of a display limited to seven characters, or another employing a NIMO CRT was ruled out from further evaluation. Pilot opinion was generally favorable to the use of a display presenting three lines of seven LED characters each, and a linear display of 32 plasma characters.

DOT-TSC-FAA-74-6
HUMAN FACTORS EXPERIMENTS FOR DATA LINK EXTENDED SUMMARY OF INTERIM REPORTS 1 THROUGH 4
Transportation Systems Center.
Edwin H. Hilborn
AD-779-308
FAA-RD-74-82
Interim Report. April 1974. 46p.

FEDERAL AVIATION ADMINISTRATION

Human Factors-Air Traffic Control; Digital Data Link; Synthetic Speech

This report provides an extended summary of Interim Reports numbers 1 through 4, dealing with Human Factors Experiments for Data Link. The material summarized includes a description of two experiments run on the GAT-1 simulator at TSC using one-man crews, three experiments run on the GAT-2 simulator at FAA/NAFEC using two-man crews, five laboratory tests of message formats and coding schemes for short message ATC (SMATC) commands and advisories, and two experiments involving the preliminary evaluation of synthetic speech as a means for providing ATC information.

DOT-TSC-FAA-74-7. I
ANALYSIS OF PREDICTED AIRCRAFT WAKE VORTEX TRANSPORT AND COMPARISON WITH EXPERIMENT VOLUME I – WAKE VORTEX PREDICTIVE SYSTEM STUDY
Lockheed Missiles & Space Company, Inc., Huntsville Research & Engineering Center.
M. R. Brashears, N. A. Logan, S. J. Robertson, K. R. Shrider and C. D. Walters.
AD-783-649
FAA-RD-74-74. I
DOT-TSC-593
Final Report. April 1974. 256p.

Aircraft-Wake Vortices

A unifying wake vortex transport model is developed and applied to a wake vortex predictive system concept. The fundamentals of vortex motion underlying the predictive model are discussed including vortex decay, bursting and instability phonomena. A parametric and sensitivity analysis is presented to establish baseline uncertainties in the algorithm to allow meaningful comparison of predicted and measured vortex tracks. A detailed comparison of predicted vortex tracks with photographic and groundwind vortex data is presented. Excellent agreement between prediction and measurement is shown to exist when sufficient wind data are available. Application of the Pasquill class criteria is shown to be an effective technique to describe the wind profile in the absence of detailed wind data. The effects of wind shear and the Ekman spiral on vortex transport are discussed. It is shown that the combination of wind shear and ground plane may be possible mechanisms underlying vortex tilting and a theoretical explanation is advanced that is somewhat supported by comparison with the experimental data. Finally, recommendations for further vortex data collection in the vicinity of an airport are presented.

DOT-TSC-FAA-74-7. II
ANALYSIS OF PREDICTED AIRCRAFT WAKE VORTEX TRANSPORT AND COMPARISON WITH EXPERIMENT. VOLUME II – APPENDIXES
Lockheed Missiles & Space Company, Inc., Huntsville Research & Engineering Center.
M. R. Brashears, N. A. Logan, S. J. Robertson, E. R. Shrider and C. D. Walters.
AD-783-665
FAA-RD-74-74. II
DOT-TSC-593
Final Report. April 1974. 246p.

Aircraft-Wake Vortices

DOT-TSC-FAA-74-8
MULTIPATH CHANNEL SIMULATION AND MODEM EVALUATION PROGRAM
Transportation Systems Center.
Christopher B. Duncombe.
AD-787-453
FAA-RD-74-151
Interim Report. August 1974. 70p.

Modems; Multipath Transmission; Satellites-Aeronautical

The Department of Transportation, Transportation Systems Center has developed a laboratory communications test facility. This facility, at present, is in support of DOT Aeronautical satellite system (AEROSAT) developments and the associated implementation and evaluation of ground and airborne communications equipment. The facility has broad application to other DOT communications development interests. The facility is available to utilize at DOT/TSC, by interested parties. The purpose of the facility is to evaluate in a laboratory controlled simulated environment, alternative modulation techniques having potential application in aeronautical and maritime satellite communications and surveillance systems. The facility offers the advantage of a "quick-check" of candidate modem performance. It may also be used as a substitute for extensive costly field experiments particularly where typical field conditions are of interest. The main feature of the communication test facility is the hardware for simulating, by means of laboratory equipment, the narrowband (50 KHz) AEROSAT satellite-to-aircraft propagation channel. The simulator also simulates the maritime satellite-to-ship propagation channel and is expandable to wideband (10 MHz) systems; e.g., future CONUS ATC Systems. The simulator includes provisions for duplicating multipath phenomena over the satellite links and includes provisions for adjustment and programming of channel parameters covering a wide range of environmental conditions. The features of the channel simulator and the

test bed set up are described in detail in this interim report. Subsequent reports will present measured performance data obtained from extensive laboratory modem tests utilizing this facility.

DOT-TSC-FAA-74-9
MICROWAVE SCANNING BEAM APPROACH AND LANDING SYSTEM PHASED ARRAY ANTENNA
Transportation Systems Center.
R. M. Kalafus, G. J. Bishop, F. J. LaRussa, P. J. Pantano, D. Spangler, W. R. Wade, R. S. Yatsko.
AD-782-860/1GI
FAA-RD-74-59
Annual Report. May 1974. 166p.

Aircraft-Antennas; Aircraft-Landing Systems; Air Traffic Control; Phased Arrays.

The design, operating instructions, detailed logic circuitry, and antenna test range results for the electronic circular scanning phased array developed at TSC (DOTSCAN) are described. Components developed for this effort are also described, and test results given.

DOT-TSC-FAA-74-13
SIMULATION OF WAKE VORTICES DESCENDING IN A STABLY STRATIFIED ATMOSPHERE
Hydronautics, Inc.
Clinton E. Brown and Karl Kirkman.
AD-783-750
FAA-RD-74-116
DOT-TSC-694
Final Report. July 1974. 40p.

Aircraft-Wake Vortices

An experimental simulation of aircraft wake vortices descending in a stable atmosphere has shown that the atmospheric stability stops the downward movement and in some cases produces a subsequent rebound. The tests were carried out in a large ship model basin using a rectangular platform wing. Lift coefficients of 0.4 and 1.0 were selected and stable atmospheric conditions were obtained by temperature (density) stratification of the towing basin. Test conditions corresponding to Vaisala-Brund periods of ∞, 109, and 51 seconds were obtained. The model parameters and stability conditions covered the most extreme cases to be expected in full scale flight.

DOT-TSC-FAA-74-14. B
ILS GLIDE SLOPE PERFORMANCE PREDICTION VOLUME B
Transportation Systems Center.
S. Morin, D. Newsom, D. Kahn, L. Jordan
AD-A009-432
FAA-RD-74-157. B
Final Report. September 1974. 174p.

Aircraft-Landing Systems; Glide Paths

A mathematical model for predicting the performance of ILS glide slope arrays in the presence of certain types of terrain irregularities has been developed. The model is discussed in detail and then applied to a number of typical glide slope siting problems for purposes of illustration. A User's Manual for exercising the model forms Part 2 of this report.

This report consists of two volumes. Volume A includes figure foldouts. Volume B does not include figure foldouts. The text, appendixes, and all figures are identical in both volumes.

DOT-TSC-FAA-74-15
LIDAR SYSTEMS FOR MEASURING VISIBILITY A TECHNICAL ASSESSMENT
Transportation Systems Center.
J. R. Lifsitz.
AD-A001-565
FAA-RD-74-149
Final Report. September 1974. 68p.

Visibility; LIDAR

A study has been made of the feasibility of using a laser backscatter system (lidar) to measure slant visibility at airports. This report summarizes the present status of lidar from a technical standpoint. Based largely on the results of experimental lidar field tests reported previously, the report isolates essential factors which bear on decisions regarding further lidar development. The following elements, upon which the success of an operational lidar visibility system will hinge, are discussed in detail:

- –Detector and receiver dynamic range
- –Minimum and maximum range limits
- –Signal processing (instant vs time-average)
- –Interpretation of data
- –Multiple scattering
- –Eye safety criteria

While some of these can be dealt with in the process of hardware design, others (e.g., multiple scattering, data interpretation) will probably require extensive testing of an engineering prototype system to acquire a "feel" for their operational significance.

DOT-TSC-FAA-74-16
SYSTEM ACCESS CONTROL STUDY
Bell Aerospace Company
L. Shub, D. Allen, E. Clune, T. Lerner
AD-782-045
FAA-RD-74-107
DOT-TSC-539
Final Report. June 1974. 317p.

Satellites-Aeronatuical; Air Traffic Control-Satellite

This report presents a summary of a study conducted for the Transportation Systems Center of promising access control techniques which are applicable to an aeronautical satellite system. Several frequency division multiple access (FDMA) and time division multiple access (TDMA) configurations are analyzed and compared which are capable of providing voice, data and independent surveillance services. One of the FDMA concepts and a burst TDMA system are rated highest and are presented in greatest detail. Procedures are outlined for different types of entry, beam switching and handling various types of interconnections. Included are preliminary designs of the avionics instrumentation.

DOT-TSC-FAA-74-18
ACCESS CONTROL AND PROCESSING STUDIES FOR GROUND-SATELLITE MOBILE COMMUNICATIONS/ SURVEILLANCE SYSTEMS
Computer Sciences Corporation.
John J. Bisaga, Howard A. Blank, Alan J. Brown.
AD-784-380
FAA-RD-74-106
DOT-TSC-565
Final Report. June 1974. 180p.

Air Traffic Control-Satellite; Satellites-Aeronautical

The report synthesizes a set of satellite communications systems configurations to provide services to aircraft flying oceanic routes. These configurations are combined with access control methods to form complete systems. These systems are analyzed using a simulation and their performance is presented in terms of avionics complexity and cost, queuing delays, pilot workload, and operational considerations. A preferred system is selected and recommendations are made.

DOT-TSC-FAA-74-20
THE DEVELOPMENT OF A SIGNAL DATA CONVERTER FOR AN AIRPORT VISIBILITY MEASURING SYSTEM
Transportation Systems Center.
Hector C. Ingrao, Melvin Yaffee, Michael F. Cartwright, Paul Madden, Mukund Desai, Glenn Mamom.
FAA-RD-75-65
Final Report. August 1974. 226p.

Visibility; Air Traffic Control

The Optical Devices Group at the Transportation Systems Center has been involved in the development of a breadboard Airport Visibility System (ARVIS) for the FAA since FY 72. One major subsystem in the ARVIS is the Signal Data Converter whose characteristics were initially identified in a report (DOT-TSC-FAA-72-1) titled "Characters of a Signal Data Converter for a Multi-Runway Visibility Measuring System," October 1971. Various aspects relative to the determination of RVR have been reviewed and efficient algorithms developed for the computation of RVR from Allard's and Koschmeider's Law. A sixteen bit wordlength has been established as necessary to provide adequate range and accuracy in the determination of RVR.

A breadboard ARVIS was designed and built. Software was developed and parameters representative of various airport operational situations synthesized, exercised and verified, adequately demonstrating the feasibility and versatility of the proposed ARVIS. There remains the ARVIS field testing.

DOT-TSC-FAA-74-21
DEROGATION OF LOCALIZER COURSE DUE TO PROPOSED WATER TOWER, PETERSON FIELD, COLORADO
Transportation Systems Center.
L. Jordan, D. Kahn. S. Morin and D. Newsom.
AD/A-000-455/6GI
FAA-RD-74-172
Interim Report. October 1974. 17p.

Aircraft-Antennas; Aircraft-Landing Systems

The additional derogation to the localizer front and back courses caused by a water tower placed near the localizer site is predicted. This prediction is made with the Transportation Systems Center (TSC) localizer model. This additional derogation to the front and back courses is expected to amount to two or three microamperes.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-74-23. I
SIMULATION OF THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (SOAR) WITH APPLICATION TO A DISCRETE ADDRESS BEACON SYSTEM – VOLUME I: TEXT
Transportation Systems Center.
Louis A. Kleiman, Mary Jane Miner.
AD-A010-473
FAA-RD-73-35. I
Final Report. April 1975. 200p.

Air Traffic Control-Models; Radar Beacon Systems; Discrete Address Beacon System

This report describes a computer simulation of the Air Traffic Control Radar Beacon System (ATCRBS). Operating on real air traffic data and actual characteristics of the relevant ground interrogators, the FORTRAN program reenacts system operation in a pulse-by-pulse manner. The level of detail thus incorporated into the program structure enables a computer-generated representation of the air traffic controller's display to be produced. The versatility of the simulation model is further evidenced by the incorporation of program modifications which also make possible investigation of the Discrete Address Beacon System (DABS). These program modifications permit examination and evaluation of the effectiveness of DABS interrogations in an ATCRBS environment. Results of simulation of DABS operation in a 1980 interrogator environment are furnished in this document.

Volume I contains the text; Volume II, appendixes.

DOT-TSC-FAA-74-23. II
SIMULATION OF THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (SOAR) WITH APPLICATION TO A DISCRETE ADDRESS BEACON SYSTEM – VOLUME II: APPENDIXES
Transportation Systems Center.
Louis A. Kleiman, Mary Jane Miner.
AD-A010-474
FAA-RD-73-35. II
Final Report. April 1975. 120p.

Air Traffic Control-Models; Radar Beacon Systems; Discrete Address Beacon System

DOT-TSC-FAA-74-24
AIRCRAFT L-BAND BALLOON – SIMULATED SATELLITE EXPERIMENTS, VOLUME I: EXPERIMENT DESCRIPTION AND VOICE AND DATA MODEM TEST RESULTS
Transportation Systems Center.
Peter D. Engels and Robert A. Wilson.
AD-A017-090
FAA-RD-75-174
Final Report. October 1975. 140p.

Multipath Transmission; Air Traffic Control-Satellite; Modems

This report details the result of an experiment performed by the Transportation Systems Center of the Department of Transportation to evaluate candidate voice and data modulation systems for use in an L-Band Air Traffic Control System. The experiment was designed to evaluate performance in the presence of oceanic multipath, using a high altitude balloon carrying an L-Band transponder as a geostationary satellite simulator. The voice modems chosen were Delta Modulation, Pulse Duration Modulation and Adaptive Narrow-Band Frequency Modulation. The data modems used employed PSK modulation with coherent demodulation.

This is Volume I of a two-volume report. Volume II "CW Multipath Test Results and Analyses," FAA-RD-73-173, details the portion of the data dealing exclusively with the measurement of oceanic multipath.

DOT-TSC-FAA-74-25
HUMAN FACTORS EXPERIMENTS FOR DATA LINK INTERIM REPORT NO. 5
Transportation Systems Center.
Edwin H. Hilborn, Robert W. Wisleder.
AD-A007-622
FAA-RD-75-14
Interim Report. February 1975. 172p.

Human Factors-Air Traffic Control; Digital Data Link; Synthetic Speech

One and two-man crews of general aviation pilots and two-man crews of FAA/NAFEC test pilots made a series of simulated flights in a GAT-2 simulator to evaluate various complements of I/O equipment for Data Link. In the earlier experiments in this series, uplink messages have been limited to short ATC commands and advisories, and downlink capabilities limited to simple "Wilco" or "Unable" responses. In the present experiment, complete uplink capability was provided, including ATIS, clearances and weather reports, and downlink capability was extended to permit generation of requests for a variety of information.

Seven different combinations of devices were evaluated, the devices including a 16-character display for Short Message ATC (SMATC), a printer for longer ATC messages, a Voice Synthesizer (Vosyn), and two different Control and Downlink Units (CDU) varying in complexity and in capability for the repertoire of downlink messages which could be generated.

Pilot opinion was universally favorable. Uplink messages were interpreted rapidly and accurately, and despite limited training in its use, the more complex CDU presented no difficulties to the crews.

DOT-TSC-FAA-74-26
AIRPORT SURFACE TRAFFIC CONTROL SYSTEMS DEVELOPMENT ANALYSIS—EXPANDED
Mitre Corporation
R. A. Bales and J. F. Koetsch.
AD-A013-579
FAA-RD-75-51
RA-73-11
Final Report. March 1975. 120p.

Airport Surface Detection Equipment;
Airport Surface Traffic Control

A previous MITRE Technical Report, Airport Surface Traffic Control Systems Deployment Analysis, FAA-RD-74-6, presented an analysis of ASTC (Airport Surface Traffic Control) system requirements and developed estimates of the depoloyment potential of proposed ASTC system alternatives for 19 air carrier airports. The primary requirement was determined to be improved surveillance which resulted in an estimated deployment of one of two surveillance systems at 16 airports by 1980. This report presents an expansion of that deployment analysis to include a total of 39 air carrier airports. The methods and assumptions for the deployment analysis of the 20 airports presented in this report are essentially the same as in the initial report. The overall result of the analysis is that by the initial deployment date (1976-1980) of the two alternative surveillance systems, the total potential market will be for 20-25 systems. By the end of the century, the total potential market for ASTC surveillance systems will exceed 30.

DOT-TSC-FAA-74-27
IMPACT OF SATELLITE AERONAUTICAL CHANNEL ON MODEM SPECIFICATIONS. PHASE II: OCEANIC MULTIPATH MEASUREMENTS AND MODEM CONCEPTS
CNR, Inc.
Phillip A. Bello, David Chase, Joseph DeRosa, Lih-Jyh Weng, Martin G. Bello
AD-A-005-788
FAA-RD-74-215
DOT-TSC-516
Final Report - Phase II. January 1975. 202p.

Satellites-Aeronautical; Multipath Transmission; Modems

This report completes the analysis initiated in the Phase I report of the effects of oceanic multipath on ranging and data modems for satellite air traffic control systems. The interaction between multipath antenna and apparent measured multipath is determined using a "vector Kirchoff" model of ocean scattering. Procedures for antenna design, sea state sensing, and multipath measurements are detailed, and tone ranging performance is computed for various antenna designs. Consideration is given to the problem of tone probing on a 50 KHz hard limiting AEROSAT channel while data transmission is taking place. The problem of how much measurement time is needed to achieve a reliable measurement of error probability in data transmission over the AEROSAT channel is addressed. It is also shown that with the proper integration of coding and modulation techniques, it is possible to construct a robust signaling scheme which is insensitive to the multipath and which can improve performance when operating in the region of low direct path signal-to-noise ratios.

DOT-TSC-FAA-75-1
SURVEY OF VISUAL GROUND AIDS AT O'HARE INTERNATIONAL AIRPORT
Computer Sciences Corporation.
Richard W. Rudmann.
AD-A007-625
FAA-RD-75-16
DOT-TSC-678
Interim Report. January 1975. 84p.

Airport Surface Traffic Control

During the period June - July 1974 a survey of Visual Ground Aids was conducted at O'Hare International Airport in Chicago, Illinois. The purpose of this survey was to identify equipment currently installed to aid in providing visual guidance to pilots in traversing various sections of

the airport and to identify certain technical and maintenance-oriented characteristics associated with these installations.

This survey provides the cost documentation for the improvement analysis for the visual ground aids portion of the airport surface traffic control program. From the survey it is possible to estimate that the cost of replicating the present taxiway guidance system is in excess of $2,250,000.00 with an average maintenance cost estimated at $271,000.00.

DOT-TSC-FAA-75-3
SIDELOBE SUPPRESSION MODE PERFORMANCE OF ATCRBS WITH VARIOUS ANTENNAS
Michigan University, Radiation Laboratory.
Jovan Zatkalik, Dipak L. Sengupta, Chen-To Tai.
AD-A015-242
FAA-RD-75-31
DOT-TSC-717
Interim Report. February 1975. 160p.

Sidelobe Reduction; Aircraft-Antennas; Radar Beacon Systems

The SLS mode performance of terminal and enroute ATCRBS using existing and various improved antennas in the presence of perfectly dielectric flat ground are investigated theoretically. Necessary analytical expressions for various quantities characterizing the system performance have been derived. A computer program has been developed for the computation and tabulation of these quantities as functions of the elevation angle of the observation point for different combinations of heights of the directional and omnidirectional antennas. For each antenna combination results are given for the following seven quantities: the P1 and P2 pulse intensities, the pulse ratio P1/P2, the mainbeam killing and sidelobe punch-through zones in space, the effective azimuth beamwidth, the number of replies and the coverage diagram. Short discussions of results are given wherever appropriate.

DOT-TSC-FAA-75-4
IMPROVED SIDELOBE SUPPRESSION MODE PERFORMANCE OF ATCRBS WITH VARIOUS ANTENNAS
University of Michigan Radiation Laboratory.
Dipak L. Sengupta, Jovan Zatkalik, Chen-To Tai.
AD-A015-243
FAA-RD-75-32
DOT-TSC-717
Interim Report. February 1975. 168p.

Sidelobe Reduction; Aircraft Antennas; Radar Beacon Systems

The ISLS mode performance of terminal and enroute ATCRBS using existing and various improved antennas in the presence of perfectly dielectric flat ground are investigated theoretically. Necessary analytical expressions for various quantities characterizing the system performance have been derived. A computer program has been developed for the computation and tabulation of these quantities as functions of the elevation angle of the observation point for different combinations of heights of the directional and omnidirectional antennas. For each antenna combination results are given for the following seven quantities: the P1 and P2 pulse intensities, the pulse ratio P1/P2, the mainbeam killing and sidelobe punch-through zones in space, the effective azimuth beamwidth, the number of replies and the coverage diagram. Short discussions of results are given wherever appropriate.

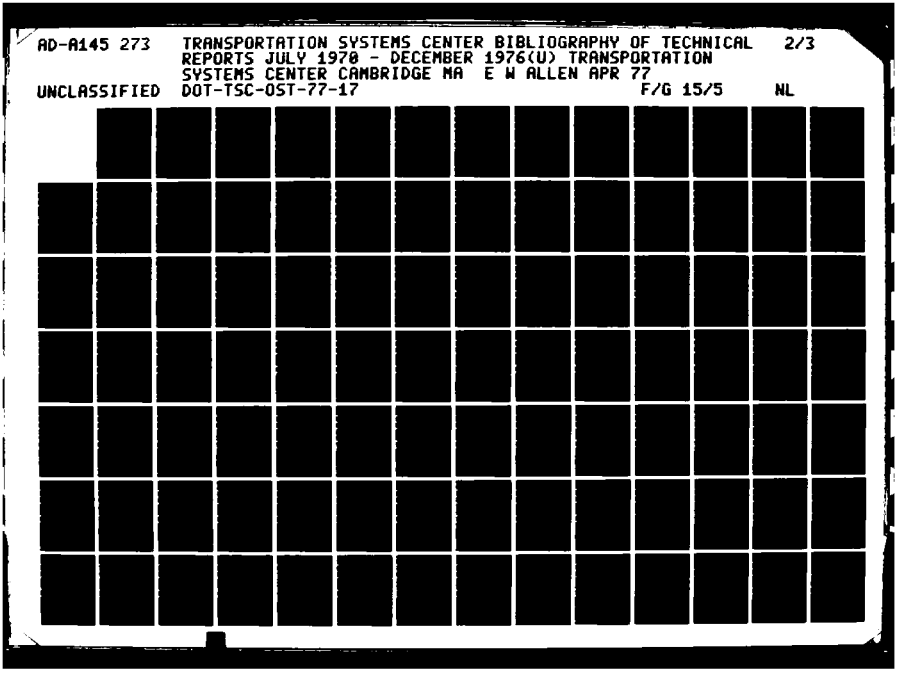
DOT-TSC-FAA-75-6
ATCRBS ANTENNA MODIFICATION KIT
Hazeltine Corporation.
E. M. Newman, P. Kendrick.
AD-A026-392
FAA-RD-75-40
DOT-TSC-598
Final Report. June 1976. 186p.

Aircraft Antennas; Radar Beacon Systems; Air Traffic Control

This report describes the design, fabrication and test results of an improved ATCRBS (Air Traffic Control Radar Beacon System) array antenna for mounting on the reflector of an ASR radar antenna.

The antenna consists of a 4-foot high by 26-foot wide array with 252 dipole radiating elements. The structure of the antenna utilizes a specially designed tuned reflector to provide a physically open ground plane which minimizes wind loading while maintaining low backlobe levels. A companion 4-foot high omni antenna, intended for mounting on a pole next to the array, was fabricated and tested, and is also described.

The work was performed under the cognizance of the Air Traffic Control Product Line of Hazeltine, with technical direction by the Wheeler Laboratory antenna group.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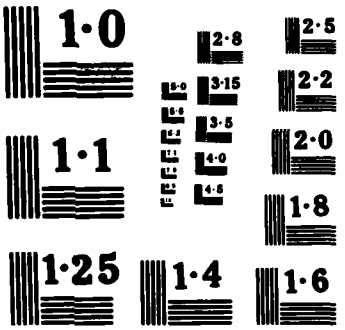
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FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-75-8. I
AIRPORT SURFACE TRAFFIC CONTROL CONCEPT FORMULATION STUDY VOLUME I – EXECUTIVE SUMMARY
Computer Sciences Corporation.
F. D'Alessandro, W. Heiser, G. Knights, P. Monteleon, R. Reffelt, R. Rudmann, W. Wolff
AD-A022-026
FAA-RD-75-120. I
DOT-TSC-678
Final Report. July 1975. 82p.

Airport Surface Traffic Control; Radar Beacon Systems

This four-volume report presents system concepts for use in semi-automated airport surface traffic control at all positions in the tower cab of the major airports. The control functions and data requirements of a Ramp Control System, a Ground Control System, and a Local Control System are presented. The concept development process has been based upon an extensive study of cab operations at O'Hare Airport. This effort has included extensive delay analysis, study of communication tapes, and personal observations of the widely-varying situations that are faced by tower controllers. Following the Operations Analysis effort, a detailed study of requirements was performed and is presented in Volume IV of this report. This requirements effort provided an estimate of the performance requirements of a surveillance sensor that would be required in a TAGS (Tower Automated Ground Surveillance) system for use in both good and poor visibility conditions. Detailed studies were made of the complex type of conflicts to be solved by both the Ground and Local Controllers and operational levels and densities were developed. One particular TAGS system concept (employing an ATCRBS Trilateration Surveillance Subsystem) is described in Volume I and an estimate is made of its deployment potential at major airports. Backup material on this concept in the form of a working paper is held by TSC. This working paper also includes synthetic digital display concepts for the three systems which have been summarized in Volume I.

DOT-TSC-FAA-75-8. II
AIRPORT SURFACE TRAFFIC CONTROL CONCEPT FORMULATION STUDY. VOLUME II – OPERATIONS ANALYSIS OF O'HARE AIRPORT – PART I
Computer Sciences Corporation
F. D'Alessandro, W. Heiser, G. Knights, P. Monteleon, R. Reffelt, R. Rudmann, W. Wolff.
AD-A022-103
FAA-RD-75-120. II
DOT-TSC-678
Final Report. July 1975. 220p.
Airport Surface Traffic Control; Radar Beacon Systems

DOT-TSC-FAA-75-8. III
AIRPORT SURFACE TRAFFIC CONTROL CONCEPT FORMULATION STUDY. VOLUME III – OPERATIONS ANALYSIS OF O'HARE AIRPORT – PART II
Computer Sciences Corporation.
F. D'Alessandro, W. Heiser, G. Knights, P. Monteleon, R. Reffelt, R. Rudmann, W. Wolff.
AD-A022-104
FAA-RD-75-120. III
DOT-TSC-678
Final Report. July 1975. 280p.

Airport Surface Traffic Control; Radar Beacon Systems

DOT-TSC-FAA-75-8. IV
AIRPORT SURFACE TRAFFIC CONTROL CONCEPT FORMULATION STUDY. VOLUME IV – ESTIMATION OF REQUIREMENTS
Computer Sciences Corporation.
F. D'Alessandro, W. Heiser, G. Knights, P. Monteleon, R. Reffelt, R. Rudmann, W. Wolff.
AD-A022-105
FAA-RD-75-120. IV
DOT-TSC-678
Final Report. July 1975. 244p.

Airport Surface Traffic Control; Radar Beacon Systems

DOT-TSC-FAA-75-10. I
AN ANALYSIS OF RADIO FREQUENCY SURVEILLANCE SYSTEMS FOR AIR TRAFFIC CONTROL. VOLUME I: TEXT
Transportation Systems Center.
Louis A. Kleiman.
AD-A023-503
FAA-RD-76-20
Final Report. February 1976. 224p.

Air Traffic Control-Models; Radar Beacon Systems; Side Lobe Reduction

Performance criteria that afford quantitative evaluation of a variety of current and proposed configurations of the Air Traffic Control Radar Beacon System (ATCRBS) are described in detail. Two analytic system models are developed to allow application of these performance criteria. A simple system model, based on the assumption of a flat earth, enables closed-form analytic expressions for some of the performance criteria to be developed for a wide range of desired areas of coverage. An extremely accurate complex system model provides a tool for simulation of operating characteristics that would be observed in the course of actual flight tests. The complex model includes a new solution for the

grazing angle of radiation over a spherical earth that is shown to be more accurate than the commonly-used solution of Fishback. Applications and limitations of both models in the evaluation of four new ATCRBS antennas and of the proposed receiver side-lobe suppression feature are discussed. Both numerical results and a computer-generated representation of an air traffic controller's display are presented.

DOT-TSC-FAA-75-10. II
AN ANALYSIS OF RADIO FREQUENCY SURVEILLANCE SYSTEMS FOR AIR TRAFFIC CONTROL. VOLUME II: APPENDIXES
Transportation Systems Center.
Louis A. Kleiman.
AD-A023-504
FAA-RD-76-20
Final Report. February 1976. 76p.

Air Traffic Control-Models; Radar Beacon Systems; Side Lobe Reduction

DOT-TSC-FAA-75-12
THE APPLICATION OF SIMULATION METHODS TO INTRA-AIRPORT LANDSIDE PROBLEMS
Transportation Systems Center.
L. J. McCabe and T. F. Carberry.
AD-A017-064
FAA-RD-75-169
Interim Report. September 1975. 94p.

Airports-Passenger Flow

This report describes methods of analyzing the flow of people through the airport landside, which is defined as extending between the airport boundary and the arrival/departure gates. Passenger delay for specified flow and holding values is taken as the desirable measure of level of service. Simulation is determined as the best method of analysis.

Two types of simulation techniques are described. The deterministic accounting model evaluates mean delay or occupancies. The time oriented queueing theory model determines delay or occupancy distributions. Time oriented simulation is demonstrated as most accurately representing the stochastic interrelationships among the various landside elements.

Various existing models are reviewed and two are recommended as offering potential applicability to investigate airport landside traffic. It is recommended that at least one of the chosen simulations be validated.

DOT-TSC-FAA-75-13
PERFORMANCE EVALUATION OF DATA MODEMS FOR THE AERONAUTICAL SATELLITE CHANNEL
Transportation Systems Center.
C. B. Duncombe and H. Salwen
AD-A017-085
FAA-RD-75-150
Interim Report. September 1975. 44p.

Multipath Transmission; Modems; Satellites-Aeronautical

Several modems and satellite subsystems were tested with the aid of an aeronautical channel simulation facility. The modems tested included a high performance DPSK modem, a high performance CPSK modem, two hybrid voice/data modems, and a lower performance CPSK modem. Data Performance results are presented in the form of Probability of Bit Error versus Signal to Noise Density and Signal to Multipath Ratios with Doppler Spread as a parameter. Some tests were conducted with a hard limiting IF processor in cascade with the channel simulator to simulate satellite characteristics.

The characteristics of the aeronautical satellite channel simulator are also described. The discussion concludes with a general evaluation of the effect of aeronautical satellite channel characteristics on modem performance, as derived from the simulation experiments.

DOT-TSC-FAA-75-14
THE DEVELOPMENT OF AN ATCRBS MONOPULSE MEASUREMENT CAPABILITY AT THE TRANSPORTATION SYSTEMS CENTER, FISCAL YEAR 1974
Transportation Systems Center.
Robert M. Weigand.
AD-A026-959
FAA-RD-76-44
Interim Report. May 1976. 58p.

Monopulse Radar; Radar Beacon Systems

To demonstrate the potential of monopulse in the ATC environment an experimental facility has been established at TSC. The components of the facility are described and a functional description of the TSC monopulse receiver used in the first year's effort is presented. An error analysis defines the measurement accuracy possible in using the TSC monopulse receiver. Results of two experiments are also presented in this report. The first shows the monopulse accuracy degradation due to receiver noise for targets at an equivalent of a 200 nmi range; the second graphically demonstrates the effect of interference on target location capability. Finally, recommendations for a follow-on activity are presented.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-75-15
MEASUREMENTS OF AIRCRAFT XENON STROBE LIGHT CHARACTERISTICS
Transportation Systems Center.
Charles O. Phillips, Jr.
AD-A030-865
FAA-RD-76-124
Final Report. August 1976. 80p.

Aircraft-Lights

This report provides data on the characteristics of aircraft xenon strobe lights related to their potential for use as the cooperative element in Optical IR (Infrared) Airborne Proximity Warning Indicator (APWI) systems. It includes a description of pertinent characteristics, measurements of radiation geometry and power output of selected strobes, a discussion of environmental effects including lamp aging, variation in supply voltage, thermal and installation effects. Detailed measurements of spectral peak radiant intensity in addition to spectral radiant energy are presented along with measurements of rise time, duration, and fall time as a function of wave length.

DOT-TSC-FAA-75-17
POSITION MEASUREMENT STANDARD EVALUATION
Transportation Systems Center.
John Canniff, Richard Gundersen, John Gakis
AD-A017-012
FAA-RD-75-26
Final Report. February 1975. 60p.

Navigation Systems

The objectives of the Position Measurement Standard Program were to collect navigation data from three DME receivers and a low-frequency GLOBAL Navigation system, and evaluate their relative performance against a reference radar.

Flight test data during June and July, 1974, established that:

- triple DME was an order of magnitude more accurate than the GLOBAL system
- triple DME accuracy was repeatable, smooth over all flight regions, and insensitive to initial condition, whereas GLOBAL system accuracy varied from run to run, exhibited large random errors and quantum "jumps", and was dependent upon error nulling procedures prior to system initialization.

DOT-TSC-FAA-75-18
U. S. AERONAUTICAL L-BAND SATELLITE TECHNOLOGY TEST PROGRAM. INTERIM TEST RESULTS
Boeing Commercial Airplane Company.
E. H. Schroeder, R. W. Sutton, A. D. Thompson, C. V. Paulson, S. G. Wilson, C. J. Kuo, and I. R. Reese.
AD-A016-171
FAA-RD-75-111
DOT-TSC-707
Interim Report. June 1975. 174p.

Multipath Transmission; Applications Technology Satellite; Satellites-Aeronautical; Modems

The U. S. Aeronautical L-Band satellite test program was performed between September 1974 and April 1975 as part of an international ATS-6 L-Band satellite test program. The U. S. program consisted of both technology and ATC communications demonstration tests. Tests were in support of the aeronautical satellite (AEROSAT) program to collect satellite-aircraft signal propagation data, evaluate L-Band avionics hardware designs and perform preliminary satellite voice and data communications demonstration tests. All tests were conducted between an FAA KC-135 aircraft and the NASA-Rosman ground station via the geostationary ATS-6 satellite. This report presents data on the U. S. technology tests. The ATC demonstration test results will be presented by the FAA.

The technology tests were comprised of multipath channel characterization tests; modem tests of voice, data, and ranging; and aircraft antenna tests. Multipath results include delay-Doppler scatter function characteristics and calculations of spectra, spreads and autocorrelations for both over-ocean and CONUS multipath. Comparison of sample results with model prediction is given. Voice modem intelligibility scores, digital data bit error rates and ranging modem performance are presented parametrically as functions of C/N_o and S/I. Experimentally derived gain and multipath rejection performance data are given for the slot-dipoles, phased array, patch, and crossed-slot antennas for various aircraft/satellite geometries.

DOT-TSC-FAA-75-19
HUMAN FACTORS EXPERIMENTS FOR DATA LINK
Transportation Systems Center.
Edwin H. Hilborn.
AD-A019-157
FAA-RD-75-170
Final Report. November 1975. 134p.

Air Traffic Control-Automation; Synthetic Speech; Digital Data Link; Human Factors-Air Traffic Control

FEDERAL AVIATION ADMINISTRATION

This report describes the results of a series of experiments to evaluate cockpit Input/Output devices for Data Link as Phase I of a larger project to explore all facets of the digital transmission of air traffic control information.

Following preliminary experiments to investigate optimum means of formatting and presenting information, prototype hardware was fabricated and evaluated on GAT-1 and GAT-2 simulators. Deficiencies in the prototypes were noted, and new improved hardware was fabricated for further evaluation on the GAT-2 and airline simulators (B-727 and DC-9).

Data Link as a concept was found to be generally acceptable, and there was widespread agreement that it would reduce crew workload. Airline pilots were concerned by the loss of information resulting from the selective address capabilities of Data Link, so that they did not hear messages intended for other aircraft. Pilots also questioned the acceptability of Data Link for ground and local control.

Visual displays were preferred for all but emergency messages; for these, the use of synthetic speech (Vosyn) is a likely candidate. In-cockpit printout of clearances, weather and ATIS information was favorably received, and the use of keyboard input for downlink message generation was found to be acceptable.

DOT-TSC-FAA-75-20
AN OVERVIEW OF AIRPORT SURFACE TRAFFIC CONTROL—PRESENT AND FUTURE
Transportation Systems Center.
Robert E. Hagerott.
AD-A019-157
FAA-RD-75-144
Final Report. September 1975. 40p.

Airport Surface Traffic Control

The Airport Surface Traffic Control System, an integral part of the nation's Air Traffic Control System, is specifically concerned with the safe and efficient control of airport airside surface traffic. The current status of airport surface traffic control in the United States is summarized, and the most important of the planned system improvements are presented.

DOT-TSC-FAA-75-21. I
SOFTWARE FOR AN EXPERIMENTAL AIR-GROUND DATA LINK. VOLUME I: FUNCTIONAL DESCRIPTION AND FLOW CHARTS
Input Output Computer Services, Inc.
C. J. Goodrow and E. Rachlis.
AD-A019-645
FAA-RD-75-163. I
DOT-TSC-887
Final Report. October 1975. 278p.

Digital Data Link; Air Traffic Control-Computer Systems

This report documents the complete software system developed for the Experimental Data Link System which was implanted for flight test during the Air-Ground Data Link Development Program (FAA-TSC Project Number FA-13). The software development is presented in three volumes. The material contained in Volume I describes the design and implementation of the system software. It is intended to be used as a complementary document to Volumes II and III.

DOT-TSC-FAA-75-21. II
SOFTWARE FOR AN EXPERIMENTAL AIR-GROUND DATA LINK. VOLUME II: SYSTEM OPERATION MANUAL
Input Output Computer Services, Inc.
C. J. Goodrow and E. Rachlis.
AD-A019-646
FAA-RD-75-163. II
DOT-TSC-887
Final Report. October 1975. 60p.

Digital Data Link; Air Traffic Control-Computer Systems

The material contained in Volume II describes the system operation and is intended as a user's guide. It is a complementary document to Volumes I and III.

DOT-TSC-FAA-75-21. III
SOFTWARE FOR AN EXPERIMENTAL AIR-GROUND DATA LINK. VOLUME III: PROGRAM LISTINGS
Input Output Computer Services, Inc.
C. J. Goodrow and E. Rachlis.
AD-A019-964
FAA-RD-75-163. III
DOT-TSC-887
Final Report. October 1975. 330p.

Digital Data Link; Air Traffic Control-Computer Systems

The listings manual contained in Volume III is intended for the use of programmer personnel to serve as a reference source for the Data-Link programs. It is intended as a complement to the Functional Description and Flowcharts (Volume I) and to the System Operation Manual (Volume II). The following ten programs are contained in this manual:

1) Ground Station Communications Supervisor Modules,
2) Airborne Station Communications Supervisor Models,
3) System Interrupt and I/O Processing Modules,
4) Ground Station Dialogue and Initialization Module,
5) Data Reduction and Analysis Modules,
6) Graph Data Reduction and Analysis Modules,
7) Load Map of Ground Station System,
8) Load Map of Airborne Station System,
9) Load Map of Data Reduction and Analysis System, and
10) Load Map of Graph Data Reduction and Analysis System.

DOT-TSC-FAA-75-22
HUMAN FACTORS EXPERIMENTS FOR DATA LINK. INTERIM REPORT NO. 6 – AN EVALUATION OF DATA LINK INPUT/OUTPUT DEVICES USING AIRLINE FLIGHT SIMULATORS
ARINC Research Corporation.
James M. Diehl.
AD-A019-963
FAA-RD-75-160
DOT-TSC-793
Interim Report. November 1975. 208p.

Digital Data Link; Air Traffic Control-Automation; Synthetic Speech; Human Factors-Air Traffic Control

An evaluation of candidate cockpit Data Link input/output (I/O) devices using airline flight simulators was conducted. The opinions of airline pilots regarding Air Traffic Control by Data Link were obtained. Three full complements of I/O devices were evaluated. The complements were differentiated by the presence of (1) a visual short message ATC (SMATC) display, (2) a voice synthesizer (Vosyn), and (3) a combination of SMATC and Vosyn. An experimental design was developed to evaluate these complements by means of three scenarios in both DC-9 and B-727 airline flight simulators. The experimental setup provided for the collection of quantitative data in the form of message response times and communications events. Qualitative data consisting of questionnaire responses and comments were obtained.

The visual SMATC display was more desirable than the Vosyn, the Vosyn/SMATC combination, or conventional voice during ground, low en route, and high en route flight. Conventional voice was favored during local control and was ranked equally with the SMATC during arrival and departure. The SMATC provided the fastest comprehension. No major differences in Data Link were found between two- and three-crew-member simulators. The loss of essential other-aircraft, weather-advisory, and terminal routing information caused by the presumed selective-address capability will necessitate a compensating ATC improvement or alternative before an ATC system based solely on Data Link will receive wide acceptance by airline pilots.

DOT-TSC-FAA-75-23
CONTROLLER/COMPUTER INTERFACE WITH AN AIR-GROUND DATA LINK
Transportation Systems Center.
J. Hagopian, T. Morgan.
AD-A031-070
FAA-RD-76-91
Final Report. June 1976. 150p.

Air Traffic Control-Computer Systems; Digital Data Link

This report describes the results of an experiment for evaluating the controller/computer interface in an ARTS III/M&S system modified for use with a simulated digital data link and a voice link utilizing a computer-generated voice system. A modified ARTS III M&S system at the National Aviation Facilities Experimental Center (NAFEC) provided the means for determining which of three candidate control and display modes was the most suitable for the display and dispatch of computer-generated M&S commands in a mixed voice/digital communications environment. The three modes tested were Control-by-Approval/Full Data Block (CBA/FDB), Control-by-Approval/Tabular List (CBA/TAB), and Control-by-Exception/Full Data Block (CBE/FDB). In Control-by-Approval, the controller must approve each command; in Control-by-Exception, the controller must intervene to disapprove commands that are otherwise automatically dispatched. The three modes were tested by NAFEC air traffic control specialists in an M&S scenario simulating south arrivals, single runway only, at Denver Stapleton International Airport. Figures of merit for evaluating the three modes included subjective data in the form of questionnaires from participating controllers and objective data such as message transaction time, command initiation delay, service time, and instantaneous aircraft load. The results of 66 hours of testing with six air traffic controllers show that the fully automated CBE/FDB control mode is preferred because it possesses the best workload, capacity and stress characteristics. Although the CBA/TAB and CBA/FDB modes tend to exhibit shorter communications delays, the former, with its list display, diverts attention; and the latter, with its trackball, increases workload.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA 75-24
DIGITAL TONE RANGING MODEM, DESIGN AND IMPLEMENTATION
Transportation Systems Center.
P. G. Mauro.
AD-A026-888
FAA-RD-76-16
Final Report. May 1976. 70p.

Applications Technology Satellite; Modems

This report describes a digital ranging modem implementation based on side-tone ranging concepts.

The ranging technique implemented and tested in the DOT/DSC avionics laboratory has direct application to the AEROSAT surveillance system. The performance of a breadboard unit was observed in the laboratory as well as under actual aeronautical and maritime experiments conducted with the NASA ATS-6 satellite.

The technique demonstrated an acquisition probability of 0.98 for a signal-to-noise power density ratio, C/No, of 37 dB-Hz.

The ranging precision of the modem (for C/No>50 dB-Hz) is less than 66 meters.

Circuit schematics, test data, test results and analyses are included in this report along with recommendations for future applications of the demonstrated hardware.

DOT-TSC-FAA-75-25
THE AIRPORT PERFORMANCE MODEL
Transportation Systems Center.
David Hiatt, Steven Gordon, and James F. Oiesen.
AD-A025-262
FAA-ASP-75-5
Interim Report. April 1976. 204p.

Airports-Models

This report describes the development of a model and companion data base for evaluating levels and qualities of service provided to the public by Air Carrier Airports. The model is designed to translate changes in airport capabilities into public service via data describing the characteristics of demand at individual airports. The model is sensitive to airport saturation capacities, aircraft mix, time distribution of demand, airport weather, and data describing passenger movements such as load factor, through passenger, and transfer passenger descriptions.

DOT-TSC-FAA-75-26
THE AIRPORT NETWORK FLOW SIMULATOR
Transportation Systems Center.
Steven Gordon.
AD-A025-740
FAA-ASP-75-6
Interim Report. May 1976. 92p.

Airports-Models

The impact of investment at an individual airport is felt throughout the National Airport System by reduction of delays at other airports in the system. A GPSS model was constructed to simulate the propagation of delays through a nine-airport system. The model is largely based on, and calibrated to, scheduled air carrier itineraries through the system. It calculates statistics and costs for landing, take-off, and gate arrival delays.

DOT-TSC-FAA-75-27
AN AERONAUTICAL AND MARITIME SATELLITE TECHNOLOGY BIBLIOGRAPHY
Transportation Systems Center.
W. I. Thompson, III.
AD-A023-069
FAA-RD-76-47
Final Report. March 1976. 60p.

Satellites-Aeronautical; Satellites-Maritime

Material used and generated over the past five years on the aeronautical and maritime satellite programs has been reviewed and organized in this report. Emphasis has been placed on advanced electronic technology and its application to the satellite surveillance, ranging and communication problems.

DOT-TSC-FAA-76-1
PRELIMINARY EVALUATION OF USER TERMINALS FOR AN AUTOMATED PILOT BRIEFING SYSTEM
Transportation Systems Center.
Eugene E. Pazera.
Final Report. August 1976. 106p.

Air Traffic Control-Automation;
Human Factors-Air Traffic Control

This report describes a preliminary evaluation of various user terminal concepts for an automated aviation pilot weather briefing and flight plan filing system. Terminals embodying differing operational concepts were used by volunteer general aviation pilots in a structured experiment

consisting of a series of simulated pre-flight briefings. Four candidate terminals were intended for application as fixed, self-service stations at strategic geographic locations. Four other terminals were provided for personal use from home or office via telephone link. Each pilot experienced extensive use of one of each class of terminal in separate two-hour test sessions and manipulated or observed the operational characteristics of the other terminals for comparison purposes.

The remote terminal concept for flight briefing by telephone was found to be a viable, acceptable means for obtaining preliminary flight weather information and filing a flight plan. Comparative performance and pilot preference scores for the candidate terminal hardware concepts were obtained.

DOT-TSC-FAA-76-3
ATCRBS IMPROVEMENT PROGRAM
REFLECTOR ANTENNA DEVELOPMENT
Texas Instruments Inc., Equipment Group.
P. N. Richardson.
AD-A027-875
FAA-RD-76-90
DOT-TSC-602
Final Report. June 1976. 148p.

Air Traffic Control; Aircraft-Antennas;
Radar Beacon Systems

This report describes the results of a program undertaken by Texas Instruments Incorporated, under contract to the Transportation Systems Center (TSC), to investigate improved antennas for the Air Traffic Control Radar Beacon System (ATCRBS).

Under this program, an engineering model of a new ATCRBS reflector antenna system was developed and tested. The antenna system was designed primarily for use in terminal area air traffic control, collocated with an Airport Surveillance Radar (ASR).

Also developed during this program was an integral beacon feed for the ARSR-2 radar, to give improved beacon coverage for en-route sites.

DOT-TSC-FAA-76-4
AIRCRAFT WAKE VORTICES –
AN ANNOTATED BIBLIOGRAPHY (1923 - 1975)
Transportation Systems Center.
J. N. Hallock.
AD-A023-415
FAA-RD-76-43
Final Report. January 1976. 314p.

Aircraft-Wake Vortices

This annotated bibliography consists of 570 abstracts of publications on aircraft wake vortices. The material is arranged alphabetically by year of publication and covers the time period through 1975. Experimental and theoretical articles are included (except for helicopter vortices) and consider the formation, structure, motion, and decay of vortices and their effect on penetrating aircraft.

DOT-TSC-FAA-76-5
QM/PSK VOICE/DATA MODEM
Bell Aerospace Corporation.
T. Lerner and J. McChesney.
AD-A024-841
FAA-RD-76-63
DOT-TSC-631
Final Report. March 1976. 96p.

Modems; Digital Data Link;
Applications Technology Satellite

Two Quadrature Modulation/Phase Shift Keyed (QM/PSK) Voice/Data Modem systems have been developed as part of the satellite communications hardware for advanced air traffic control systems. These systems consist of a modulator and demodulator unit which provides for the one-way communication of voice and/or data signals.

The modulator and demodulator unit provides simultaneous transmission of analog voice and digital data signals multiplexed on a single carrier, using quadrature modulation techniques. The modem interfaces with the transmitter/receiver at 70 MHz intermediate frequency.

The report contains design theory, circuit descriptions, diagrams, calibration procedures, and laboratory test results.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-76-6
FLIGHT TESTS OF DIGITAL DATA TRANSMISSION AT VHF
Institute for Telecommunication Sciences.
J. R. Juroshek, G. E. Wasson, G. H. Stonehocker.
AD-A024-431
FAA-RD-76-45
Final Report. March 1976. 71p.

Digital Data Link

This report describes the results of a series of eleven experimental flights that measured the characteristics of air-to-ground digital transmission in the VHF aeronautical mobile frequency band. The tests were conducted for the Federal Aviation Administration at the National Aviation Facilities Experimental Center in Atlantic City, N. J. Digital transmission rates of 2400 and 4800 bps were used with minimum-shift-keying (MSK) as the baseband modulation format. The MSK signal was transmitted on a test frequency of 120.85 MHz using conventional, air/ground voice communication equipment.

A number of parameters were measured during the flights and an extensive description is given of the bit error rates that were encountered. Received signal level was also monitored and data describing average signal level and signal fading are presented. Other parameters measured were clock slips, carrier losses, distribution of errors, and signal fading due to aircraft maneuvering. The tests show that digital transmission rates of 2400 and 4800 bps can be supported, with existing equipment, at an average bit error rate near 5×10^{-5}.

DOT-TSC-FAA-76-8
VHF DATA LINK COMMUNICATION CHARACTERISTICS
Transportation Systems Center and Proteon Associates, Inc.
D. F. Collins, H. C. Salwen, and J. A. Dumanian.
AD-A034-223
FAA-RD-76-171
DOT-TSC-1119
Final Report. November 1976. 364p.

Digital Data Link; Multipath Transmission

This report describes the results of a series of laboratory, field, and flight test experiments designed to characterize the performance of current VHF communication equipment and the VHF channel relative to the communication of digital data in the ATC environment. The experiments were conducted at data rates of 2400 and 4800 bits per second with minimum-shift-keying (MSK) as the baseband modulation. Laboratory experiments were performed to determine the performance of individual VHF communication equipments and subsystems of equipments in Gaussian noise and simulated multipath environments. Field tests utilizing continuous pseudo-random data streams were conducted at Logan Airport, Boston, to obtain estimates of VHF data link performance in the multipath environment of an airport surface. Flight tests were performed utilizing continuous pseudo-random data streams transmitted air to ground to determine bit and block error rates, received signal level, signal fading characteristics, and geographical coverage. Other parameters that were measured include clock slips, carrier losses, and signal fading due to aircraft maneuvers. A second series of flight tests were performed with a computer controlled experimental VHF data link system. The system was tested in a simplex mode with a single aircraft and utilized formatted messages transmitted ground to air and air to ground. The performance of the system was measured in terms of bit error rate, message transaction failure rate, and message throughput. Error distribution data is presented and analyzed. The results of the test program indicate that VHF data link can provide reliable communications for ATC purposes.

DOT-TSC-FAA-76-10
RESULTS OF AEROSAT CHANNEL SIMULATION TESTS. Q-M/PSK, VOICE/DATA MODEM, TSC RANGING MODEM
Transportation Systems Center.
Christopher B. Duncombe.
AD-A031-803
FAA-RD-76-103
Interim Report. July 1976. 28p.

Modems; Multipath Transmission; Satellites-Aeronautical

Two modems which are candidates for the Aeronautical Satellite (AEROSAT) Test and Evaluation Program have been tested by the Transportation Systems Center channel simulation facility. One was a hybrid modem which can simultaneously transmit and receive both data at 1200 bps using differentially encoded phase-shift keying and voice using quadrature modulation (on a single carrier). The other modem tested was the Transportation Systems Center developed digital ranging modem. Both modems were evaluated as a function of carrier to noise density with carrier to multipath ratio as a parameter. This report presents the results of these experiments.

FEDERAL AVIATION ADMINISTRATION

DOT-TSC-FAA-76-11
JOINT US/UK VORTEX TRACKING PROGRAM AT HEATHROW INTERNATIONAL AIRPORT VOLUME I: EXECUTIVE SUMMARY
Transportation Systems Center.
J. N. Hallock and W. D. Wood.
AD-A024-842
FAA-RD-76-58, I
Final Report. March 1976. 34p.

Aircraft-Wake Vortices

From May 1974 through June 1975 the approach region to Runway 28R at Heathrow International Airport was equipped with aircraft wake vortex tracking equipment. The vortices from approximately 13000 aircraft were monitored along with the attendant meteorological conditions. The joint US/UK project represents a major step in learning how vortices move and die in the terminal environment. An overview of the Heathrow project is given and it is shown how the project has significantly contributed to the capability to develop a vortex advisory system promising increased capacity through decreased aircraft separations.

DOT-TSC-FAA-76-12
STEERABLE BEAM ARRAY ANTENNA FOR USE IN ATS-6 TEST PROGRAM
Ball Brothers Research Corporation.
G. G. Sanford.
AD-A030-661
FAA-RD-76-86
DOT-TSC-763
Final Report. May 1976. 142p.

Aircraft-Antennas; Phased Arrays; Applications Technology Satellite

The design and development of an advanced L-Band microstrip phased array antenna for aircraft is described. The array is:

- Electronically steerable in elevation
- Conformal to the surface of an aircraft
- 0.20 inch thick
- Low cost fabrication technique
- Installed without cutting large holes in the aircraft
- Capable of 12 dB gain relative to a right hand circular isotope

The development of the microstrip radiator, array configuration, diode phase shifter and the antenna control unit is described. The array design is considered in relation to the ground plane curvature, grating lobes, side lobes, beam shape and gain. Radiation pattern measurements of the full size antenna and scale model antennas on a scale model aircraft are presented. The design of simple loaded line and switched line phase shifters is reported. In addition, preliminary flight test performed from the ATS-6 satellite test program is presented.

DOT-TSC-FAA-76-14
WAKE VORTEX AND GROUNDWIND METEOROLOGICAL MEASUREMENTS
Lockheed Missiles & Space Company, Inc., Huntsville Research & Engineering Center.
M. R. Brashears, K. R. Shrider, D. A. Love, S. J. Robertson, and A. D. Zalay.
AD-A029-164
FAA-RD-76-93
DOT-TSC-904
Final Report. May 1976. 174p.

Aircraft-Wake Vortexes

Wake vortex groundwind and meteorological measurements obtained by DOT-TSC at John F. Kennedy (JFK) International Airport have been reduced, analyzed, and correlated with a theoretical vortex transport model. The predictive Wake Vortex Transport Model has been updated so that detailed on-site meteorological measurements can be interpreted and utilized to predict more accurately the vortex transport and decay characteristics. A discussion of the wake vortex test data analysis and software development is presented, including a description of the JFK wake vortex test program, the computer processing of wake vortex measurements, the analysis of groundwind sensor measurements, and the analysis of meteorological measurements.

DOT-TSC-FAA-76-15
DEVELOPMENT OF PREDICTIVE WAKE VORTEX TRANSPORT MODEL FOR TERMINAL AREA WAKE VORTEX AVOIDANCE
Lockheed Missiles & Space Company, Inc., Huntsville Research & Engineering Center.
M. R. Brashears, A. D. Zalay, L. C. Chou, K. R. Shrider.
AD-A029-049
FAA-RD-76-94
DOT-TSC-988
Final Report. May 1976. 232p.

Aircraft-Wake Vortexes

The wake vortex transport program has been expanded to include viscous effects and the influence of initial roll-up, atmospheric turbulence, and wind shear on the persistence of wake vortices in terminal areas. Analysis of wake characteristics has shown that changes in the spanwise loading due

to flaps increase the initial sink rate, decrease the separation, and initiate the circulation decay process earlier. Buoyancy due to jet exhaust entrainment and ambient stratification retards vortex spreading and increases descent. Atmospheric turbulence and shear promote a more rapid decay reducing the late-time descent and spread rates of vortices. Vortex tilting has been related to an interaction involving the wind shear, ground plane, and the vorticity detrainment process.

Recognition of the effects of tilting, spanwise loading, vorticity detrainment, burst/sink instabilities, and atmospheric conditions has resulted in an analytic wake transport and decay model with increased accuracy and improved predictive capabilities.

DOT-TSC-FAA-76-17
MEASUREMENT OF THE ATCRBS SURFACE INTERROGATION ENVIRONMENTS AT CHICAGO O'HARE AND LOS ANGELES INTERNATIONAL AIRPORTS
Transportation Systems Center.
M. J. Moroney and H. J. Glynn.
AD-A031-147
FAA-RD-76-136
Interim Report. July 1976. 42p.

Airport Surface Traffic Control; Airport Surface Detection Equipment; Radar Beacon Systems

The Transportation Systems Center is conducting a program to develop a surface surveillance sensor that uses replies from ATCRBS transponders. The operation of this system can be affected by surface interrogations at major airports where such a system might eventually be deployed. Consequently, tests were conducted at Chicago O'Hare and Los Angeles International Airports to measure the surface interrogation environment and to determine the number of interrogators causing surface transponders to reply.

This report describes the tests that were performed, presents the analysis of collected data, and offers conclusions pertinent to future operational ASTC systems.

DOT-TSC-FAA-76-18
AEROSAT ACCESS CONTROL SUMMARY
Computer Sciences Corporation.
H. A. Blank, G. V. Kinal, L. Klein.
AD-A034-068
FAA-RD-76-112
DOT-TSC-1079
Final Report. October 1976. 90p.

Satellites-Aeronautical

The purpose of this report is to summarize U. S. Department of Transportation activities with regard to the AEROSAT access control studies that have been conducted in the recent past and to make recommendations for future efforts. In particular this report concentrates upon the studies conducted by Aerospace Corporation, Bell Aerospace Company, and Computer Sciences Corporation on behalf of the Department.

The report consists of three basic sections. Section 2 is a discussion of the communications concepts germane to AEROSAT access control. It defines and reviews the principles of multiplexing, multiple access, demand access, and access control and relates them to the system parameters of AEROSAT. Section 3 is a complete summary of the three AEROSAT access control studies. The evaluation approach taken, the access control techniques considered, and the conclusions reached by each study are summarized. No attempt is made to critique these results or to combine them into a common set of recommendations. Section 4 presents the recommendations for AEROSAT access control techniques, mainly based upon the results of the three studies and the access control techniques defined in appropriate AEROSAT documentation. Also included are recommendations for AEROSAT test and evaluation, as well as future simulation efforts.

DOT-TSC-FAA-76-19
USER'S MANUAL FOR GENERALIZED ILSGLD-ILS GLIDE SLOPE PERFORMANCE PREDICTION: MULTIPATH SCATTERING
Transportation Systems Center.
S. Morin, D. Newsom and M. Scotto.
FAA-RD-76-186
Final Report. November 1976. 84p.

Aircraft-Landing Systems; Glide Paths

This manual presents the computer program package for the generalized ILSGLD scattering model. The text includes a complete description of the program itself as well as a brief description of the ILS system and antenna patterns. The program listings are included as appendixes, and contain both input-generation programs and output-plotting programs.

For a technical mathematical analysis of the system see the FAA report, "ILS Glide Slope Performance Prediction: Multipath Scattering."

The present report is a partial revision of part II of report FAA-RD-74-157B. The revisions include the treatment of scattering from randomly oriented rectangular surfaces.

DOT-TSC-FAA-76-20
AIRPORT VISIBILITY MEASURING SYSTEMS ELEMENTS OF DEPLOYMENT COST ANALYSIS
Transportation Systems Center.
Hector C. Ingrao.
AD-A033-058
FAA-RD-76-170
DOT-TSC-765
Final Report. September 1976. 228p.

Visibility

This report analyzes the deployment cost for different visibility measuring systems necessary to satisfy CAT I, II, and III operations. The analysis is based on airport operational requirements and data for commercially available visibility measuring equipment.

Estimated deployment schedules of visibility measuring equipment for the FY76-FY85 period are developed. Visibility equipment requirements for each runway category are identified. Eight (8) selected airports are analyzed for their existing visibility equipment, future plans and estimated requirements. Cost comparisons of various alternatives are performed for typical visibility measuring systems.

Commercially available visibility measuring equipment relevant to airport operation are listed and described. Specification and performance characteristics as well as cost factors are considered.

The deployment cost for the SVR system which may become operational in the next few years is investigated. The deployment cost for the airport visibility system (ARVIS) developed by TSC as well as modification kits for the FAA/NBS transmissometer system are analyzed.

DOT-TSC-FAA-76-21
REQUIREMENTS FOR DABS COMPUTER PERFORMANCE MEASUREMENTS
Transportation Systems Center.
John Dumanian, David Clapp.
AD-A031-824
FAA-RD-76-151
Interim Report. September 1976. 20p.

Discrete Address Beacon System

Special equipment for measuring the computing power of a complex of computers in the DABS (Discrete Address Beacon System) is described.

DOT-TSC-FAA-76-24
AIRLINE DELAY TRENDS, 1973-1974. A STUDY OF BLOCK TIME DELAYS, GROUND AND AIRBORNE, FOR SCHEDULED AIR CARRIERS
Transportation Systems Center
Helen M. Condell and Alan S. Kaprelian.
AD-A032-559
FAA-EM-76-8
Annual Report. August 1976. 440p.

Air Transportation-Delays

Estimates of block, airborne and ground delays for route segments flows by United States domestic scheduled airlines operating out of twenty large airports are presented in this document. The data were determined from the CAB ER-586 Service Segment data base, which provides monthly operational times, both ground and airborne, for all route segments receiving scheduled air carrier service. The data in this report are limited to the three-hundred and twenty-five route segments connecting the twenty airports included in the study.

Average monthly estimates of the ground and airborne components of block delays, defined as delays encountered from "ramp to ramp" on a route segment, are presented for the two-year period from 1973-1974. Average monthly estimates of delays for the airborne portion of the segment ("wheels off" to 'wheels on") are categorized according to (1) route segment, (2) airline, (3) aircraft type and (4) local scheduled arrival or departure time. Average monthly estimates of delays for the ground portion of the route segments are categorized according to departure and arrival times at the twenty airport locations included in the study. These estimates of ground delays are further categorized into "busy" time intervals (07:00 - 22:59) and "dull" time intervals (23:00 - 06:59).

DOT-TSC-FAA-76-25
A COMPUTER PROGRAM FUNCTIONAL DESIGN OF THE SIMULATION SUBSYSTEM OF AN AUTOMATED CENTRAL FLOW CONTROL SYSTEM
Transportation Systems Center.
Manuel F. Medeiros, Paul M. MacDonald, Vito P. Maglione, and Richard D. Wright.
FAA-RD-76-144
Final Report. August 1976. 146p.

FEDERAL AVIATION ADMINISTRATION

Air Traffic Control-Models

This report contains a functional design for the simulation subsystem of a future automation concept in support of the ATC Systems Command Center. The simulation subsystem performs airport airborne arrival delay predictions and computes flow control tables for the traffic management of excess airborne delays. Two flow control procedures are supported: Quota Flow and Fuel Advisory Departure procedures. This simulation subsystem works in conjunction with an input subsystem, a centralized data base of national air traffic schedules, a data and flight list retrieval subsystem and a report generator, all of which have been designed by the FAA and reported in separate documentation.

FEDERAL HIGHWAY ADMINISTRATION

DOT-TSC-FHWA-71-1
AUTOMATIC DATA REDUCTION FROM AERIAL PHOTOGRAPHS – PHASE I REPORT
Transportation Systems Center.
Juris G. Raudseps, David S. Prerau.
PB-204-810
August 1971. 119p.

Traffic-Data Processing

Aerial photographs are useful in various studies of highway traffic behavior. From a timed sequence of aerial photographs of a fixed highway area, one can find for each vehicle crossing the area data on position, velocity, trajectory (i.e., entrancing, lane changing, and exiting) and type (i.e., car, truck, or bus). In this project, an interactive system consisting of a computer, a computer-controlled flying-spot scanner, and a graphics tablet is utilized to significantly automate the data reduction process. This report describes the current state-of-the-art of data reduction and the system being developed. The pertinent computer programs developed to date are documented in detail.

DOT-TSC-FHWA-72-1
MANUAL FOR HIGHWAY NOISE PREDICTION
Transportation Systems Center.
J. E. Wesler.
PB-226-086/AS
March 1972. 75p.

Noise-Models; Noise-Traffic

This manual is intended for use as a tool in predicting the noise which will be generated by freely-flowing vehicle traffic along a highway of known characteristics. The manual presents two separate approaches to the prediction problem. The first approach utilizes a simple nomograph to provide first-approximation solutions to the traffic noise prediction problem. The second approach utilizes a computerized traffic noise simulation model, for more accurate and more flexible noise level predictions. This volume contains an explanation of the bases for both approaches, to indicate the assumptions and limitations inherent in the prediction procedures, and a User's Manual for the computer program. Appendix B, published under separate cover, contains the Programmer's Manual and the computer listing for the simulation model. A short version of this report without Appendices A and B, is published as Report DOT-TSC-FHWA-72-2 for convenient use by most users.

DOT-TSC-FHWA-72-1
MANUAL FOR HIGHWAY NOISE PREDICTION APPENDIX B
Transportation Systems Center.
J. E. Wesler.
PB-226-087
March 1972. 80p.

Noise-Traffic; Noise-Models

The basic manual, published as the first volume of this report, is intended for use as a tool in predicting noise levels which will be generated by freely-flowing vehicle traffic along a highway of known characteristics. The first volume explains the basis for the computerized prediction model, used for highway noise level prediction, and contains the user's manual for the computer program. This volume contains the programmer's manual for the computer program, and the program listing in FORTRAN IV.

DOT-TSC-FHWA-72-2
MANUAL FOR HIGHWAY NOISE PREDICTION (SHORT VERSION)
Transportation Systems Center.
J. E. Wesler.
PB-226-088
March 1972. 47p.

Noise-Traffic; Noise-Models

This report is a short version of Report No. DOT-TSC-FHWA-72-1, consisting of only the first four sections of that longer report for more convenient use by most of those involved in highway noise predictions. This report contains a brief description of the bases for both prediction approaches, to indicate the assumptions and limitations inherent in the procedures, and a Users' Manual for the computer program. Appendices A and B of the longer report provide a more detailed description of the prediction theory, and a Programmers' Manual.

DOT-TSC-FHWA-73-1
FREEWAY TRAFFIC FLOW FOLLOWING A LANE BLOCKAGE
Transportation Systems Center.
David Kahn and Ronald Mintz.
PB-222-399/8
Final Report. January 1973. 60p.

Traffic Flow-Theory

The theory of traffic flow following a lane blockage on a multi-lane freeway has been developed. Numerical results have been obtained and are presented both for the steady state case where the traffic density remains constant and

the non-steady state case where the traffic density changes with time.

DOT-TSC-FHWA-73-3
LANE BLOCKAGE EFFECTS OF FREEWAY TRAFFIC FLOW
Transportation Systems Center.
D. Kahn, M. Kierstead, W. Stevens.
PB-223-991
Final Report. January 1974. 38p.

Traffic Flow-Theory

The traffic-density buildup following a lane blockage on a four-lane freeway carrying low-density traffic is determined for several different densities (0.0065, 0.0100, and 0.0106 vehicles per foot) characterizing the freeway. The time for the traffic to return to normal after the blockage is removed is also calculated. The traffic-density buildup following a lane blockage on a four-lane freeway carrying high-density traffic has been considered.

DOT-TSC-FHWA-73-12
SOME CONSIDERATIONS ON THE PROBLEM OF NON-STEADY STATE TRAFFIC FLOW OPTIMIZATION
Transportation Systems Center.
David Kahn, Ronald Mintz.
PB-225-088
Final Report. October 1973. 62p.

Traffic Flow-Models

This report contains our initial efforts aimed at extending the steady state freeway model for optimizing freeway traffic flow to a non-steady state model. The steady-state model does not allow reaction to continuously changing conditions which are often important. The non-steady state or dynamic model will allow this and is intended to be used whenever a metering rate which changes with time is needed. The dynamic modeling is accomplished by developing optimization procedures based on the principles of traffic dynamics, specifically, the continuum equations. In this initial effort only a tunnel roadway and a single lane freeway (but with exits and ramps) are considered.

DOT-TSC-FHWA-75-1
AUTOMATIC EXTRACTION OF HIGHWAY TRAFFIC DATA FROM AERIAL PHOTOGRAPHS
Transportation Systems Center.
Juris G. Raudseps.
PB-242-002
Final Report. April 1975. 78p.

Traffic-Data Processing.

The design of a system for scanning sequences of aerial photographs with a computer-controlled flying-spot scanner and automatically measuring vehicle locations is described. Hardware and software requirements for an operational system of this type are enumerated. Measurement accuracy is predicted to be comparable to that achieved with manual methods in high-volume applications. The cost of such a system is estimated to exceed $500,000. Efficient operation is shown to be critically dependent on the development of an algorithm for predicting vehicle positions that is significantly better than that now available.

DOT-TSC-FRA-71-1A
POWER CONDITIONING FOR HIGH-SPEED TRACKED VEHICLES
Transportation Systems Center.
F. L. Raposa.
Interim Report. February 1971. 65p.

Linear Induction Motor;
High Speed Ground Transportation-Propulsion

The linear induction motor is to provide the propulsion of high-speed tracked vehicles and speed control of the motor is essential for vehicle operation. The purpose of power conditioning is to provide the matching interface between the available power and the desired power for driving the motor. As an integral part of the propulsion system the power conditioner provides the means for controlling both the thrust and the braking of the vehicle.

This interim technical report identifies and describes candidate power conditioners for driving linear induction motors in the variable frequency power mode. The power conditioners described include those for application with either on board electric power sources or with wayside electric power sources.

DOT-TSC-FRA-71-2
METROLINER AUXILIARY POWER ELECTRICAL SYSTEM RELIABILITY STUDY
Transportation Systems Center.
J. D. Abbas and C. W. Watt, Jr.
PB-204-795
Interim Report. June 1971. 135p.

High Speed Ground Transportation-Propulsion

The reliability of the electrical system of any vehicle is greatly affected by the way the system is configured. The propulsion and braking systems of a train must be unaffected by failures occurring in the nonessential power areas. With these criteria in mind the so-called "Auxiliary Power System" of the Metroliner car was analyzed. This auxiliary power system was found to be deficient in achieving these ends. Recommendations suggest methods of satisfying these criteria by segregating the essential from the nonessential elements, thereby enhancing the overall availability of the Metroliner car.

DOT-TSC-FRA-71-3
TECHNOLOGICAL INNOVATION IN GRADE CROSSING PROTECTIVE SYSTEMS
Transportation Systems Center.
John B. Hopkins and Morrin E. Hazel.
PB-204-796
June 1971. 90p.

Grade Crossing Protection

The constraints on innovative grade crossing protective systems are delineated and guidelines for development indicated. Inventory data has been arranged to permit an estimate of the classes of systems needed, the allowable costs, and contribution of various types of crossings to accidents. Many crossings warrant very limited expense and account for very few deaths. A number of approaches are possible for the intermediate cost classes, based on use of conventional signals with low-cost activation systems. Use of similar elements, singly or in combination, can also improve effectiveness of more expensive systems. The very high cost locations may well benefit from interconnection of train and vehicle detectors and small computers.

Extensive analysis and laboratory investigation has been carried out relating to a microwave telemetry alternative to conventional track circuits and possible crossing-located radar and impedance train detection systems.

DOT-TSC-FRA-71-5
TRAIN CONTROL AND OPERATIONS
Transportation Systems Center.
K. Hergenrother.
Final Report. June 1971. 31p.

Automatic Train Control; Exhaust Emissions-Locomotives

ATO (automatic train operation) and ATC (automatic train control) systems are evaluated relative to available technology and cost-benefit. The technological evaluation shows that suitable mathematical models of the dynamics of long trains are required before substantial improvements can be made to ATO systems, and the present ATC systems are presently near optimum. The cost-benefit analysis concludes that only railroads which find CTC (centralized traffic control) economically desirable will also find that ATC offers improved operating economies. ATO does not seem economically or politically practical in the general railroad environment.

A brief evaluation is made of both the contribution of the railroad locomotive to air pollution and the possible means of controlling this pollution.

FEDERAL RAILROAD ADMINISTRATION

DOT-TSC-FRA-71-7
PROGRESS ON THE RAM WING CONCEPT WITH EMPHASIS ON LATERAL DYNAMICS
Transportation Systems Center.
Timothy M. Barrows.
PB-210-743
June 1971. 69p.

Ram Wing

Theoretical and experimental efforts conducted at TSC in the ram wing program are described. Glide Tests were performed using a simple ram wing model operating in an open rectangular trough 50 feet long. Lift drag ratios of 13 were recorded, and a low-frequency roll oscillation was observed. A theoretical model for a flat-plate airfoil in a rectangular trough of infinite depth is described and compared with existing theories and experimental data. The lateral dynamics of tracked vehicles of this type are reviewed and the most important stability parameters are identified.

- It is recommended that future research continue to focus on lateral dynamics and that careful experimental measurements be made for the stability derivatives.

DOT-TSC-FRA-71-8
COMMUNICATIONS FOR HIGH SPEED GROUND TRANSPORTATION
Transportation Systems Center.
G. Chin, R. Eaves, L. Frenkel, and R. Kodis.
PB-212-745/5
November 1971. 62p.

High Speed Ground Transportation-Communication Systems

This report is an account of investigations and analyses undertaken for the OHSGT, beginning in July of 1970, which relate to communications systems for high speed ground vehicles. The authorized scope of the effort was at the rate of one man-year. The first task undertaken was a survey of work carried out by OHSGT contractors and others since 1968. Subsequently, specific aspects of the problem were explored in greater detail, and reports were prepared on the following:

(a) Mechanical Properties of Long Rigid Lines. (Section 2)
(b) Electromagnetic Properties of Surface Wave Couplers (Section 3).
(c) Electromagnetic Properties of Bends in Surface Wave Lines (Section 4).
(d) Propagation Properties of a Trench Line (Section 5).
(e) Pulse Code Modulation for Long Line Communications (Section 6).

DOT-TSC-FRA-72-1
SIMULATION OF POWER COLLECTION DYNAMICS FOR SIMPLY SUPPORTED POWER RAIL
Transportation Systems Center.
C. H. Spenny.
PB-221-616
FRA-RT-73-15
Final Report. November 1972. 48p.

Tracked Air Cushion Vehicle

The mathematical model of a sprung mass moving along a simply supported beam is used to analyze the dynamics of a power-collection system. A computer simulation of one-dimensional motion is used to demonstrate the phenomenon of collector-power rail interaction. Parametric resonance in an undamped collector is shown to exist at several speeds below 300 miles per hour. However, it is demonstrated that amplitude can be controlled at all of these resonant speeds with the proper use of damping.

DOT-TSC-FRA-72-2
IMPROVEMENT OF METROLINER TELEPHONE CHANNEL CAPACITY AND MODELING OF TELEPHONE CHANNEL DEMANDS
Transportation Systems Center.
G. Y. Chin, R. E. Eaves, Jr., R. D. Kodis, P. Yoh.
March 1972. 42p.

Railroads-Telephone Equipment

The channel capacity of the present Metroliner telephone system is analyzed and methods are proposed to increase that capacity without increasing the overall bandwidth. To determine the number of channels required, calculations have been carried out using two available mathematical models: the Erland Modal and the Waiting Model. Three criteria have been used: (1) the probability that no channel is available, (2) the mean waiting time and (3) the probability of having to wait at least t minutes.

FEDERAL RAILROAD ADMINISTRATION

DOT-TSC-FRA-72-3
AUTOMATIC CAR IDENTIFICATION – AN EVALUATION
Transportation Systems Center.
Kenneth F. Troup, III.
PB-209-553
March 1972. 30p.

Automatic Car Identification

In response to a Federal Railroad Administration request, the Transportation Systems Center evaluated the Automatic Car Identification System (ACI) used on the nation's railroads. The ACI scanner was found to be adequate for reliable data output while the label was found to cause most problems with ACI data accuracy. System costs are discussed with several considerations which, depending on the application, can minimize system cost. A number of effective applications of ACI are cited. In addition several reasons why system implementation has not proceeded as planned are discussed. Finally, recommended Department of Transportation actions are included.

DOT-TSC-FRA-72-5
MEASUREMENTS AND ANALYSIS OF 115 kV POWER LINE NOISE AND ITS EFFECT ON PUEBLO TEST SITE RADIO LINKS
Transportation Systems Center.
R. E. Buck, R. E. Esposito, R. Gagnon, E. T. Leonard, R. D. Kodis, P. Yoh.
PB-222-410/3
May 1972. 45p.

Radio Frequency Interference

Noise measurements were made for 115 kV power lines near the frequencies 166, 217 and 406.8 MHz with a receiver bandwidth of 1 MHz. The measurements consisted of counting the numbers of pulses per minute at preset threshold values and RMS. The variations of the noise level vs the lateral distance from the power line were also measured. The worst noise level, -40 dBm, was observed at 217 MHz under a noisy power line. The results of these measurements show that, under normal conditions, power line noise will not have significant effects on the radio links at the Pueblo Test Site. Recommendation is made for a monitoring system to detect the level of a noisy power line when its noise reaches a preset level. Further studies are recommended of other possible noise sources – automobile ignition noise, electrical equipment noise – and of the multipath effects.

DOT-TSC-FRA-72-7
EVALUATION OF NONCONTACT POWER COLLECTION TECHNIQUES
Transportation Systems Center.
John J. Stickler.
PB-222-408/7
FRA-RT-73-7
Interim Report. July 1972. 43p.

Tracked Air Cushion Vehicle

An evaluation is made of four basic noncontacting techniques of power collection which have possible applicability in future high-speed ground transportation systems. The techniques considered include the electric arc, magnetic induction, electrostatic (capacitive) coupling, and electromagnetic waveguide coupling. The report concludes that the electric arc is the only feasible technique from the standpoint of power coupling efficiency and design practicality.

A test program is recommended for investigating the power transfer capabilities of the arc coupler. Details of an experimental test setup are presented which can be used to obtain empirical data required for the design of a prototype unit.

DOT-TSC-FRA-72-10
ANALYTICAL STUDIES OF THE LIFT AND ROLL STABILITY OF A RAM AIR CUSHION VEHICLE
Transportation Systems Center.
Timothy M. Barrows.
PB-219-820
FRA-RT-73-21
Interim Report. December 1972. 68p.

Tracked Air Cushion Vehicle

A ram air cushion vehicle (a type of ram wing) is described schematically and compared with a conventional air cushion vehicle design. The nonlinear equations for the flow in the cushion region are derived. A review is made of the most recent literature on the subject of wings operating in a rectangular channel, and an approximate solution is developed which shows the relative effects of momentum and viscosity on the pressure distribution. Several analytic solutions are presented which show the effect of a small roll angle on the flow pattern; equations for the rolling moment coefficient are also obtained. It is recommended that future efforts be aimed at developing proper numerical techniques which can solve the nonlinear flow relations and that recent experimental efforts to obtain the lateral stability coefficients be continued and expanded.

FEDERAL RAILROAD ADMINISTRATION

DOT-TSC-FRA-72-12
THE EFFECT OF SOLID STATE POWER CONVERTER HARMONICS ON ELECTRIC POWER SUPPLY SYSTEMS
Alexander Kusko, Inc.
Alexander Kusko.
FRA-RT-73-24
DOT-TSC-203
Final Report. March 1973. 38p.

Tracked Air Cushion Vehicle

The United States utility industry has not set suitable standards other than TIF (Telephone Interference Factor), for controlling the design of solid-state wayside and on-board power-conversion equipment, to limit the harmonic currents and voltages in both the transit and electric-power-supply systems. To reduce interference with telecommunications and control equipment, and to insure reliable operation of power equipment, the manufacturers can attenuate the power harmonics by selecting the converter pulse number and by the use of filters. Techniques for calculating the harmonic voltages have been developed and can be applied to transit systems. We propose a standard of 10 percent of fundamental amplitude for each harmonic voltage at the connection point to the utility and 3 percent for each harmonic voltage within the transit system such as the power rails.

DOT-TSC-FRA-72-13
POWER CONDITIONING FOR HIGH SPEED TRACKED VEHICLES
Transportation Systems Center.
Frank L. Raposa, Thorlief Knutrud, John J. Wawzonek.
PB-222-350/1
DOT-TSC-FR 71-1A
Final Report. January 1973. 252p.

High Speed Ground Transportation-Propulsion; Linear Induction Motor

The linear induction motor is to provide the propulsion of high-speed tracked vehicles; speed and brake control of the propulsion motor is essential for vehicle operation. The purpose of power conditioning is to provide the power matching interface between the available power and the desired power for driving the propulsion motor.

This report presents a technical survey of power conditioners that are applicable for driving the linear induction motor in the variable frequency power mode. Power conditioning systems have been selected for technical evaluation and the results are also presented in this report. These systems include the motor-alternator, naturally commutated inverter, forced commutated inverter, and the synchronous inverter-condenser power conditioners.

DOT-TSC-FRA-73-1
ENHANCEMENT OF TRAIN VISIBILITY
Transportation Systems Center.
John B. Hopkins.
PB-223-889/6
FRA-ORD&D-74-15
Final Report. September 1973. 90p.

Train Visibility

This report describes a study of the most effective and practical means of enhancing the conspicuity of the trailing end of trains, in order to reduce the possibility of train-train collisions. There are five elements: (a) definition of a usable number of categories of target, background, and ambient conditions which include the great majority of situations actually encountered; (b) estimation of the stimuli required for each category to increase significantly the detection probability for typical observers; (c) examination of all potentially feasible visibility aids in terms of these criteria; (d) determination of estimated costs, lifetime, and power consumption of techniques which appear promising in terms of effectiveness, and (e) delineation of alternative systems, consistent with one another, comprising a hierarchy of effectiveness and cost. Special deficiencies, advantages, and implications for policy which may be associated with particular realizations are indicated. The devices suggested as optimal include large areas of fluorescent material arranged in a distinctive pattern, retro-reflectors at each corner, and flash lamps of moderate intensity. Detailed specifications are given for such aids.

DOT-TSC-FRA-73-3
GRADE CROSSING PROTECTION IN HIGH-SPEED, HIGH-DENSITY, PASSENGER-SERVICE RAIL CORRIDORS
Transportation Systems Center.
John B. Hopkins.
PB-233-902/8
FRA-ORD&D-74-14
Final Report. September 1973. 42p.

Grade Crossing Protection

This report is a preliminary examination of special aspects of grade crossing protection for operation of high-speed passenger trains in rail corridors for which complete grade separation is not possible. Overall system needs and constraints are indicated, and their implications examined. Application of conventional and improved hardware is considered, with special attention to activation criteria, appropriate motorist-warning devices, stalled-vehicle indicators, and train-mounted components. Non-technical aspects of the problem are also discussed, and areas for which future research efforts may be appropriate are identified.

DOT-TSC-FRA-73-4
INPUT POWER CHARACTERISTICS OF A THREE-PHASE THYRISTOR CONVERTER
Transportation Systems Center.
Raymond A. Wlodyka, Joseph D. Abbas, George Ploetz.
PB-226-281
FRA-ORD&D-74-20
Final Report. October 1973. 90p.

Thyristors

A phase delay rectifier operating into a passive resistive load was instrumented in the laboratory. Techniques for accurate measurement of power, displacement reactive power, harmonic components, and distortion reactive power are presented. The characteristics of the phase delay rectifier operating with unfiltered and inductively filtered resistive loads are presented using both derivations and measurements. The changes of the phase delay rectifier characteristics with a free wheeling diode in the circuit are also presented.

DOT-TSC-FRA-73-7
GUIDELINES FOR WRITING RAILROAD OPERATING RULES
Transportation Systems Center.
Donald B. Devoe and Anne W. Story.
PB-223-733/7
FRA-RT-74-1
July 1973. 25p.

Railroads-Operating Rules

This report constitutes an aid to persons or groups who must create or revise railroad operating rules. It provides guidance for avoiding confusion, ambiguity and misconceptions in the wording of rules. Content, style and organization are discussed, with illustrations of both desirable and undesirable practices taken from current codes of operating rules.

DOT-TSC-FRA-73-8
TOWING TANK TESTS ON A RAM WING IN A RECTANGULAR GUIDEWAY
Massachusetts Institute of Technology, Aerophysics Laboratory
Yves A. Boccadoro.
PB-222-476/4
FRA-RT-73-34
DOT-TSC-239
Final Report. July 1973. 116p.

Ram Wing; Tracked Air Cushion Vehicle; Towing Tank Tests

The object of this study was to set the theoretical and experimental basis for a preliminary design of a ram wing vehicle. A simplified one-dimensional mathematical model is developed in an attempt to estimate the stability derivatives of this type of vehicle. Although very basic, the approach that was taken allows for any geometry of both the model and the guideway. A survey is made of various possible testing techniques. The experimental results obtained using the towing tank technique are reported and compared with the computed estimates. Although many results are very encouraging, the limited data do not allow for a precise estimation of the validity of the mathematical model. It is concluded that the towing tank technique is adequate for the type of investigation that is required at this early stage of the design.

DOT-TSC-FRA-73-9
ASSESSMENT OF CONTROL TECHNIQUES FOR REDUCING EMISSIONS FROM LOCOMOTIVE ENGINES
Southwest Research Institute.
J. O. Storment, K. J. Springer.
PB-212-358
FRA-ORD&D-74-21
Final Report. November 1973. 318p.

Exhaust Emissions-Locomotives

The primary objective of this study was to determine the most effective method of reducing emissions of oxides of nitrogen from a two-cylinder version of an EMD series 567C locomotive engine. The control method judged most effective was that which resulted in the greatest reduction in NO_x, had the least adverse effects on other emission constituents and engine operation, yet was simple to install and maintain.

The NO_x control techniques selected for use in this study included: (1) change in fuel injector design, (2) variation in injection timing from the standard setting, (3) inlet air humidification (water induction), (4) reduction of scavenging air volume (air box bleed) and (5) exhaust gas recirculation (EGR). In addition, methods (2) and (3) were used in combination.

Results of these tests indicated that the most effective control method was retarded injection timing (4° from standard). The next most effective method was EGR, with the recirculated exhaust cooled to 125-150°F. It was necessary to derate (or reduce) engine power at certain points to maintain smoke opacity at acceptable levels with all of these control techniques.

FEDERAL RAILROAD ADMINISTRATION

DOT-TSC-FRA-73-10
STUDY OF REACTION FORCES IN A SINGLE SIDED LINEAR INDUCTION MOTOR (SLIM)
Transportation Systems Center.
J. J. Stickler.
PB-230-268
FRA-ORD&D-74-28
Final Report. January 1974. 84p.

Linear Induction Motor; High Speed Ground Transportation-Propulsion

SLIM reaction forces were measured on a laboratory model having aluminum and aluminum-iron secondaries and the results were correlated with the theoretical forces derived for different idealized SLIM models. The first part of the report discusses wave solutions for single- and multi-region secondaries utilizing the Maxwell Stress Tensor to evaluate the thrust and normal forces. The second part of the report presents data of thrust and normal forces as a function of the stator excitation frequency for different SLIM configurations. The results are helpful both in providing an insight into improved SLIM design and in defining those applications in which the SLIM possesses certain advantages over its double-sided counterpart, as for example, in the application of the LIM to levitated high-speed vehicles.

The correlation of the experimental data with theory is generally fair to good. An exception to the above occurs for the composite SLIM operated at low 'slip frequencies', which gives considerably lower thrust than predicted by theory. Suggestions are made for refining the theory to include boundary and magnetic saturation effects. Further laboratory studies are indicated in those areas where good correlation of experiment with theory is lacking.

DOT-TSC-FRA-73-12
INPUT POWER CHARACTERISTICS OF THE THRYSTOR VARIABLE VOLTAGE POWER CONDITIONER
Transportation Systems Center.
John J. Stickler, George P. Ploetz, Frank L. Raposa.
PB-231-048
FRA-ORD&D-74-24
Final Report. November 1973. 50p.

Thyristors; Linear Induction Motor; Tracked Air Cushion Vehicle

A laboratory study was made of transformer and thyristor voltage control for speed control of a rotary induction motor. The test program consisted of two parts; the first dealing with measurements of the induction motor characteristics and the second with the distribution of complex electric power in the system with both types of voltage-control. The current harmonics which are generated by thyristor control are shown to give rise to additional motor losses and reduction in motor efficiency. The non-sinusoidal currents present with thyristor control produce reactive distortion power. Suggestions are made regarding the suitable instrumentation to use in measuring the distortion power as well as the other components of complex power in the system.

DOT-TSC-FRA-73-13
AN ANALYSIS OF THE JOB OF RAILROAD TRAIN DISPATCHER
Transportation Systems Center.
D. B. Devoe.
PB-233-597
FRA-ORD&D-74-37
Final Report. April 1974. 276p.

Human Factors-Railroads

This report constitutes a detailed study of the job of railroad train dispatcher, conducted to provide a data base for the derivation of criteria of job knowledge, skills and training consonant with safe operations. Documentation was reviewed; specialists were consulted, and selected dispatching operations were observed in detail. The report describes the responsibilities and duties of train dispatchers, their workplaces and job aids, the principal functions they perform, and the records they must maintain. Special characteristics of the job, such as workload, stress, inadequacies in aids, and trends toward improvements are discussed, and estimates are made of the physical and psychological attributes, job knowledge and skills basic to safe operations and possible approaches to assurance of safety through selection, placement and training.

DOT-TSC-FRA-73-14
NORTHEAST CORRIDOR TRAVEL SURVEY 1968-1971
Herbert O. Whitten & Associates.
H. O. Whitten.
PB-229-868
FRA-ORD&D-74-31
DOT-TSC-725
Final Report. January 1974. 252p.

Travel-Surveys; Northeast Corridor

The Northeast Corridor Travel Survey was conducted by the U. S. Census Bureau for the Federal Railroad Administration to determine the impact of High Speed Rail Demonstration

Projects operated between Washington-New York and New York-Boston. This report publishes data from that survey on travel by members of households residing in the Northeast Corridor for the years 1968-1971. Profiles and indices were prepared which compare person-trip information within the Northeast Corridor. Specific travel markets within the Corridor were analyzed for growth trends and shifts resulting from the improved high speed rail transportation. Data were summarized, analyzed, and displayed in appropriate tables within this report.

DOT-TSC-FRA-73-15
MEASUREMENTS OF LEAKY COAXIAL CABLES AND POSSIBLE APPLICATIONS TO TRAIN COMMUNICATION
Transportation Systems Center.
P. Yoh, R. Esposito, R. Gagnon, R. D. Kodis.
PB-262-000
FRA-ORD&D-74-43
Final Report. May 1974. 90p.

Railroads-Communication Systems; Coaxial Cable

The electrical and radiation properties of the Radiax have been measured. The main results are: i) the surface wave exists, ii) the radial radiation follows $1/r^2$ relation for frequency below 190 MHz and 1/r relation for frequency near 400 MHz, iii) the transverse radiation pattern is nearly omnidirectional, iv) the coherent bandwidth is on the order of 3 MHz and the operating frequency range is several hundred megahertz; and v) better coupling efficiency is observed at lower frequency. Possible applications for railroad communication are discussed.

DOT-TSC-FRA-74-2
INTRODUCTION TO THE APPLICATION OF THE DYNALIST COMPUTER PROGRAM TO THE ANALYSIS OF RAIL SYSTEMS DYNAMICS
Transportation Systems Center.
A. B. Perlman, J. J. Lanza.
PB-235-361
FRA-ORD&D-75-2
Interim Report. August 1974. 46p.

Rail Vehicle Dynamics

DYNALIST, a computer program that extracts complex eigenvalues and eigenvectors for dynamic systems described in terms of matrix equations of motion, has been acquired and made operational at TSC. In this report, simple dynamic systems are used to define the DYNALIST terminology. Input parameters required to model a rail vehicle are described. Preparation of a card deck to run the program is detailed. The program output is examined in terms of an application to a hunting analysis of a rail vehicle.

DOT-TSC-FRA-74-5
STATE GRADE CROSSING PROGRAMS: A CASE STUDY
CONSAD Research Corporation.
Ralph G. Kennedy III.
PB-244-175
FRA-ORD&D-75-8
DOT-TSC-34
Final Report. September 1974. 66p.

Grade Crossing Protection

This report reviews the California Railroad-Highway Grade Crossing Program, analyzing the factors influencing the reduction in grade crossing accidents. The report concludes that the greater than average success in grade crossing safety in California has resulted from the long standing financial support of the installation and maintenance of grade crossing warning devices, a strong, well managed Public Utilities Commission providing the analytical support for crossing improvement decisions, unusually strong safety efforts by the financially healthy railroads operating within the state, and an effective framework for city-county-state cooperative determination of grade crossing priorities. California ranks eighth overall in terms of active protection installed and first in the percentages of total crossings equipped with automatic gate installations.

Areas for potential improvement and refinement of the California program are likewise discussed.

DOT-TSC-FRA-74-6
LATERAL STABILITY OF A DYNAMIC RAM AIR CUSHION VEHICLE
Massachusetts Institute of Technology, Aerophysics Laboratory.
Paul V. Aidala.
PB-236-516/1GI
FRA-ORD&D-75-6
DOT-TSC-239
Final Report. August 1974. 72p.

Ram Wing; Tracked Air Cushion Vehicle; Towing Tank Tests

The lateral stability derivatives of a dynamic ram air cushion vehicle in a rectangular guideway were measured using a ship model towing tank. Lift and pitching moment are also

reported. The primary lateral derivatives are all stabilizing, with significant cross coupling in some cases. The longitudinal forces are compared with the numerical prediction of the one-dimensional mass conservation theory given by Boccadoro, with good agreement. A trailing edge Trefftz analysis is presented and used to predict the lateral derivatives. Comparison with the lateral data is good for side displacement derivatives but is less successful for yaw angle derivatives. The towing tank is found to be an effective method for testing dynamic air cushion vehicles.

DOT-TSC-FRA-74-7
EFFECTS OF LONGITUDINAL IMPACT FORCES ON FREIGHT CAR TRUCK BOLSTERS
IIT Research Institute.
Milton R. Johnson.
PB-244-225
FRA-ORD&D-75-10
DOT-TSC-727
Final Report. September 1974. 42p.

Truck and Bolster Systems

The design of truck bolster center plate rims was investigated as a result of increased reports of their failure on 100-ton capacity freight cars. The damage occurs when cars are coupled at moderate to high speeds, since the rapid deceleration of the truck causes high loads between the truck and body bolsters. Test measurements were made on an unloaded 100-ton hopper car impacting a string of loaded cars. The forces between the truck and body bolsters on the moving car were determined at impact speeds from 2.9 to 9.2 mph. Tests were made with two different energy absorbing capacities of draft gear.

Loads at the truck-bolster/body-bolster interface averaged approximately 40,000 lbs. for impact velocities up to 5 mph and reached 100,000 lbs. at 7 mph. A peak load of 160,000 lbs. was measured at 8.4 mph. Within the lower speed range there were no significant differences in load associated with the two draft gear, but at 6.7 mph the loads with the higher capacity gear were 25 percent less. Strain gages placed near the center rim indicated yielding on the first impact at 2.9 mph. Additional yielding continued as the impact velocity was increased.

A finite-element stress analysis showed that loads of the magnitude measured on the test would cause severe stresses in the center plate rim and that yielding of the material would be expected. Several potential modifications of the truck bolster center plate rim were analyzed which showed that significant improvements could be obtained by making the rim wider and by increasing the radius of the fillet at the inside of the rim.

DOT-TSC-FRA-74-8
GUIDELINES FOR ENHANCEMENT OF VISUAL CONSPICUITY OF THE TRAILING END OF TRAINS
Transportation Systems Center.
John B. Hopkins.
PB-236-276/AS
FRA-ORD&D-75-7
Final Report. August 1974. 23p.

Train Visibility

This report summarizes a comprehensive study of potential means of reducing the probability of train-train collisions through enhancement of the visual conspicuity of the trailing end of trains. The basic function requirements and constraints for such devices are set forth, followed by a review of relevant past research. The form and parameter values of the warning system found to incorporate the best combinations of practicality and effectiveness are specified; in essence the system consists of clear xenon flash-tube beacons mounted on opposite sides of the car at the roofline, flashing simultaneously.

Experimental use and observations of the system are described, and detailed recommendations are included.

DOT-TSC-FRA-74-10
FRACTURE RESISTANCE OF RAILROAD WHEELS
Boeing Commercial Airplane Company.
C. S. Carter and R. G. Caton.
PB-243-638
FRA-ORD&D-75-12
DOT-TSC-617
Interim Report. September 1974. 216p.

Railroad Wheels-Stress Analysis

The effects of manufacturing method, chemical composition, heat treatment, temperature, and loading rate on the plane strain fracture toughness K_{IC} of railroad wheels have been determined. Carbon content of the wheels is shown to be the principal factor which controls their toughness.

One hundred wheels which fractured in service are analyzed by means of fracture mechanics procedures. The locations, configurations, and size of thermal and plate cracks which initiated brittle fracture are reviewed, and estimates made of the stress levels which resulted in failure.

Estimates have been made of the minimum size of crack which could result in the failure of wheels under adverse service conditions. These are discussed with respect to the minimum size of defect which can be reliably detected by NDT.

Included in the report are state-of-the-art reviews on thermal and plate cracking and on the stresses developed in railroad wheels.

DOT-TSC-FRA-74-11
FIELD EVALUATION OF LOCOMOTIVE CONSPICUITY LIGHTS
Transportation Systems Center.
D. B. Devoe, C. N. Abernethy.
PB-244-532/AS
FRA-OR&D-75-54
Final Report. May 1975. 66p.

Train Visibility

Flashing xenon strobe lamps were installed on locomotives in revenue service as a means of alerting motorists to the hazards they are approaching at a rail-highway grade crossing. Effectiveness of these lights in attracting motorists' attention was evaluated. The reactions of both motorists and locomotive crews to the use of strobe lights were also evaluated.

Field observations, interviews, and experiments confirmed the attention-getting value of locomotive-mounted strobe lights used in revenue service to alert motorists and suggested operational procedures and device specifications that are the subject of a separate application guideline report. Experimentation and observation of the strobe lights under railroad operating conditions verified that these lights do not interfere with perception of trackside signals or with normal motorist and crew operations.

The work reported in this document supports a technical recommendation favoring use of strobe lights on more extensive research tests in railroad operational service.

DOT-TSC-FRA-74-12
BRUSH TESTING FOR THE TLRV POWER COLLECTION SYSTEM
Transportation Systems Center.
C. H. Spenny and I. Litant
FRA-OR&D-75-57
Interim Report. April 1975. 62p.

Tracked Levitated Vehicles

This report describes work which has been completed to demonstrate the use of laboratory tests in simulating and measuring brush wear for application in the power collection system of the U. S. Department of Transportation's tracked levitated research vehicle (TLRV). Initial tests have demonstrated that materials exist for power pickup from the wayside for speeds up to 300 miles per hour, when conditions exist similar to that of a brush on a motor commutator. Subsequent testing has been performed to determine what parameters of the brush-rail system can deviate from brush-commutator conditions and still provide acceptable performance. Parameters identified and studied in this report include brush material, current density, surface speed, and pressure. Other parameters are identified for future testing.

DOT-TSC-FRA-74-13
SURVEY OF INDUCTIVE COMMUNICATION SYSTEMS
Transportation Systems Center.
G. Y. Chin and P. Yoh.
FRA-ORD&D-75-35
Interim Report. April 1975. 60p.

Railroads-Communication Systems; Radio Frequency Interference; Coaxial Cable

A survey is made of various inductive systems proposed for low frequency train communication. It is found that thick dielectric jackets or coaxial and metallic shields may be required to reduce the environmental effects that lead to high attenuation. Twisted wire cables with inversely connected coupling antennas attain reduction of induced electrical noise and of radiated fields. External noise interference in various environments is discussed. Analysis is made of the coupling variation effect due to wire separation.

DOT-TSC-FRA-74-14. I
DYNALIST II, A COMPUTER PROGRAM FOR STABILITY AND DYNAMIC RESPONSE ANALYSIS OF RAIL VEHICLE SYSTEMS, VOLUME I: TECHNICAL REPORT
J. H. Wiggins Company.
T. K. Hasselman, Allen Bronowicki, Gary C. Hart.
PB-256-046
FRA-OR&D-75-22. I
DOT-TSC-760
Final Report. February 1975. 118p.

Rail Vehicle Dynamics

A methodology and a computer program, DYNALIST II, have been developed for computing the response of rail vehicle systems to sinusoidal or stationary random rail irregularities. The computer program represents an extension of the earlier DYNALIST program. A modal synthesis procedure is used which permits the modeling of subsystems or components by partial modal representation using complex eigenvectors. Complex eigen-

vectors represent the amplitude and phase characteristics of rail vehicle systems which occur as a result of wheel-rail interaction, heavy damping in the suspension system and rotating machinery. Both vertical and lateral motion are handled by the program which allows up to twenty-five component and fifty system degrees of freedom.

DOT-TSC-FRA-74-14. II
DYNALIST II, A COMPUTER PROGRAM FOR STABILITY AND DYNAMIC RESPONSE ANALYSIS OF RAIL VEHICLE SYSTEMS, VOLUME II: USER'S MANUAL
J. H. Wiggins Company.
Allen Bronowicki, T. K. Hasselman.
PB-257-733
FRA-OR&D-75-22. II
DOT-TSC-760
Final Report. February 1975. 100p.

Rail Vehicle Dynamics

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DOT-TSC-FRA-74-14. III
DYNALIST II, A COMPUTER PROGRAM FOR STABILITY AND DYNAMIC RESPONSE ANALYSIS OF RAIL VEHICLE SYSTEMS,
VOLUME III: TECHNICAL REPORT ADDENDUM
J. H. Wiggins Company.
Allen Bronowicki and T. K. Hasselman.
PB-258-193
FRA-OR&D-75-22. III
DOT-TSC-990
Final Report. July 1976. 76p.

Rail Vehicle Dynamics

Several new capabilities have been added to the DYNALIST II computer program. These include: (1) a component matrix generator that operates as a 3-D finite element modeling program where elements consist of rigid bodies, flexural bodies, wheelsets, suspension elements and point masses assembled on a nodal skeleton; (2) a periodic and transient time-history response capability; (3) a component update capability for parametric studies; (4) an orthogonality check on component and system complex eigenvectors; (5) an option for improving low-frequency convergence under modal trunction; (6) a more general sine-amplitude forcing function capability; (7) automatic phase lag generation; (8) user-controlled scaling options on all response plots; and a number of additional minor improvements. A Technical Report Addendum and a completely revised User's Manual document these changes to the previous version of DYNALIST II.

DOT-TSC-FRA-74-14. IV
DYNALIST II, A COMPUTER PROGRAM FOR STABILITY AND DYNAMIC RESPONSE ANALYSIS OF RAIL VEHICLE SYSTEMS,
VOLUME IV: REVISED USER'S MANUAL
J. H. Wiggins Company.
Allen Bronowicki and T. K. Hasselman.
PB-258-194
FRA-OR&D-75-22. IV
DOT-TSC-990
Final Report. July 1976. 160p.

Rail Vehicle Dynamics

DOT-TSC-FRA-74-15
GUIDELINES FOR ENHANCEMENT OF VISUAL CONSPICUITY OF TRAINS AT GRADE CROSSINGS
Transportation Systems Center.
John B. Hopkins and A. T. Newfell.
PB-244-551/AS
FRA-OR&D-75-71
Final Report. May 1975. 56p.

Train Visibility; Grade Crossing Protection

This report summarizes a comprehensive study of potential means of reducing the probability of train-motor vehicle collisions at railroad-highway grade crossings through enhancement of the visual conspicuity of locomotives. Passive techniques are reviewed, and requirements and constraints upon active systems are described. Past research is reviewed, followed by derivation of functional specifications and discussion of practical operating considerations. Operational tests of devices deemed most appropriate to the application are described, with detailed recommendations.

The preferred system consists of clear ("white") xenon flash-tube beacons mounted on opposite sides of the locomotive cab roof, flashed alternately, used in conjunction with amber incandescent lamps outlining the locomotive.

DOT-TSC-FRA-74-16
RAILROADS AND THE ENVIRONMENT—ESTIMATION OF FUEL CONSUMPTION IN RAIL TRANSPORTATION
VOLUME I — ANALYTICAL MODEL
Transportation Systems Center.
John B. Hopkins.
PB-244-150/AS
FRA-OR&D-75-74
Final Report. May 1975. 90p.

Fuel Consumption-Railroads

This report describes an analytical approach to estimation of fuel consumption in rail transportation, and provides sample computer calculations suggesting the sensitivity of fuel usage to various parameters. The model used is based upon careful deliniation of the relevant physical mechanisms of energy dissipation under steady-state conditions rolling and aerodynamic resistance (using the Davis equations), braking, idling, and locomotive power generation and conversion losses. Both simple and more complex formulations are applied as appropriate. Several classes of service are considered: branch line freight, intercity freight, conventional and high-speed passenger, and commuter. Numerous graphs illustrate typical results for specific fuel consumption as a function of speed, grade, power/weight, load factor, weight per seat, etc.

DOT-TSC-FRA-75-4. I
MULTISPAN ELEVATED GUIDEWAY DESIGN FOR PASSENGER TRANSPORT VEHICLES VOLUME I. TEXT
Massachusetts Institute of Technology,
Department of Mechanical Engineering.
D. N. Wormley, C. C. Smith, A. J. Gilchrist.
PB-253-008
FRA-OR&D-75-43. I
DOT-TSC-349
Final Report. April 1975. 142p.

Tracked Air Cushion Vehicle; Automated Guideway Transportation; Magnetically Levitated Vehicles

Analysis techniques, a design procedure and design data are described for passenger vehicle, simply supported, single span and multiple span elevated guideway structures. Analysis and computer programs are developed to determine guideway deflections, moments and stresses and vehicle accelerations resulting from a two-dimensional vehicle with finite pad length front and rear suspensions traversing a multispan elevated guideway. A preliminary design procedure is described to estimate guideway beam structural requirements so that a vehicle-guideway system will meet specified levels of passenger comfort. Design data for 150 mph and 300 mph intercity 40,000, 80,000 and 120,000 lb. air cushion vehicle single and multiple span (span lengths of 50 to 150 ft.) guideways is summarized. For both urban and intercity operating regimes, the data indicates that improvements in the vehicle suspension and the use of multiple span structures rather than single span structures may result in reduced guideway material requirements. The nomenclature is contained in Appendix H, Volume II.

DOT-TSC-FRA-75-4. II
MULTISPAN ELEVATED GUIDEWAY DESIGN FOR PASSENGER TRANSPORT VEHICLES
Massachusetts Institute of Technology,
Department of Mechanical Engineering.
D. N. Wormley, C. C. Smith, A. J. Gilchrist.
PB-253-009
FRA-OR&D-75-43. II
DOT-TSC-349
Final Report. April 1975. 220p.

Automated Guideway Transportation; Tracked Air Cushion Vehicle; Magnetically Levitated Vehicle

DOT-TSC-FRA-75-5
PRELIMINARY ANALYSIS OF THE EFFECTS OF NON-LINEAR CREEP AND FLANGE CONTACT FORCES ON TRUCK PERFORMANCE IN CURVES
Transportation Systems Center.
A. B. Perlman, H. Weinstock.
FRA-OR&D-75-56
Interim Report. May 1975. 44p.

Rail Vehicle Dynamics.

Prediction of wheel displacements and wheel-rail forces is a prerequisite to the evaluation of the curving performance of rail vehicles. This information provides part of the basis for the rational design of wheels and suspension components, for establishing criteria for maintenance of track and wheels, for use as a guideline for safety standards, and for understanding the mechanism of noise generation and wheel-climbing. The analysis presented here extends the results from linear steady-curving appropriate to flangeless guidance, and provides a foundation for the examination of the details of forces and displacements under more severe conditions necessary to the understanding, prevention, and suppression of undesirable effects.

DOT-TSC-FRA-75-6
DESCRIBING FUNCTION TECHNIQUES FOR THE NON-LINEAR ANALYSIS OF THE DYNAMICS OF A RAIL VEHICLE WHEELSET
Transportation Systems Center.
Devendra P. Garg.
FRA-OR&D-75-83.
Interim Report. July 1975. 102p.

Rail Vehicle Dynamics

The describing function method of analysis is applied to investigate the influence of parametric variations on wheelset

critical velocity. In addition, the relationship between the amplitude of sustained lateral oscillations and critical speed is derived. The non-linearities in the model include the difference in rolling radii as a function of lateral displacement of the wheelset from its mean position, profile conicity, and gravitational stiffness in the lateral and yaw directions.

The proposed method is validated by applying it to a wheelset example cited in the literature. Comparable results are obtained using the proposed technique. The describing function method presented in the report is quite general and is applicable to dynamic models exhibiting severe non-linear characteristics in profile. Critical speed, frequency of limit cycles, gravitational force, effective conicity, gravitational stiffness and creepage, etc., can be easily computed using the proposed algorithm.

DOT-TSC-FRA-75-7
A COMMUNICATION-LINK APPROACH TO ACTUATION OF GRADE-CROSSING MOTORIST-WARNING SYSTEMS
Transportation Systems Center.
John B. Hopkins, Robert Abbott, F. Ross Holmstrom, Edward F. White, A. Timothy Newfell.
PB-244-584
FRA-OR&D-75-80
Final Report. July 1975. 118p.

Grade Crossing Protection

Previous studies indicate that one promising avenue to grade-crossing motorist-warning systems, offering lower cost and independent of railroad-track circuits, is use of a radio-communication link for signal activation. By this means, the presence of a train approaching a crossing can be communicated to the crossing from an appropriate distance. This study describes analysis, development, and test activities carried out at the Transportation Systems Center to determine the basic feasibility and practicality of a microwave realization of this approach. A brief review of the conceptual framework is followed by detailed discussion of field-test procedures and results, with special attention then given to train detectors, microwave-propagation aspects, use of solar power, and radar train detection.

DOT-TSC-FRA-75-8
PROPOSED QUALIFICATION REQUIREMENTS FOR SELECTED RAILROAD JOBS
Dunlap and Associates, Inc.
A. Hale, H. H. Jacobs
PB-244-090/AS
FRA-OR&D-75-44
DOT-TSC-736
Final Report. May 1975. 130p.

Human Factors-Railroads

This report proposes minimum, safety-related knowledge, performance and training requirements for the jobs of railroad engineer, conductor, brakeman and train dispatcher. Analyses performed were primarily based upon job and task analytic documentation already in existence, and were critically reviewed by government and civilian railroad specialists.

Recommendations are also offered for the conduct of job training and for techniques to measure and evaluate job knowledge and performance.

DOT-TSC-FRA-75-9
ODOMETERS FOR RAIL APPLICATION
Transportation Systems Center.
Frederick M. Seekell.
PB-244-460/AS
FRA-OR&D-75-70
Interim Report. May 1975. 16p.

Odometers-Rail

Available mileage counters were evaluated, anticipating the possibility of using mileage intervals, rather than elapsed time, for freight car inspection. Simple, reliable and reasonably low costing devices were required. Only two unpowered mileage counting odometers were uncovered, one built in the U. S., the other in Switzerland. The Swiss device is not currently available in this country, presumably because of its particular suitability to European style trucks. The American built device was tested in eccentric rotation and for accuracy at both low and average freight car speeds. It was concluded that the American unit could serve satisfactorily in freight service, without modification, at what would appear to be acceptable cost levels.

FEDERAL RAILROAD ADMINISTRATION

DOT-TSC-FRA-75-10
TASK ANALYSIS FOR THE JOBS OF FREIGHT TRAIN CONDUCTOR AND BRAKEMAN
U. S. Department of the Navy,
Naval Ammunition Depot.
Mark S. Sanders and John P. Jankovich.
AD-A007-528
FRA-OR&D-75-69
RDTR 263
Final Report. May 1975. 236p.

Human Factors-Railroads

This document describes the results of a research effort undertaken to detail the tasks of freight train conductors and brakemen. Included with text are detailed operational sequence diagrams for both conductor and brakeman. This task analysis is subsequent to a similar study conducted by McDonnell Douglas describing the tasks of freight train engineers.

DOT-TSC-FRA-75-11
ANALYSIS OF RAILROAD CAR TRUCK AND WHEEL FATIGUE, PART I – SERVICE LOAD DATA AND PROCEDURES FOR THE DEVELOPMENT OF FATIGUE PERFORMANCE CRITERIA
IIT Research Institute.
Milton R. Johnson.
PB-244-090/AS
FRA-OR&D-75-68
DOT-TSC-727
Interim Report. May 1975. 146p.

Railroad Wheels-Stress Analysis; Truck and Bolster Systems

The development of fatigue performance standards for freight car truck components and wheels requires a knowledge of the fluctuating service load environment, and a basis for stating the conservatism of the design with respect to the environment. On this program special emphasis was given to determining the load environment by analyzing data from 53 test runs conducted on the Erie Branch test track of the Bessemer and Lake Erie Railroad. A number of test parameters were varied, such as speed, type of truck, modifications to the suspension system, etc., to determine those parameters having the greatest influence on the severity of the load. Vertical loads were measured at the sideframe-pedestal/roller-bearing-adapter interface and lateral loads were determined at the wheel/rail interface. The cyclic load data are summarized in a series of load spectra. Factors which must be considered in the development of fatigue performance standards from these spectra include reliability goals, the statistical spread of both load and fatigue strength data, and the philosophy followed in the design of the truck itself.

DOT-TSC-FRA-75-13
PERFORMANCE MODEL OF INTERCITY GROUND PASSENGER TRANSPORTATION SYSTEMS
Transportation Systems Center.
Steven E. Shladover.
FRA-OR&D-76-08
Final Report. August 1975. 134p.

High Speed Ground Transportation

An essential step in the process of evaluating the merits of various proposed intercity ground passenger transportation systems is determining the level of service they can offer to the public. This report describes a technology-independent modeling procedure which can be used to predict the service characteristics of such systems, given basic information on vehicle performance, operating policy, and the nature of the guideway route alignment. The service descriptors of interest which can be predicted include average speeds, travel times, minimum headways, system capacity, and vehicle utilization.

Mathematical models of system performance are derived from basic kinematic relationships, and the simplifying assumptions on which the procedure is founded are explained and justified in detail. Preliminary analyses of system performance are provided as a demonstration of the models' capabilities. Further applications for which the models are well-suited are also suggested.

DOT-TSC-FRA-75-14
OPERATION OF HIGH SPEED PASSENGER TRAINS IN RAIL FREIGHT CORRIDORS
Transportation Systems Center.
Robert K. Abbott.
PB-247-055/AS
FRA-OR&D-76-07
Final Report. September 1975. 82p.

High Speed Ground Transportation; Railroads-Signaling

A preliminary examination of the problems associated with mixed-traffic operations—conventional freight and high speed passenger trains—is presented. Approaches based upon a modest upgrading of existing signal systems are described. Potential costs to the operating railroads, impact on railroad efficiency, and safety of passengers and train crews are considered. Special attention is given to analysis of stopping distance for various conditions and rolling stock. Basic conclusions are that speeds above 125 MPH are likely to require substantial signal system modification and that freight service capacity will be severely degraded by large numbers of HSPT's; further analysis is required to determine well-founded control-system guidelines.

DOT-TSC-FRA-75-15
A METHODOLOGY FOR DETERMINATION OF GRADE CROSSING RESOURCE–ALLOCATION GUIDELINES
Transportation Systems Center.
John B. Hopkins and Morrin E. Hazel.
PB-259-005
FRA-OR&D-76-04
Final Report. August 1975. 68p.

Grade Crossing Protection

This report describes a computer-aided analytical approach to estimation of the potential benefits, costs, and implementation implications associated with allocation of grade crossing safety resources. Three types of information are required as input: (1) the grade crossing population, categorized by hazard, location (urban/rural), and existing systems; (2) warning system alternatives, characterized by cost and effectiveness; and (3) criteria for acceptable or preferred resource-allocation strategies (required benefit-cost ratio, total resources available, number of fatalities to be prevented, etc.). A computer program has been prepared that determines all solutions meeting stated criteria and characterizes them in detail (specifying warning systems for each crossing category). Operation is highly interactive, and requires only seconds of computer time. Examples are presented based upon national statistics, and cases are chosen to indicate sensitivity to uncertainties in input data. An extensive discussion of the currently-estimated crossing population is included, with a brief review of accident prediction equations.

DOT-TSC-FRA-75-16. I
FREQUENCY DOMAIN COMPUTER PROGRAMS FOR PREDICTION AND ANALYSIS OF RAIL VEHICLE DYNAMICS, VOLUME I: TECHNICAL REPORT
Transportation Systems Center.
A. B. Perlman and F. P. DiMasi.
PB-259-287, PB-259-286-SET
FRA-OR&D-76-135. I
Final Report. December 1975. 116p.

Rail Vehicle Dynamics

Frequency domain computer programs developed or acquired by TSC for the analysis of rail vehicle dynamics are described in two volumes.

Volume I defines the general analytical capabilities required for computer programs applicable to single rail vehicles and presents a detailed description of frequency domain programs developed at TSC in terms of analytical capabilities, model description, equations of motion, solution procedure, input/output parameters, and program control logic. Descriptions of programs FULL, FLEX, LATERAL, and HALF are presented. TSC programs for assessing lateral dynamic stability of single rail vehicles are also described.

Volume II contains program listings including subroutines and card-by-card descriptions for inputing data for the four TSC frequency domain programs described in Volume I.

DOT-TSC-FRA-75-16. II
FREQUENCY DOMAIN COMPUTER PROGRAMS FOR PREDICTION AND ANALYSIS OF RAIL VEHICLE DYNAMICS, VOLUME II: APPENDIXES
Transportation Systems Center.
A. B. Perlman and F. P. DiMasi.
PB-259-288, PB-259-286-SET
FRA-OR&D-76-135. II
Final Report. December 1975. 102p.

Rail Vehicle Dynamics

DOT-TSC-FRA-75-17
THE EFFECT OF IMPERFECTIONS ON THE VERTICAL BUCKLING OF RAILROAD TRACKS
Princeton University,
School of Engineering and Applied Science.
Yehia M. El-Aini.
PB-259-389
FRA-OR&D-76-09
DOT-TSC-900
Interim Report. June 1976. 40p.

Track Stress

This report deals with an analytic prediction of the effect of geometric imperfections on the post-buckling characteristics of railroad tracks. The analysis is restricted to the case of vertical track buckling due to constrained thermal expansion in which the track is assumed to lift itself up over a finite span. The imperfections are categorized into two cases: Case (A) in which the region of imperfection is larger than the span of lift-off and Case (B) in which the imperfection region is smaller than the span of lift-off. It is shown that while a perfectly straight track does not exhibit bifurcation points from the undeformed state, the imperfect track does and that the bifurcation temperature in Case (A) is lower than in Case (B) for the same ratio of imperfection amplitudes reduces the bifurcation temperatures significantly. It is found that the bifurcation temperature as well as the safe temperature increase are higher for heavier tracks.

DOT-TSC-FRA-75-18
LOCOMOTIVE TO AUTOMOBILE BASELINE CRASH TESTS
Utrasystems, Inc., Dynamic Science Div.
R. L. Anderson.
PB-250-564/AS
FRA-OR&D-76-03
DOT-TSC-700
Final Report. August 1975. 150p.

Motor Vehicles-Impact Tests

Four locomotive to automobile crash tests were performed by the Dynamic Science Division of Ultrasystems at DOT's High Speed Ground Test Center under contract to the Transportation Systems Center, which is conducting the work for the Federal Railroad Administration. This report documents these four tests, which will provide baseline data for evaluation of future locomotive front structure modifications designed to attenuate the severity of the grade crossing accident. The automobiles were all 1973 standard size sedans of the same model with similar options. For each test, a 130-ton Alco locomotive impacted a stationary automobile at a nominal 50 mph. The first two tests contained no instrumentation on either the locomotive or automobile except for high-speed cameras. The last two tests were instrumented repeats of the first two tests which also involved a direct side impact and a side impact centered on the automobile front fender. The last two tests had an anthropomorphic dummy in the automobile and over 50 accelerometers installed in it. Each test had extensive high frame rate photographic coverage.

DOT-TSC-FRA-75-19
RAILROAD CLASSIFICATION YARD TECHNOLOGY: AN INTRODUCTORY ANALYSIS OF FUNCTIONS AND OPERATIONS
Transportation Systems Center.
Kenneth F. Troup, III, Editor.
PB-246-724.
FRA-OR&D-75-55
Final Report. May 1975. 134p.

Railroads-Classification Yards

A review of the basic operating characteristics and functions of railroad classification yards is presented. Introductory descriptions of terms, concepts, and problems of railroad operations involving classification yards are included in an attempt to provide a "primer" on railroad yards. The report describes certain railroad operating practices and identifies problems that inhibit the efficient operation of railroad yards and the rail system of which they are a part An extensive bibliography has been provided.

DOT-TSC-FRA-75-20
A PARAMETRIC COST STUDY OF AC-DC WAYSIDE POWER SYSTEMS
Alexander Kusko, Inc.
Hans Rutishauser, Alexander Kusko, Michael Barrett.
PB-257-744
FRA-OR&D-76-24
Final Report. September 1975. 138p.

Electric Vehicles

The wayside power system provides all the power requirements of an electric vehicle operating on a fixed guideway. For a given set of specifications there are numerous wayside power supply configurations which will be satisfactory from a technical standpoint. The purpose here is to determine among a set of technically feasible designs, the one which is most cost effective.

The primary cost tradeoff used in this study is between power rails and substations. Included is a presentation of the major technical and cost characteristics of each and a means of parameterizing these quantities, a procedure of optimizing costs, identification of the principal characteristics of a cost effective solution, and a comparison of ac and dc wayside power systems. For purposes of illustration, numerical values and costs for the Tracked Levitated Research Vehicle and the wayside power rail at the High Speed Train Test Center at Pueblo, Colorado, are used.

DOT-TSC-FRA-75-21
LIGHTNING AND ITS EFFECTS ON RAILROAD SIGNAL CIRCUITS
Lowell Technological Institute Research Foundation.
F. Ross Holmstrom.
PB-250-621/AS
FRA-OR&D-76-129
DOT-TSC-589
Final Report. December 1975. 106p.

Lightning; Railroads-Signaling

This study discusses the occurrence of lightning, its effects on railroad signal equipment, and protection of such equipment from lightning damage, with special attention to known protective techniques which are employed in a variety of situations in the power, communications, and railroad industries. A brief review is offered of the causes of lightning and other surges, followed by an extensive treatment of the means by which lightning and power-line transients induce surges and over-voltages in signalling circuits. Specific topics include the effects of the direct stroke current, the collapsing electric field when the stroke occurs, inductive coupling, and the effects of ground currents in the earth.

A survey of protective devices and techniques currently in use for specific types of equipment is presented, including categorization of arrestors by type and application. Preferred lightning protection practices in railroad signalling are examined and related to practices in other fields. The problem of lightning protection is addressed from an overall systems viewpoint, encompassing development and testing of protective systems and design of systems. so that they can more easily be protected. Recommendations for future research are made.

DOT-TSC-FRA-75-22
ULTRASONIC DETECTION OF PLATE CRACKS IN RAILWAY WHEELS
Battelle Pacific Northwest Laboratories.
F. L. Becker.
PB-262-644
FRA-OR&D-76-277
DOT-TSC-726
Final Report. July 1976. 88p.

Railroad Wheels-Stress Analysis

The results of experimental efforts established the feasibility of the detection of railway wheel plate cracks by an ultrasonic pulse echo testing technique from the tread surface.

Feasibility and test sensitivities were established using artificial notches in a flat plate test reference and in full-size wheels.

Concepts for manual inspection of stationary wheels and the automatic testing of moving wheels are described.

Recommendations for further development are included.

DOT-TSC-FRA-75-25
PERFORMANCE ANALYSES OF INTERCITY GROUND PASSENGER TRANSPORTATION SYSTEMS
Transportation Systems Center.
John S. Hitz.
PB-261-950
FRA-OR&D-76-248
Final Report. April 1976. 192p.

Railroads-Passenger Service

This report documents the development of analytical techniques and their use for investigating the performance of intercity ground passenger transportation systems. The purpose of the study is twofold: (1) to provide a capability of evaluating new passenger train systems and (2) to provide information that assists in the formulation of development policies for new systems, thus, investigations evaluate the physical performance (average velocity, system capacity, mode split) of train systems with various design characteristics operating in a range of application conditions. Based on these analyses, conclusions are made regarding the potential performance effectiveness of train systems. The analyses cover design cruise speed, acceleration and braking rates, train length, seat density and lateral acceleration limits. Application characteristics considered include station spacing, dwell time, curve length, spacing and speed, switch concepts and train control strategies.

DOT-TSC-FRA-76-2
AN ASSESSMENT OF RAILROAD LOCOMOTIVE NOISE
FRA-OR&D-76-142

See DOT-TSC-OST-76-4 for complete documentation. •

DOT-TSC-FRA-75-26
FUEL EFFICIENCY IMPROVEMENT IN RAIL FREIGHT TRANSPORTATION
Emerson Consultants, Inc.
J. N. Cetinich.
PB-250-673/AS
FRA-OR&D-76-136
DOT-TSC-1105
Final Report. December 1975. 92p.

Fuel Consumption-Railroads;
Fuel Consumption-Diesel Engines

Railroad diesel fuel conservation is becoming increasingly cost-effective. The price of diesel fuel has increased almost two and one-half times since the October 1973 Embargo. The estimated value of diesel fuel, if in short supply, is over 1 dollar a gallon.

A comparison of the fuel performance of 10 selected railroads, before and after the Embargo, showed improvement in net-ton-miles hauled per gallon of diesel fuel. However, some roads used fuel less efficiently from an operating standpoint, as measured in gross-ton-miles per gallon.

The most promising immediate avenue for conserving diesel fuel is designing train operating policies specifically to conserve fuel while continuing to provide desired schedule performance. Reducing horsepower-per-ton assignment to trains is a preferable strategy to that of reducing maximum allowable train operating speeds. The key to successful

implementation is the appropriate short term regulation of the locomotive fleet.

The basic diesel locomotive now used was designed during an era of plentiful fuel supply at a relatively low price. Many features can be improved to provide greater fuel efficiency.

Corporate strategies need re-examination in the light of the high cost and uncertain supply of diesel fuel. The control of fuel must be improved and contingencies for a fuel shortage should be planned.

DOT-TSC-FRA-76-1
PROGRAM MULTI – A MULTI-PURPOSE PROGRAM FOR COMPUTING AND GRAPHING ROOTS AND VALUES FOR ANY REAL FUNCTION – USERS/PROGRAMMERS MANUAL
Transportation Systems Center.
Russel Brantman.
PB-261-121
FRA-OR&D-76-143
Final Report. May 1976. 56p.

Computer Programs

A generalized multi-purpose program has been developed that can be used to compute and graph cross sections of any surface in space, or to compute and graph the roots of any equation and any functions of these roots. It can therefore be used for a variety of applications, including the graphing of multi-valued functions whose branches are not known beforehand. This capability is unique among graphing programs, and it greatly facilitates the analysis of any system with multiple equilibrium branches.

The program is especially suited for computing the equilibrium branches and investigating the stability of nonlinear finite-degree of freedom systems subjected to static loads.

The program is oriented towards systems with one or two degrees of freedom, but it can also handle additional degrees of freedom and any number of parametric variables.

DOT-TSC-FRA-76-3. I
FINANCIAL ANALYSIS OF THE NORTHEAST CORRIDOR DEVELOPMENT PROJECT, VOLUME I: MAIN TEST AND APPENDIXES A THROUGH D
Peat, Marwick, Mitchell & Co.
H. S. Baker, M. O. Laughlin.
PB-256-441
DOT-TSC-FRA-NCD-76-3, I
DOT-TSC-936
Final Report. June 1976. 174p.

Railroads-Passenger Service-Northeast Corridor

A high speed passenger rail service between Washington, D. C., and Boston was called for in the Regional Rail Reorganization Act of 1973. Planning for the service has been conducted by the Office of Northeast Corridor Development in the Federal Railroad Administration. Engineering studies were undertaken to develop detailed plans and costs for the required facilities improvements.

This report described the development of financial projections for the service. Operating unit costs were estimated. The operating cost estimates were combined with capital costs based on the engineering studies, and with proposed organizational and funding arrangements to develop financial projections. A computer model was developed to produce pro forma cash flow statements, income statements, and balance sheets for future years. Several organization and funding arrangements were tested. The results were measured in net present value and return on investment. Sensitivity analysis was performed.

The report has been published in two volumes.

Volume I details the assumptions, analytical techniques, and results of the financial analysis. Volume II contains pro forma financial statements and a users' manual for the computer model.

DOT-TSC-FRA-76-3. II
FINANCIAL ANALYSIS OF THE NORTHEAST CORRIDOR DEVELOPMENT PROJECT, VOLUME II: APPENDIXES E THROUGH I
Peat, Marwick, Mitchell & Co.
H. S. Baker, M. O. Laughlin.
PB-256-442
DOT-TSC-FRA-NCD-76-3. II
DOT-TSC-936
Final Report. June 1976. 180p.

Railroads-Passenger Service-Northeast Corridor

DOT-TSC-FRA-76-4
DEMAND PROJECTIONS FOR THE NORTHEAST CORRIDOR, FINANCIAL ANALYSIS
Peat, Marwick, Mitchell & Co.
J. C. Prokopy, D. E. Ruina.
PB-256-443
DOT-TSC-FRA-NCD-76-4
DOT-TSC-936
Final Report. June 1976. 82p.

Railroads-Passenger Service-Northeast Corridor

This report describes the development and results of intercity travel demand projections by city-pair prepared for the Northeast Corridor financial analysis. In addition associated analyses of projected passenger volumes by station and of selected alternative station sites are included.

The report first presents the methodology used both to develop projections of total travel by all modes for each city-pair and to assess the rail share of the total. Next, the development of the travel and socioeconomic data base is discussed. The assumptions and sources used for calibration and projection data sets are given, including travel patterns, travel impedances, and population and income information for each city-pair.

Two basic rail alternatives were analyzed: rail service would remain unchanged for 1974 service levels; and the Northeast Corridor Development Program would be implemented by 1982.

The results of each of the scenarios and sensitivity analyses performed for each alternative are described. Detailed annual rail passenger volume estimates were prepared for the primary scenario, and station loading estimates for selected years were developed for high volume days and peak hours.

Finally, the potential benefits of additional service to new or additional suburban station sites north of Philadelphia and New York City are examined.

DOT-TSC-FRA-76-5
MECHANICS OF TRAIN COLLISION
Transportation Systems Center.
Pin Tong.
PB-258-993
FRA-OR&D-76-246
Final Report. April 1976. 74p.

Railroads-Collisions-Models

A simple and a more detailed mathematical model for the simulation of train collisions are presented. The study presents considerable insight as to the causes and consequences of train motions in impact. Comparison of model predictions with two full scale train-to-train impact tests shows good correlation. Methods for controlling train motion and kinetic energy dissipation for the minimization of train collision induced damage are suggested.

DOT-TSC-FRA-76-6
FEASIBILITY OF FLAW DETECTION IN RAILROAD WHEELS USING ACOUSTIC SIGNATURES
Univ. of Houston, Dept. of Mechanical Engineering.
K. Nagy and R. D. Finch.
FRA/OR&D-76-290
DOT-FR-30002
Final Report. October 1976. 206p.

Railroad Wheels-Stress Analysis

The feasibility study on the use of acoustic signatures for detection of flaws in railway wheels was conducted with the ultimate objective of development of an intrack device for moving cars. Determinations of the natural modes of vibrating wheels under various conditions are reported. Differences in acoustic signatures are found between good and cracked wheels, including spectral changes and variations in the time decay of sound. Various sounds occurring in normal railroad practice, such as rolling noise on welded rail and over joints and retarder screech were investigated. It was concluded that special purpose impacters will have to be used for a servicable device. Pattern recognition techniques were used for selecting good and bad wheels with a computerized processing scheme. A laboratory demonstration system has been constructed and found to be 85% reliable when system malfunctions are discounted.

DOT-TSC-FRA-76-8
EVALUATION OF PROTOTYPE HEAD SHIELD FOR HAZARDOUS MATERIAL TANK CAR
IIT Research Institute.
Milton R. Johnson.
FRA/ORD 75-96
DOT-TSC-727
Final Report. December 1976. 60p.

Hazardous Materials-Transportation; Railroads-Tank Cars

The structural integrity of a prototype tank car head shield for hazardous material railroad tank cars was evaluated under conditions of freight car coupling at moderate to high speeds. This is one of the most severe environments encountered in normal railroad service. Two versions of the shield were tested. They were installed on a DOT Spec. 112A340W tank car and instrumented to measure forces at the points of attachment between the shield and the car. Test data were obtained when the car was impacted into standing cars over a 3 to 9 mph speed range. The tests produced no visible damage to the shield or structure connecting it to the tank car, but they demonstrated the presence of severe vibrations resulting from the car impact. The likelihood of fatigue damage was indicated in the connecting structural members where the weight of the shield was supported.

Modifications to the supporting structure are recommended before proceeding with additional impact tests and over-the-road tests.

DOT-TSC-FRA-76-9
OPTICAL AUTOMATIC CAR IDENTIFICATION (OACI) FIELD TEST PROGRAM
Transportation Systems Center.
Hector C. Ingrao.
PB-254-810
FRA/ORD-76/249
Final Report. May 1976. 186p.

Railroads-Classification Yards

The results of the Optical Automatic Car Identification (OACI) tests at Chicago conducted from August 18 to September 4, 1975 are presented. The main purpose of this test was to determine the suitability of optics as a principle of operator for an automatic car identification. Readabilities by standard and "modified" scanners were measured. Based on the optical information available in the label-scanner communication channel and the determination of the non-read causes, the label-scanner readability and limit of readability were obtained. Also the same readabilities were obtained using multiplexed data from two scanners, one at each side of the track. The benefits of redundance in the multiplexed data are based on the analysis of the test results. Conclusions and recommendations are presented. No attempt has been made to evaluate the hardware implementation of the OACI systems used during the Chicago test.

DOT-TSC-FRA-76-10
EVALUATION OF ANALYTICAL AND EXPERIMENTAL METHODOLOGIES FOR THE CHARACTERIZATION OF WHEEL/RAIL LOADS
Battelle-Columbus Laboratories and IIT Research Institute
Donald R. Ahlbeck, Harold D. Harrison, Robert H. Prause, and Milton R. Johnson.
FRA-OR&D-76-276
DOT-TSC-1051
Interim Report. November 1976. 278p.

Railroad Wheels-Stress Analysis; Track Stress

This report has been prepared as part of the Improved Track Structures Research Program sponsored by the Office of Rail Safety Research of the Federal Railroad Administration. The major modes of track degradation have been reviewed to identify the significant wheel/rail loading mechanisms. Analytical models for vehicle/track interaction have been selected for predicting the loads in appropriate formats for each of the major modes of track degradation. This report also evaluates the data required to validate the analytical procedures, and both track and vehicle-borne instrumentation are reviewed for fulfilling these requirements. Available data on wheel/rail loads have been used to assemble a preliminary statistical characterization for interim use.

DOT-TSC-FRA-76-12
SYSTEM REQUIREMENTS AND BENEFITS OF A TERMINAL INFORMATION SYSTEM AND TI... KANSAS CITY RAILROADS
Transportation Systems Center.
Robert D. Reymond and Kenneth F. Troup.
AD-A030-661
FRA-OPPD-76-6
Final Report. May 1976. 144p.

Railroads-Information Systems; Automatic Car Identification

The Kansas City Terminal Railway Company proposed that the Federal Railroad Administration assist in funding the implementation of a Terminal Information and Message Exchange system (TIME), designed to enhance the operations of the twelve railroads in Kansas City. The purpose of this system is to automate the flow of information about cars being interchanged among the railroads in Kansas City. A detailed system requirements and cost/benefit analysis of the proposed system has been conducted by the Transportation Systems Center at the request of the Federal Railroad Administration. The study characterizes current railroad operations in Kansas City and the flow of information about the cars moving into and through the terminal. The costs of some of these operations are developed and the potential benefits of the proposed information system are assessed. A specific example of potential benefits is developed based on reasonable improvement assumptions. Operating costs are developed from experience with a similar system in Chicago. A five to one ratio of the net present value of benefits to the development and implementation costs resulted. The terminal information system is an attractive addition to Kansas City railroad activities and holds promise for improved planning and more efficient terminal operations.

DOT-TSC-FRA-76-13
COMPUTATIONAL METHODS TO PREDICT RAILCAR RESPONSE TO TRACK CROSS-LEVEL VARIATIONS
Massachusetts Institute of Technology,
Department of Mechanical Engineering.
B. E. Platin, J. J. Beaman, J. K. Hedrick, D. N. Wormley.
FRA-OR&D-76-293
Final Report. September 1976. 86p.

Track Train Dynamics

The rocking response of railroad freight cars to track cross-level variations is studied using (1) a reduced complexity digital simulation model, and (2) a quasi-linear describing function analysis. The reduced complexity digital simulation model employs a rail truck model that neglects the high-frequency dynamics of the bolster and wheelset masses, yet includes kinematic center plate, side bearings, and wheelset nonlinear effects. This model has computation-time requirements that are less than one eighth those of more detailed computer simulation models and agrees within 15% percent for the prediction of roll angle, side bearing force, center plate force and wheel force at maximum roll angle response with the more detailed models.

A study of quasi-linear describing function techniques to compute the steady-state response of freight cars to equivalent sinusoidal cross-level track variations has demonstrated the feasibility of the technique for the types of nonlinearities important in car response. This technique, which computes steady-state response from a set of nonlinear algebraic equations rather than by numerical integration, is effective for parametric studies in which a series of the responses is required as a parameter is varied incrementally since once the solution is obtained for one set of parameter values, additional responses for an incremental change in the parameter are obtained efficiently.

DOT-TSC-FRA-76-15
STANDBY POWER FOR RAILROAD-HIGHWAY GRADE CROSSING WARNING SYSTEMS
University of Lowell Research Foundation.
F. Ross Holmstrom.
PB-263-592
FRA-OR&D-76-286
DOT-TSC-589
Final Report. September 1976. 26p.

Grade Crossing Protection

The requirements for standby power at railroad-highway grade crossings, as established by the states, the Association of American Railroads, and the individual railroads, are described. Standard means of satisfying these requirements, using 115 vac primary power and storage batteries for standby, are compared with a number of new techniques, now passing from experimental to operational use, that incorporate solar cells or thermoelectric generators. In addition, other even more innovative techniques are examined. The conclusion of this survey is that for most railroad grade crossing applications, the existing standard techniques (reliance on ac primary power and standby storage batteries) will continue to be the preferred choice. In a number of circumstances in which the provision of ac primary power is very expensive, the combination of solar cells or thermoelectric generators as the primary source, with storage batteries as standby, will be optimal.

DOT-TSC-FRA-76-18
LOCOMOTIVE/CABOOSE CRASHWORTHINESS
Transportation Systems Center.
Pin Tong.
PB-261-110
FRA-OR&D-76-289
Final Report. October 1976. 26p.

Locomotives-Crashworthiness;
Railroads-Cabooses-Crashworthiness

This report presents the results of Phase I of the locomotive/caboose crashworthiness program and the proposed work for the Phase II investigation. The results of the Phase I study include the mechanics of train impact that lead to override, recommended action to control override and means of protection for locomotives and cabooses.

DOT-TSC-FRA-76-20
NORTHEAST CORRIDOR PASSENGER TRANSPORTATION DATA STUDY
Aerospace Corporation.
PB-259-264
FRA/NECPO-76-09
RA-76-22
Final Report. August 1976. 118p.

Railroads-Passenger Service-Northeast Corridor

Fourteen measures of performance are recommended for use in Northeast Corridor rail system evaluation and multimodal comparisons. These include performance measures in the categories of system configuration (e.g., daily available-seat miles by vehicle and segment), system performance (e.g., load factor by vehicle and segment) and system economics (e.g., cost per revenue-passenger mile by vehicle and segment).

Although current data reported by certificated air carriers and participating passenger railroads are not entirely consistent, sufficient data exist to permit effective intra- and inter-modal evaluation and comparison. Certain disaggregation or allocation algorithms are recommended in some cases, however, to obtain travel segment data at the suggested aggregation level and frequency.

Publicly available data for intercity motor passenger carriers are insufficient for the effective evaluation of Northeast Corridor performance. Current data reported to the Interstate Commerce Commission are published only at various aggregated levels and are limited to selected economic data and overall performance measures.

DOT-TSC-FRA-76-22, I
LOCOMOTIVE CAB DESIGN DEVELOPMENT
VOLUME I: ANALYSIS OF LOCOMOTIVE CAB ENVIRONMENT & DEVELOPMENT OF CAB DESIGN ALTERNATIVES
Boeing Vertol Company
J. Robinson, D. Piccione, G. Lamers.
PB-262-976
FRA/OR&D-76/275. I
DOT-TSC-913
Interim Report. October 1976. 206p.

Human Factors-Railroads; Locomotives-Design

This report presents an analysis of the line haul freight engineer's working and living environment, the resulting locomotive cab design and design alternatives. The analysis is based on a delineation of functional requirements found in current line haul operations together with those additional requirements which could arise during the next 10-15 years. The recommended design is the result of a detailed human factors engineering analysis of these requirements according to state-of-the-art criteria and system design practices. Substantial engineering analysis was devoted to the recommended design; this included disciplines of cost, occupant protection, component and subsystem reliability, and system safety analysis.

DOT-TSC-FRA-76-22, II
LOCOMOTIVE CAB DESIGN DEVELOPMENT
VOLUME II: OPERATOR'S MANUAL
Boeing Vertol Company.
J. Robinson, D. Piccione.
PB-264-114
FRA/OR&D-76/275. II
DOT-TSC-913
Interim Report. October 1976. 42p.

Human Factors-Railroads; Locomotives-Design

Locomotive Cab 913 designed as a result of Contract DOT-TSC-913 has been built as a hard mock-up. This Operator's Manual is to familiarize the user with the mock-up. Normal and emergency procedures and cab facilities are described.

DOT-TSC-FRA-76-22, III
LOCOMOTIVE CAB DESIGN DEVELOPMENT
VOLUME III: DESIGN APPLICATION ANALYSIS
Boeing Vertol Company.
J. Robinson.
PB-264-115
FRA/OR&D-76/275. III
DOT-TSC-913
Interim Report. October 1976. 82p.

Human Factors-Railroads; Locomotives-Design

In Volume II of this series of reports on Locomotive Cab Design Development, changes were recommended in the layout and equipment content of locomotive cabs. This report studies the impact of these changes on the interface of the cab with the rest of the locomotive, the required structure, the reliability, the development costs, and the cost of introduction to the operating locomotive fleet. In addition, this report assesses the uses of various techniques of mockup use during the development phases of the design.

DOT-TSC-FRA-76-26, I
MODELS OF RAILROAD PASSENGER-CAR REQUIREMENTS IN THE NORTHEAST CORRIDOR
VOLUME I: FORMULATION AND RESULTS
Computer Research Center for Economics and Management Science.
Robert Fourer.
PB-264-115
FRA/NECPO-76-21
DOT-TSC-1179
Final Report. September 1976. 72p.

Railroads-Passenger Service-Northeast Corridor

Models and techniques for determining passenger-car requirements in railroad service were developed and applied by a research project of which this is the final report. The report is published in two volumes, as follows:

Volume I: Formulation and Results. The first part of this volume considers a general problem of determining optimal passenger-car allocations given a fixed schedule of predetermined demands. Requirements for car movements are

modeled as a set of linear constraints having a transshipment structure, and alternative linear objectives are formulated. Various optimization techniques are developed for one or more objectives, and properties of the sets of optimal solutions are demonstrated.

The remainder of Volume I shows how the linear model and optimization techniques may be applied to the Northeast Corridor. Derivations of a schedule and demands are explained, and results of a number of optimizations and analyses are displayed.

Volume II: User's Guide. The solution and analysis of the Northeast Corridor models required the creation of a number of computer programs of several kinds. These programs are available for the use of others and are described in Volume II of this report.

DOT-TSC-FRA-76-26, II
MODELS OF RAILROAD PASSENGER-CAR REQUIREMENTS IN THE NORTHEAST CORRIDOR
VOLUME II: USER'S GUIDE
Computer Research Center for Economics and Management Science.
Robert Fourer.
FRA/NECPO-76-22
DOT-TSC-1179
Final Report. September 1976. 66p.

Railroads-Passenger Service-Northeast Corridor

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

DOT-TSC-NHSB-71-1
OCCUPANT MOTION SENSORS
Transportation Systems Center.
Joseph L. Horner.
PB-204-808 or PB-211-469
March 1971. 54p.

Sensors; Passive Restraint Systems; Occupant Kinetics

An analysis has been made of methods for measuring vehicle occupant motion during crash or impact conditions. The purpose of the measurements is to evaluate restraint system performance using human, anthropometric dummy, or animal occupants. A detailed Fourier frequency analysis is made of the sensor requirements. Potential candidate systems are evaluated, and five of these recommended for further development and field testing.

DOT-TSC-NHTSA-71-3
DEVELOPMENT OF ANTICIPATORY AUTOMOBILE CRASH SENSORS
Transportation Systems Center.
J. Hopkins, F. Holmstrom, E. Apgar, M. Hazel, E. White, and A. T. Newfell.
PB-204-806 or PB-211-469
HS-802-200
June 1971.

Sensors; Passive Restraint Systems

A comprehensive examination is carried out to determine the basic system constraints and required operational characteristics for anticipatory sensing of impending automobile crashes. This is followed by consideration of a wide variety of possible sensing techniques and selection of those deserving of further study. Two methods are chosen, microwave radar and ultrasonic sonar, and the advantages, weaknesses, and uncertain areas of both are delineated.

Realization of both sensors is described. The radar sensor, comprising standard microwave components and solid state circuitry, has been installed on a test vehicle for characterization. Results are promising, but preliminary; the complexity of the sensing task and the reliability demands on the system require extensive analysis and testing before a conclusion can be drawn as to overall viability.

The sonar approach is a translation of the radar sensor into acoustic form. Transducers have been the subject of particular study and modification. Preliminary results suggest that environmental considerations and adequate target discrimination will be the major problem areas.

DOT-TSC-NHTSA-71-4
OCCUPANT MOTION SENSORS: METHODS OF DETECTION AND ANALYSIS
Transportation Systems Center.
J. L. Horner, D. S. Ofsevit, G. R. Plank, G. G. Lawrence.
PB-204-809
HS-820201
July 1971. 55p.

Sensors; Passive Restraint Systems; Occupant Kinetics

A study has been made of methods for measuring occupant motion within a vehicle during crash or impact conditions. The purpose of the measurements is to evaluate restraint systems, using anthropometric dummy, animal, or human occupants.

A list of general specifications for occupant motion sensors was drawn up. This was used to establish criteria for evaluation of proposed systems. From a study of various possible systems, five were selected for further development. These systems were built and prepared for field testing. In addition, computer methods for Fourier analysis of the data produced by these systems have been developed in theory and in programs for a digital computer.

DOT-TSC-NHTSA-71-5
SURVEY OF NON-DESTRUCTIVE TIRE INSPECTION TECHNIQUES
Transportation Systems Center.
A. L. Lavery, I. Litant, R. P. Ryan, N. Knable, H. L. Ceccon.
PB-213-434
HS-820205
Preliminary Memorandum. July 1971. 50p.

Tire Tests-Nondestructive

The status of several promising methods for non-destructive tire inspection is surveyed with the conclusion that radiographic, infrared, holographic and ultrasonic techniques warrant further evaluation. A program plan is outlined to correlate non-destructive tire inspection data to tire failure data. The emphasis is on inspection systems having sufficient resolution and discrimination capability to detect a broad range of "anomalies." The inspected tires will be subjected to dynamic wheel testing such as specified in Safety Standards 109. Failed tires will be analyzed to determine those anomalies that lead to tire failure and eventually to provide a capability for failure prediction based upon non-destructive inspection techniques.

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

DOT-TSC-NHTSA-71-7
MEASUREMENT OF VEHICLE CONTAMINATION BY EXHAUST GASES
Transportation Systems Center.
Steven M. Mathews.
PB-211-470
HS-820202
Final Report. October 1971. 74p.

Exhaust Emissions-Motor Vehicles

An investigation of the concentration of carbon monoxide (CO) within the passenger compartment of motor vehicles has been made. A sample handling system has been developed to measure the concentrations of CO at as many as six locations inside and outside of a motor vehicle. To use this system effectively, a test procedure was developed with sixteen possible configurations of window, vent, and trunk lid openings. The sample system and test procedures were used on six different vehicles which represented several aerodynamic shapes and utilized different design features and auxiliary equipment. Data obtained in situations of low traffic density are presented.

DOT-TSC-NHTSA-71-8
EVALUATION OF LENGTH-OF-STAIN GAS INDICATOR TUBES FOR MEASURING CARBON MONOXIDE IN AIR
Transportation Systems Center.
Earl C. Klaubert, Joseph C. Sturm.
PB-213-437
HS-820203
November 1971. 15p.

Exhaust Emissions-Motor Vehicles

Techniques for measurement of carbon monoxide (CO) in air are of utility in many aspects of automotive safety. Concentrations ranging from less than 0.01 to about 10 percent CO are of interest. Gas indicator tubes for carbon monoxide (CO) were considered to be potentially useful for this application. An empirical study was conducted to determine the degree of precision obtained from these tubes. A breadboard model of a semi-automated analyzer was constructed. The coiled tube sample reservoir permitted gas transport by following purge air with little mixing or dilution. One brand and type of indicator tube was evaluated at several different CO concentrations, gas flow rates, and at two different sample volumes. All tests were conducted at room temperature. The averaged values for ten tests at each experimental condition were found to fit very well to power-curve equations of the type predicted by theoretical analysis. The standard deviations for each group of tests indicated that any single measurement might differ from the true value by ±30 per cent.

DOT-TSC-NHTSA-72-1.A
ISOLATION OF FLAWS BY USE OF THERMAL DIFFERENTIALS ON A TIRE UNDER MILD LOADING CONDITIONS
Transportation Systems Center.
Stephen Bobo.
PB-211-895
HS-820206
Preliminary Memorandum. April 1972. 14p.

Tire Tests-Nondestructive

An experiment was conducted using a Monsanto Infrared Tire Flaw Detector (TFD) to confirm the hypothesis that areas in tires having poor adhesion or separations tend to achieve a greater rate of temperature rise under conditions of moderate stress than unflawed areas. Three types of stress were tried: constant tire deflection; alteration of inflation pressure; alteration of wheel speed. Tire-to-wheel force in at least one case gave evidence of greater thermal rise rates than in other areas of the tire believed to be normal.

DOT-TSC-NHTSA-72-1, B
OCCUPANT MOTION SENSORS: ROTATIONAL ACCELEROMETER DEVELOPMENT
Transportation Systems Center.
A. Warner, D. Ofsevit, G. Plank.
PB-214-287/5
DOT-HS-820-211
April 1972. 35p.

Sensors; Passive Restraint Systems; Occupant Kinetics

A miniature mouthpiece rotational accelerometer has been developed to measure the angular acceleration of a head during vehicle crash or impact conditions. The device has been tested in the laboratory using a shake table and in the field using dummies and humans. The results of the testing show that while the accelerometer is sensitive to angular acceleration it is also sensitive to linear acceleration, and in practical applications a correction factor for linear accelerations must be applied to the rotational output.

DOT-TSC-NHTSA-72-2
EXPERIMENT IN ASSESSING COLOR SEPARATION TECHNIQUES FOR IDENTIFYING SMALL DENSITY VARIATIONS IN TIRES
Transportation Systems Center.
Stephen N. Bobo.
PB-220-736/3
Interim Report. July 1972. 17p.

Tire Tests-Nondestructive

An experimental color system was tested as an adjunct to the X-ray fluoroscopy system already in use. Shades of gray were translated into various colors as a means of enhancing small defects normally observed with difficulty, and to provide for more rapid identification of gross defects.

DOT-TSC-NHTSA-72-3
AN INFRARED EXPERIMENT ON A ROAD WHEEL DURING AN FMVSS 109 TYPE COMPLIANCE TEST
Transportation Systems Center.
S. N. Bobo.
PB-214-255/2
Interim Report. June 1972. 38p.

Tire Tests-Nondestructive

This report outlines an experiment conducted at a compliance center to gain information on relating a tire's thermal performance during testing, to tire failure. To substantiate this correlation, the instrumentation used is described as well as the method of data retrieval. The tires were inspected by various non-destructive tests before and after compliance testing.

The population of inspected tires was inadequate for general conclusions about the relationship between temperature and failure but the data obtained indicates the technique shows promise. The experiment found a definite relationship between the number of tires being run on a test wheel and the thermal stress applied to those tires.

DOT-TSC-NHTSA-72-4
HOLOGRAPHIC TECHNIQUES FOR NONDESTRUCTIVE TESTING OF TIRES
Transportation Systems Center.
Harry L. Ceccon.
PB-214-258/6
Interim Report. April 1972. 64p.

Tire Tests-Nondestructive

Holographic interferometric techniques were used in a development program to evaluate the feasibility of the technique in the nondestructive testing (NDT) of commercial automobile tires.

Passenger tires with built-in defects were holographically inspected to determine the types of tire defects that can be detected using this method. Separations and voids were located reliably. Defects other than separations and voids were detected in some cases.

A program is currently underway in which "off-the-shelf" passenger tires are first inspected holographically as well as by other NDT methods, then subjected to the Motor Vehicle Safety Standard 109 endurance or high speed tests, reholographed and then sectioned analytically. The objective of the program is to correlate nondestructive test data with tire failure.

DOT-TSC-NHTSA-72-9
INSTRUMENTATION DEVELOPMENT FOR DRUG DETECTION ON THE BREATH
Transportation Systems Center.
J. R. Hobbs and A. E. Barrington.
PB-220-168/9
Final Report. September 1972. 38p.

Mass Spectrometry; Drug Breath Tests

Based on a survey of candidate analytical methods, mass spectrometry was identified as a promising technique for drug detection on the breath. To demonstrate its capabilities, an existing laboratory mass spectrometer was modified by the addition of a membrane separator and a field-ionization source.

Fourteen drugs were selected for investigation and it was possible to identify the signatures (mass spectra) of ten of these drugs with the modified instrument. Some drugs have been detected by direct sniffing, others first had to be dissolved in a suitable solvent and evaporated. The mass spectra presented in the report indicate the basic simplicity of field ionization as compared with ionization by the conventional method of electron impact. The report concludes with a description of the ease and rapidity of the new technique for clinical analysis.

DOT-TSC-NHTSA-72-10
EXHAUST-SYSTEM LEAK TEST: QUANTITATIVE PROCEDURE
Transportation Systems Center.
Earl C. Klaubert.
PB-230-892
HS-801037
Final Report. January 1974. 110p.

Exhaust Emissions-Motor Vehicles

A quantitative, periodic motor vehicle safety-inspection test for determining the leakage rate of engine exhaust from an automotive exhaust system was investigated. Two technical approaches were evaluated, and the better one was selected for development of necessary special equipment and test procedures. The results of the measurement are expressed as the diameter of a single round hole, equivalent in leakage rate to the sum of all leaks in the exhaust system being tested. This method is capable of measuring leaks equivalent in size down to about 1/16-inch hole; discrimination between leaks of 1/8- to 1/2-inch diameter is reliable and easily achieved. Total time to conduct a test and evaluate results is estimated to be from 2 to 5 minutes. In addition, the test imposes a reproducible pressure stress on each system tested; this provides reasonable assurance that the system will remain structurally intact until the next inspection period without developing catastrophic leakage. A field test kit has been developed which can accommodate engine displacements to 460 cubic inches. Flow calibration data are given. A detailed test procedure complete with leak-size determination graphs and a calculation nomograph is presented in an appendix.

DOT-TSC-NHTSA-72-11
FEASIBILITY OF HIGH-RESOLUTION PULSE-ECHO TECHNIQUES FOR AUTOMOBILE TIRE INSPECTION
Transportation Systems Center.
Robert P. Ryan.
PB-231-201
HS-801067
Interim Report. June 1973. 80p.

Tire Tests-Nondestructive

This report presents ultrasonic A-scan reflection oscillograms and B-scan one-dimensional scanning displays for small sections of automobile tires, and for tire-like rubber and cord composite structures, using impulse excitation of 1-MHz and 5-MHz transducers. Adequate penetration and resolution are exhibited to permit depth characterization of structures and defects. Small reflections at bonding interfaces exhibit variations indicating a potential capability for detection of interface bonding anomalies in tires.

DOT-TSC-NHTSA-73-2
AUTOMOBILE CRASH SENSOR SIGNAL PROCESSOR
Burroughs Corporation, Defense, Space and Special Systems Group.
C. J. Bader.
PB-225-868
DOT-HS-800-970
DOT-TSC-409
Final Report. November 1973. 104p.

Sensors; Passive Restraint Systems

The Crash Sensor Signal Processor described interfaces between an automobile-installed doppler radar and an air bag activating solenoid or equivalent electromechanical device. The processor utilizes both digital and analog techniques to produce an output pulse when specified input signal amplitude and frequency conditions are met. The device is intended to be implemented with monolithic MOS large scale integrated circuitry and Bipolar driver. The design and reliability studies indicate that very low cost and very high reliability can be achieved concurrently by monolithic techniques without compromising processor performance.

DOT-TSC-NHTSA-73-3, I
LABORATORY EVALUATION OF ALCOHOL SAFETY INTERLOCK SYSTEMS,
VOLUME I – SUMMARY REPORT
Transportation Systems Center.
Charles N. Abernethy, III and E. Donald Sussman.
PB-231-138
HS-800925
Final Report. January 1974. 188p.

Alcohol Detection and Interlock Systems

This report contains the results of an experimental and analytical evaluation of instruments and techniques designed to prevent an intoxicated driver from operating his automobile. The prototype "Alcohol Safety Interlock Systems" tested were developed both by private industry and by the Transportation Systems Center and all were drawn from a class of instruments which detect intoxication by measuring changes in the subjects ability to perform a psychomotor task. The final report consists of the following documents:

Volume I, Summary Report – Summarizes all of the ASIS evaluation work performed through July 1972 and the results of the evaluation. Volume I is supported by an extensive appendix.

Volume II, Instrument Screening Experiments – Contains details of the experiments conducted by the Guggenheim Center, Harvard School of Public Health, including experimental procedures, results and some preliminary data analyses.

Volume III, Instrument Performance at High BAL – Contains the results of the experimental work performed by Dunlap and Associates, Inc., covering the performance of subjects with relatively high blood alcohol levels on selected instruments.

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

DOT-TSC-NHTSA-73-3, II
LABORATORY EVALUATION OF ALCOHOL SAFETY INTERLOCK SYSTEMS, VOLUME II – INSTRUMENT SCREENING EXPERIMENTS
Guggenheim Center for Aerospace Health and Safety, Harvard School of Public Health.
Ross A. McFarland, John D. Dougherty, Edward A. Arees, Joyce J. Gird.
PB-224-703
HS-800926
DOT-TSC-213
Final Report. January 1974. 204p.

Alcohol Detection and Interlock Systems

DOT-TSC-NHTSA-73-3, III
LABORATORY EVALUATION OF ALCOHOL SAFETY INTERLOCK SYSTEMS, VOLUME III – INSTRUMENT PERFORMANCE AT HIGH BAL
Dunlap & Associates, Inc.
John F. Oates, Jr., Robert T. McCay.
PB-224-702
HS-800927
DOT-TSC-251
Final Report. January 1974. 124p.

Alcohol Detection and Interlock Systems

DOT-TSC-NHTSA-73-5
OCCUPANT MOTION SENSORS: DEVELOPMENT AND TESTING OF A PIEZORESISTIVE MOUTHPIECE ROTATIONAL ACCELEROMETER
Transportation Systems Center.
G. Plank, D. Ofsevit, A. Warner.
PB-223-141/3
Interim Report. July 1973. 42p.

Sensors; Occupant Kinetics

A miniature piezoresistive mouthpiece rotational accelerometer has been developed to measure the angular acceleration of a head during a simulated vehicle crash. Corrections have been electronically applied to the rotational accelerometer to reduce its linear sensitivity. The device has been successfully tested in the laboratory on a high speed shake table and in the field using humans and dummies. New techniques in photogrammetry have been developed to speed the reduction of motion picture data.

DOT-TSC-NHTSA-73-6
DEVELOPMENT AND EVALUATION OF ANTICIPATORY CRASH SENSORS FOR AUTOMOBILES
Transportation Systems Center.
J. Hopkins, R. F. Holmstrom, M. Hazel, and R. Abbott.
PB-230-964
HS-801036
Final Report. February 1974. 304p.

Sensors; Passive Restraint Systems

This report delineates the preferred means, potential effectiveness, and estimated costs of carrying out anticipatory sensing of automobile collisions. Actuation of passive restraint systems requires only a small advance warning to extend the protection of such safety devices to impact speeds of 30 to 60 MPH – a range encompassing a large number of fatal and severe-injury accidents. This examination of means of achieving this function indicates that radar is the most promising crash sensing technique. Design, construction, and extensive test of prototype systems, accompanied by specific studies of component cost and reliability, show that an OEM price of $20 per unit (in volume of 10^6 per year) should be attainable for systems exhibiting extremely high electronic reliability. However, due to inherent limitations of radar, such sensors are likely to detect only 60% to 80% of the major collision objects encountered. A very low rate of inadvertent actuations is possible, occurring only in the course of certain minor (but high-speed) collisions. Potential benefits of full implementation are estimated to exceed prevention of 5000 deaths and 200,000 injuries annually. However, ultimate viability of anticipatory sensing systems will depend upon the use and effectiveness of improved vehicle structures and passive restraint systems.

DOT-TSC-NHTSA-73-7
FABRICATION TECHNIQUES AND PRINCIPLES FOR FLAT PLATE ANTENNAS
Emerson Electric Co., Rantec Div.
PB-225-865
DOT-HS-800969
DOT-TSC-390
Final Report. September 1973. 40p.

Sensors

This final report documents the work performed by Rantec under Department of Transportation Contract No. DOT-TSC-390. Defined herein are the fabrication techniques and principles Rantec has selected to produce one million and ten million flat plate antennas per year.

An engineering analysis of the reliability, electrical integrity, and repeatability is made, and a cost analysis summary is included for a production run of both one and ten million units per year, and a technical discussion of the maximum RF frequency to which these fabrication techniques can be extended without performance degradation and/or major cost increase is included.

The fabrication techniques selected by Rantec to produce 1 to 10 million flat plate antennas per year include die casting, pierce and blanking, injection molding, and cold heading. The flat plate antenna would be fabricated in six elements using these techniques. An automatic assembly center would be used to achieve the high volume production runs. One such unit operating at maximum efficiency will produce 1 million units per year at a cost of $0.41 per unit. Two additional stations will achieve production runs in excess of 10 million per year at a cost of $0.30 per unit, not including overhead.

The flat plate antennas can be scaled to a frequency of 17.5 GHz with no cost impact or significant effect on performance. Scaling to a frequency of 21 GHz is possible but at a higher cost per unit.

DOT-TSC-NHTSA-73-8
MODEL 0102 FLAT PLATE ANTENNA FOR USE IN AUTOMOBILE RADAR ANTICIPATORY CRASH SENSORS
Cutler Hammer, AIL Division.
Kalman V. Toth and Ronald M. Rudish.
PB-225-864
DOT-HS-800968
DOT-TSC-437
Final Report. September 1973. 36p.

Sensors

AIL has analyzed alternative methods of construction and production costs for a flat plate antenna based on the use of etched circuit techniques. The antenna is proposed for use in certain new automotive radar anticipatory crash sensor systems now under development.

The antenna is a minimal volume planar array structure, ideally suited for low cost production. Using a design approach that was previously developed for advanced battlefield radars, the antenna is unique in that the radiating elements and feed circuitry are etched on the same substrate.

The antenna is 2-5/8 x 4-5/8 x 15/16 inches (exclusive of output connector). Although its active region is only a fraction of this space, a breadboard version of this highly efficient antenna achieves more than 13-dB gain over the required one percent region of X-band, with radiation patterns having excellent suppression of side lobes.

A production design is postulated which is suitable for automated production processes. The resulting antenna is a simple sandwich of one printed circuit between two layers of foam; this sandwich is encased in a molded, metallized lexan housing, and is faced with a lexan radome.

In quantities of at least one million antennas, the estimated OEM selling price is under 3 dollars each, not including the cost of preparing for large-scale production. In quantities in excess of ten million antennas, the estimated selling price is under 2 dollars each, also not including the cost of preparing for large-scale production.

DOT-TSC-NHTSA-73-9
EXPERIMENTAL EVALUATION OF SECOND-GENERATION ALCOHOL SAFETY-INTERLOCK SYSTEMS
Dunlap and Associates, Inc.
John F. Oates, Jr.
PB-227-103
DOT-HS-800967
DOT-TSC-251
Interim Report. December 1973. 114p.

Alcohol Detection and Interlock Systems

This report documents the results of laboratory testing of four "second-generation" alcohol safety-interlock systems. As a group, these systems were found to produce appreciable discrimination between sober and intoxicated subjects.

DOT-TSC-NHTSA-73-10
LEGAL ISSUES RAISED BY ORBIS, A MOTOR VEHICLE SPEED DETECTION DEVICE TAKING PHOTOS OF SPEEDERS
Transportation Systems Center.
David Glater.
PB-226-891
DOT-HS-801020
Interim Report. December 1973. 48p.

Speed Recorders-Legal Aspects

This report reviews the legal basis for certain potential challenges to the use of unmanned mechanical devices which (a) detect motor vehicles exceeding predetermined speed limits, and (b) photograph both the front portion of these vehicles and the faces of their drivers and passengers.

In particular, the report is focused on the operation of Orbis, a member of this class of speed-detection devices manufactured by the Boeing Corporation. Three aspects of the device's legality are discussed: (1) the question of whether its operation violates individuals' right of "privacy" as protected by the Federal Constitution, State statutes, and common-law precedents; (2) the issue to unlawful inequities in traffic-law enforcement, resulting from the device's operational limitations, which permit some speeders to pass by undetected; and (3) the admissibility into evidence in speeding prosecutions of photographs taken by the device.

DOT-TSC-NHTSA-73-11
EVALUATION PLAN FOR ORBIS
Transportation Systems Center.
Philip W. Davis.
PB-231-349
HS-801105
Interim Report. March 1974. 64p.

Speed Recorders

This report contains the evaluation plan and experimental design for determining the effectiveness and usability of ORBIS, a proprietary device for automatically detecting and recording speeding motorists. The experimental evaluation will be conducted in two phases, in cooperation with several local jurisdictions who will install, operate, and maintain the ORBIS system. The first phase will examine changes in speed behavior due to ORBIS; the second will test for changes in accident rate and severity.

DOT-TSC-NHTSA-73-12
ANALYTICAL FINITE ELEMENT SIMULATION MODEL FOR STRUCTURAL CRASHWORTHINESS PREDICTION
Transportation Systems Center.
J. Rossettos, H. Weinstock, S. Pasternack.
PB-228-136
HS-801018
Interim Report. February 1974. 66p.

Motor Vehicles-Crashworthiness

The analytical development and appropriate derivations are presented for a simulation model of vehicle crashworthiness prediction. Incremental equations governing the nonlinear elasto-plastic dynamic response of three-dimensional frame structures are derived, where the associated stiffness and compatibility matrices also incorporate large geometry changes. A discussion of yield criteria is given, together with bound type estimates for thin walled cross section beams. The Newmark beta method is then used to solve the equations of motion, and is oriented toward the particular incremental equations typical of the present application.

DOT-TSC-NHTSA-74-1
INSTRUMENTATION METHODOLOGY FOR AUTOMOBILE CRASH TESTING
Transportation Systems Center.
Frank P. Di Masi.
PB-236-315/8GI
HS-801211
Interim Report. August 1974. 124p.

Motor Vehicles-Impact Tests

Principal characteristics of existing data acquisition practices and instrumentation methodologies have been reviewed to identify differences which are responsible for difficulties in comparing and interpreting structural crash test data. Recommendations are made for standardizing these differences which include non-uniform practices in transducer location, data acquisition and presentation of plotted data. The general nature of current filtering specifications used in structural data acquisition also adversely affects data interpretation and comparison. Examples emphasizing the importance of low frequency data content of occupant compartment accelerometer data are presented and a possible analysis criterion for specifying suitable filtering characteristics for this parameter, is described. A method which has the potential to analytically describe and "filter" test results by fitting a polynomial curve having limited frequency reproduction capability to digitized crash test data is also proposed.

Recommendations for standardized structural data acquisition parameters have been made to establish a structural performance base and evaluation criteria for application to full scale production vehicle crash test results.

The role of structural crash test data for use in computer simulation model development is also reviewed and its role in current and advanced simulation models is defined based on model input/output characteristics.

DOT-TSC-NHTSA-74-2
PRESSURE EFFECTS ON WORN PASSENGER CAR TIRE CARCASSES
Michigan University.
S. K. Clark, R. N. Dodge, D. W. Lee, J. Luchini.
PB-244-308/AS
HS-801206
DOT-TSC-316
Interim Report. February 1975. 36p.

Tire Failure

Work is described to examine the value of hydrostatic proof pressure testing in selecting used tire carcasses for retreading. Preliminary experiments on single tire cords indicate that overloads close to rupture do not damage subsequent fatigue life. A selected population of used 15-inch passenger car tires was selected and burst hydrostatically yielding a wear burst pressure of 207 psi. Additional tires are to be retreaded after pressurization to 170 psi. Their performance on MVSS 109 will be compared with an unpressurized control set of tires which are also to be recapped.

DOT-TSC-NHTSA-74-4
REBREATHED AIR AS A REFERENCE FOR BREATH-ALCOHOL TESTERS
Transportation Systems Center.
A. L. Flores.
PB-239-843
HS-801-333
Interim Report. January 1975. 23p.

Alcohol Detection and Interlock Systems

A technique has been devised for a reference measurement of the performance of breath-alcohol measuring instruments directly from the respiratory system. It is shown that this technique is superior and simpler than comparison measurements based on blood-alcohol analysis.

DOT-TSC-NHTSA-74-5
BLOOD-ALCOHOL PROFICIENCY TEST PROGRAM
Transportation Systems Center.
A. L. Flores.
PB-239-849
HS-801-332
Interim Report. January 1975. 20p.

Alcohol Detection and Interlock Systems

A preliminary survey has been performed to ascertain the validity of the blood alcohol analysis performed by a number of laboratories on a voluntary basis. Values of accuracy and precision of the tests are presented.

DOT-TSC-NHTSA-74-6
RESULTS OF THE FIRST SEMI-ANNUAL QUALIFICATION TESTING OF DEVICES TO MEASURE BREATH ALCOHOL
Transportation Systems Center.
A. L. Flores.
PB-240-104
HS-801355
Interim Report. January 1975. 24p.

Alcohol Detection and Interlock Systems

Eight Evidential Breath Testers were performance tested according to the Standard for Devices to Measure Breath Alcohol, Federal Register, Vol. 38, No. 212, November 5, 1973. In addition, a prototype breath tester not commercially available was tested. Test results are presented.

DOT-TSC-NHTSA-74-7
MODULAR APPROACH TO STRUCTURAL SIMULATION FOR VEHICLE CRASHWORTHINESS PREDICTION
Transportation Systems Center.
Pin Tong and J. N. Rossettos.
PB-246-784
HS-801-475
Final Report. March 1975. 42p.

Motor Vehicles-Crashworthiness

A modular formulation for simulation of the structural deformation and deceleration of a vehicle for crashworthiness and collision compatibility is presented. This formulation includes three dimensional beam elements, various spring elements, rigid body elements, and modal elements.

DOT-TSC-NHTSA-75-2
ANALYSIS OF AUTOMOBILE CRASH TEST DATA AND RECOMMENDATIONS FOR ACQUIRING AND FILTERING ACCELEROMETER DATA
Transportation Systems Center.
Frank P. DiMasi.
PB-244-308
HS-801 521
Final Report. June 1975. 94p.

Motor Vehicles-Impact Tests

An attempt is made to define the meaningful frequency content of occupant compartment deceleration data in order to establish effective filtering guidelines which will enhance the important features of the deceleration pulse.

Acceleration and displacement spectral distributions of crash test and structural resonance data are compared to assess the presence and effects of resonances in the deceleration time history. A typical accelerometer package — floor pan configuration is modeled to characterize resonant modes associated with current accelerometer package size and mounting. Guidelines are suggested for partitioning data frequency content based on these analyses and also on the comparative effects of high and low frequency decelerations on occupant loading.

An alternative method to analog filtering of crash data, which employs a least squared error polynomial curve fitting routine, has been developed and is described. This method has the desired capability to partition the data frequency content into decelerations associated with gross vehicle crush, and residual high-frequency, low displacement amplitude decelerations associated with structural resonances, without discarding any data. Applications of the method to crash test data are presented.

DOT-TSC-NHTSA-75-3
PROJECT LATEDAY: THE LEVEL OF ACCIDENTS UNDER THE EFFECT OF DAYLIGHT SAVING ALL YEAR
Transportation Systems Center.
David S. Prerau.
PB-247-089
HS-801 639
Final Report. October 1975. 136p.

Daylight Saving Time; Motor Vehicles-Accidents

Year-round daylight saving time (YRDST) has recently been observed in the United States. The observance of double daylight saving time (DDST) is under some consideration. One of the principal expected effects of the adoption of these time systems is a change in the level of motor vehicle accidents.

The objective of this study was to determine the effect of year-round daylight saving time and of year-round double daylight saving time on the motor vehicle accident rate.

An experiment was designed to employ computer analysis of available motor vehicle accident data to model the accident situation in the United States under YRDST and DDST. The Daylight Savings Equivalent Day, a novel concept, was developed to allow the available data, from non-YRDST and non-DDST years, to be used to find an estimate of the effect of YRDST and DDST.

DOT-TSC-NHTSA-75-4
NONDESTRUCTIVE TESTING SYSTEM FOR RETREADS
Transportation Systems Center.
Henry H. Bessler, Stephen N. Bobo, Manuel J. Lourenco, William R. Wade.
PB-247-083
HS-801-736
Final Report. November 1975. 94p.

Tire Tests-Nondestructive

An important problem in retreading tires is the assurance of a satisfactory casing. Since 1972 the National Highway Traffic Safety Administration has had under development an air-coupled through-transmission ultrasonic inspection system for finding anomalies in casings. This report describes the results of this development in sufficient detail to permit its reproduction by a reasonably competent electronics manufacturer. The reader is cautioned that the equipment described will not find all anomalies in every casing, and that system cost effectiveness depends heavily on the way the equipment is used, the tires it inspects, and the types of anomalies considered to be detrimental to retreading.

DOT-TSC-NHTSA-76-2
PROOF PRESSURE EVALUATION OF WORN PASSENGER CAR TIRE CARCASSES
University of Michigan.
S. K. Clark, R. N. Dodge, D. W. Lee, and J. R. Luchini.
HS-802-103
DOT-TSC-316
Final Report. November 1976. 56p.

Tire Failure

Test work is described that examines the value of hydrostatic proof pressure testing in screening worn tire carcasses before retreading. Results are given from dynamometer wheel tests on a significant sample of retreaded passenger car tires. Each sample unit consisted of a pair of tires, one of which was hydrostatically pressurized to approximately 75% of the mean burst pressure before testing. There is evidence from the tests that the pressurization is neither beneficial nor harmful to the subsequent tire durability.

Acoustic emission, pressure, pressure rate and volume were also recorded as functions of time from a large sample of worn passenger car tires during hydrostatic pressurization. Correlation studies between these data and the carcass condition show no simple relationships between structural flaws and these recorded variables.

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-71-3
BIBLIOGRAPHY ON GROUND VEHICLE COMMUNICATION & CONTROL: A KWIC INDEX
Transportation Systems Center.
W. I. Thompson, III.
PB-204-807
August 1971. 191p.

High Speed Ground Transportation-Communication Systems; Radio Frequency Interference

This bibliography covers the subject of communication and control of ground vehicles. This covers the fields of land-mobile communication, computer aided traffic control, communication with high speed ground vehicles, and radio frequency noise. Emphasis is placed on the 150, 450, and 900 MHz frequency bands.

DOT-TSC-UMTA-71-6
GROUND VEHICLE COMMUNICATIONS & CONTROL
Transportation Systems Center.
R. E. Buck, L. A. Frasco, H. D. Goldfein, S. Karp, L. Klein, E. T. Leonard, J. Liu, and P. Yoh.
July 1971. 164p.

Radio Frequency Interference

A program for improving vehicular communications in the urban environment is described. The first major item was the development of a capability to measure and record both the multipath structure of any particular urban channel and the associated noise environment. This will be accomplished by outfitting a van to make noise measurements and also to be the receiving site for suitably designed probing signals which will be transmitted from fixed locations. The frequencies to be used are: 149.95, 416.6 and 902.2 MHz.

The second part of the program is directed toward analyzing the noise and multipath characteristics measured above. Effort has been directed toward constructing a channel simulator and a communication system simulator.

Contractor reports are included.

DOT-TSC-UMTA-71-7
OPERATION DIAL-A-RIDE DISPATCHING PROGRAM: INSTRUCTIONS FOR USING THE SYSTEM TAPE
Transportation Systems Center.
B. Paul Bushueff, Jr.
September 1971. 20p.

Demand Responsive Systems

This handbook contains notes and instructions on using the magnetic tapes that contain the Operational Dial-A-Ride computer dispatching program that was produced by MIT Urban Systems Laboratory under Grant Mass MTD-6, for the Department of Transportation Urban Mass Transit Administration.

DOT-TSC-UMTA-72-1, I
OPERATIONAL DIAL-A-RIDE COMPUTER PROGRAM, TEST AND EVALUATION REPORT, VOLUME I
Transportation Systems Center.
Juan F. Bellantoni.
September 1971. 142p.

Demand Responsive Systems

This report presents the results of the evaluation of the MIT Urban Systems Laboratory's (USL's) Dial-A-Ride operational computer program. The evaluation was carried out by the Transportation Systems Center (TSC) under PPA UM-02, "Transportation Systems Computer Package", FY'72. The general purpose of the evaluation was to test the Operational Dial-A-Ride (O D-A-R) DOS program against the work statement of November 24, 1970, for extension of the UMTA Grant MASS-MTD-6.

DOT-TSC-UMTA-72-1, II
OPERATIONAL DIAL-A-RIDE COMPUTER PROGRAM, TEST SCENARIOS AND TEST DATA, VOLUME II
Transportation Systems Center.
Juan F. Bellantoni.
September 1971. 142p.

Demand Responsive Systems

DOT-TSC-UMTA-72-3
NOISE LEVEL MEASUREMENTS ON THE UMTA MARK I DIAGNOSTIC CAR (R42 MODEL)
Transportation Systems Center.
Edward J. Rickley, Robert Quinn, George Byron.
October 1971. 100p.

Noise-Rapid Transit

The R42 Model mass transit car currently operating on the "N" line of the New York City Transit System was selected for experimentation and tests. For this purpose, the car

was instrumented and designated as the UMTA Mark I Diagnostic Car.

Noise levels generated by "stop and go" operations of the Diagnostic Car were measured and tabulated in this report. Measurements were made inside of and outside the car during operation on the "N" line of the New York Transit System and during operation at the DOT High Speed Ground Test Center at Pueblo, Colorado.

The report contains tabulations of the noise levels measured, time history charts, 1/3 octave frequency analyses and pertinent comments on the information obtained.

DOT-TSC-UMTA-72-10
ANALYSES OF RAIL VEHICLE DYNAMICS IN SUPPORT OF DEVELOPMENT OF THE WHEEL RAIL DYNAMICS RESEARCH FACILITY
Transportation Systems Center.
Herbert Weinstock.
PB-222-654/6
UMTA-MA-06-0025-73
Interim Report. June 1973. 230p.

Rail Vehicle Dynamics

The development of experimental facilities for rail vehicle testing at the DOT High Speed Ground Test Center is being complemented by analytical studies conducted by Transportation Systems Center under the UM204 Rail Supporting Technology Program to the Urban Mass Transportation Administration's Office of Research, Development, and Demonstrations. The purpose of this effort has been to gain insight into the dynamics of rail vehicles to guide the equipment development and to establish an analytic framework for the design and interpretation of tests to be conducted at the facility. The mechanics of rail vehicle lateral guidance are reviewed on the basis of linearized models. Computer programs are developed for predicting stability and general lateral response characteristics. Computer programs for predicting vertical and pitch vehicle response to track irregularities are included. Implications of non-linear effects are discussed. The report describes the status of work currently in progress and subject to revision. Publication is intended primarily to stimulate the exchange of information.

DOT-TSC-UMTA-72-11
CORRELATION OF SIDE-FORCE AND YAWING-MOMENT DATA FOR TACV CONFIGURATIONS AT LARGE ANGLES OF SIDESLIP
Kaman Sciences Corporation.
J. Ray Ruetenik.
PB-230-000
FRA-ORD&D-74-29
DOT-TSC-171
Final Report. January 1974. 72p.

Tracked Air Cushion Vehicle

Methods developed by Woolard and Ruetenik and Zartarian for predicting the side force and yawing moment on TACV configurations due to side winds are compared against available data from wind-tunnel tests.

The predicted side force based on slender-body theory is found in good agreement with the data from moving-ground plane tests for sideslip angles less than 5 degrees. Above 5 degrees, fair agreement is found by incorporating viscous-cross flow effects in the theory, although characteristic differences are observed from previous correlations for missile-type bodies. The measured yawing moment is 15 to 35 percent less than the slender-body prediction, and it differs markedly from viscous-flow predictions.

Data from tests with an elevated inverted-tee guideway correlate similarly. But test data from an elevated channel guideway differ considerably from the other correlations, indicating the need for systematic tests on the effect of side rails on the air loads for various vehicle configurations.

Verification is needed of the present wind-tunnel testing techniques for the simulation of side-wind effects on high-speed ground vehicles on guideways. A study is made, therefore, of concepts for performing tests of full-scale air cushion vehicles for cross wind conditions.

DOT-TSC-UMTA-73-1
DEVELOPMENT AND TESTING OF A COMPLETELY PASSIVE AIR SUSPENDED, AIR PROPELLED PERSONAL RAPID TRANSIT VEHICLE
Uniflo Systems Company.
Charles H. Smoot et al.
PB-220-795/9
DOT-TSC-367
Final Report. April 1973. 102p.

Personal Rapid Transit; Tracked Air Cushion Vehicle

A prototype Uniflo vehicle base with mock-up superstructure was tested on 55 ft. of full-scale track.

Sound treatment to meet NCA 60 at 25 ft. from the guideway enclosure and within the vehicle was proposed and the costs determined.

A heating and cooling system using passive vehicle heat sink elements with station berth recharging was found desirable because of its lower cost and reliability.

An evaluation of the estimated production quantity costs for the vehicle base, guideway surface, levitation and thrust elements showed a reduction of 49% compared to previous design estimates.

Extensive tests confirmed the feasibility of the track based linear air turbine used for acceleration and service braking in the Uniflo PRT system.

Ride quality measurements indicated a need for improved secondary suspension.

Empty vehicle speeds over 20 ft./sec. and accelerations exceeding 5 ft./sec.^{2} were achieved with an air flow of 72.0 ft.^{3}/sec. Vehicle starting drag was less than 5 lbs. force.

DOT-TSC-UMTA-73-2
NOISE AND VIBRATION OF A STEEL WHEEL/STEEL RAIL PERSONALIZED RAPID TRANSIT SYSTEM
Pullman-Standard.
Harold E. Gramse, John H. Spence.
PB-227-806
UMTA-MA-06-0027-74-I
DOT-TSC-436
Interim Report. January 1974. 84p.

Personal Rapid Transit-Noise

This report describes a test program which has been conducted to establish baseline noise levels and ride characteristics for a state-of-the-art steel wheel on steel rail personalized rapid transit vehicle. A full-scale test vehicle and an 840-foot track, including two 30-foot curves, have been built and used for 128 test runs under various conditions of operation. Permanent records have been made on magnetic tape and oscillograph paper for future analysis as needed.

The vehicle has been successfully demonstrated and has met speed and acceleration design goals. Noise levels of 82 to 85 dB(A) have substantially exceeded proposed criteria for both tangent track and curve track. The ride vibration has met current criteria on tangent track to the 30-mph test speed and to a 5-mph speed limit on the tight 30-foot curve track. There is some tendency to vehicle-hunting.

DOT-TSC-UMTA-73-8
DEVELOPMENT AND TEST OF AN EDDY-CURRENT CLUTCH-PROPULSION SYSTEM
Mobility Systems Equipment Company.
G. J. Adams.
PB-225-093
UMTA-MA-06-0027-73-1
DOT-TSC-357
Final Report. October 1973. 202p.

Personal Rapid Transit-Propulsion; Eddy Current Clutch

This report covers the Phase 1 effort which is to develop and to test an AC-propulsion system for personal rapid-transit vehicles. This propulsion system incorporates an AC-induction motor in conjunction with an eddy-current clutch and brake.

Also included are development of the propulsion system, fabrication of the propulsion system, description of the laboratory test program, and analysis of the test results.

DOT-TSC-UMTA-74-1, I
MBTA GREEN LINE TESTS-RIVERSIDE LINE, DECEMBER 1972
Transportation Systems Center.
PB-224-207
DOT-TSC-UMTA-74-1, I
Final Report. September 1973. 148p.

Massachusetts Bay Transportation Authority; Noise-Rapid Transit; Track Geometry-Measurement; Rapid Transit-Ride Quality.

The UMTA sponsored Urban Rail Supporting Technology Program emphasizes three major task areas; facilities development, technology development, and test program development. The test program development is composed of three sub-areas; vehicle testing, ways and structures testing, and track geometry measurement. This report presents the technical methodology, data samples, and results of tests conducted on the Massachusetts Bay Transit Authority (MBTA) Green Line in December, 1972 prior to initiation of the Green Line refurbishment effort.

An instrumented revenue type car was used for the measurement of track geometry, ride roughness, and interior noise. Actual car speed was approximately the same as normal revenue speed. The objectives of the tests were to identify critical track sections for improvement to quantify the benefits produced by the track rehabilitation program, and to provide data for TSC's development of an advanced track geometry measurement system.

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-73-9, II
MBTA GREEN LINE TESTS-RIVERSIDE LINE, DECEMBER 1972, VOLUME II TRACK GEOMETRY DATA PLOTS
Transportation Systems Center.
George W. Neat, Editor.
PB-225-093-2
DOT-TSC-UMTA-74-1, II
Final Report. October 1973. 124p.

Noise-Rapid Transit; Massachusetts Bay Transportation Authority; Track Geometry-Measurement; Rapid Transit-Ride Quality

Volume II presents track geometry analog data plots for the complete length of track.

DOT-TSC-UMTA-73-9, III
MBTA GREEN LINE TESTS-RIVERSIDE LINE, DECEMBER 1972, VOLUME III EASTBOUND TRACK PROFILE
Transportation Systems Center.
George W. Neat, Editor.
PB-225-093-3
DOT-TSC-UMTA-74-1, III
Final Report. October 1973. 256p.

Noise-Rapid Transit; Massachusetts Bay Transportation Authority; Track Geometry-Measurement; Rapid Transit-Ride Quality

Volume III presents the track profile computer printout for the Eastbound Track.

DOT-TSC-UMTA-73-9, IV
MBTA GREEN LINE TESTS-RIVERSIDE LINE, DECEMBER 1972, VOLUME IV WESTBOUND TRACK PROFILE
Transportation Systems Center.
George W. Neat, Editor.
PB-225-093-4
DOT-TSC-UMTA-74-1, IV
Final Report. October 1973. 260p.

Noise-Rapid Transit; Massachusetts Bay Transportation Authority; Track Geometry-Measurement; Rapid Transit-Ride Quality

Volume IV presents the track profile computer printout for the Westbound Track.

DOT-TSC-UMTA-73-9, V
MBTA GREEN LINE TESTS-RIVERSIDE LINE, DECEMBER 1972, VOLUME V GAGE COMPUTER PRINTOUT
Transportation Systems Center.
George W. Neat, Editor.
PB-225-093-5
DOT-TSC-UMTA-74-1, V
Final Report. October 1973. 210p.

Noise-Rapid Transit; Massachusetts Bay Transportation Authority; Track Geometry-Measurement; Rapid Transit-Ride Quality

Volume V presents the gage computer printout for the complete length of track.

DOT-TSC-UMTA-73-13
COMMUNICATION SYSTEMS FOR DUAL MODE TRANSPORTATION
Transportation Systems Center.
R. E. Eaves, R. D. Kodis
PB-237-747
UMTA-MA-06-0029-73-1
Final Report. February 1974. 48p.

Dual Mode Systems-Communications

The communications requirements of dual mode transportation systems are discussed for both the on-guideway and off-guideway modes. Candidate communication systems are classified according to their principle of operation, and the characteristics of the systems are described. The suitability of these systems is assessed on the basis of dual mode requirements, FCC restrictions, and physical and electrical limitations.

DOT-TSC-UMTA-73-14
TRACK GEOMETRY DEVELOPMENT, UMTA URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM
Transportation Systems Center.
F. J. Rutyna.
PB-233-394
UMTA-MA-06-0025-74-6
Final Report. April 1974. 44p.

Track Geometry-Measurement

The DOT Transportation Systems Center (TSC) has been designated by the Urban Mass Transp. Admin. as Systems Manager for its Urban Rail Supporting Technology Program.

As part of this effort, TSC has been developing a track geometry system for use on rail transit properties.

Measurement of transit system track geometry parameters, under normal operating conditions, is essential for planning and conducting an effective maintenance program. The pertinent parameters are profile, gage, alignment, and cross level.

Present methods of determining track conditions are inefficient and highly subjective. To overcome these deficiencies, TSC has investigated and evaluated several track geometry measurement methods. These methods are all designed for use under revenue service conditions. The goal is to make available to the operating properties a system which is simple, reliable, mobile, inexpensive, and which yields a real-time output in a form directly useable for track diagnostics and maintenance planning.

The general results of the investigations and tests are presented here, together with a discussion of the system selected for prototype test and evaluation.

DOT-TSC-UMTA-73-15, I
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72", VOLUME I
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-192
UMTA-MA-06-0031-73, I
DOT-TSC-375
Final Report. January 1974. 58p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

An X-Y plot is made of the ambient radiated electromagnetic signals and noise between 1KHz and 50KHz at Dulles International Airport for the purpose of assessing the local environment at each of the four Personalized Rapid Transit (PRT) sites prior to operation of each system. A Polaroid scope camera was used in conjunction with a spectrum analyzer to photograph signals between 50KHz and 50MHz.

The purpose of the measurements program was to establish some base line information on the electromagnetic signal characteristics in the Dulles area in the event there was an interaction between the PRT Command and Control Systems and the Federal Aviation Administration Air Traffic Control equipment.

The measurements obtained during this series of tests will be used for a comparison with data obtained under the same conditions first with each system operating individually and then with all four systems operating simultaneously.

DOT-TSC-UMTA-73-15, II
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME II – DASHAVEYOR SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-193
UMTA-MA-06-0031-73, II
DOT-TSC-375
Final Report. January 1974. 60p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

DOT-TSC-UMTA-73-15, III
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME III – FORD SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-194
UMTA-MA-06-0031-73, III
DOT-TSC-375
Final Report. January 1974. 56p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

DOT-TSC-UMTA-73-15, IV
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME IV – MONOCAB SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-195
UMTA-MA-06-0031-73, IV
DOT-TSC-375
Final Report. January 1974. 56p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

DOT-TSC-UMTA-73-15, V
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME V – TTI SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-196
UMTA-MA-06-0031-73, V
DOT-TSC-375
Final Report. January 1974. 38p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

DOT-TSC-UMTA-73-15, VI
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME VI
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-197
UMTA-MA-06-0031-73, VI
DOT-TSC-375
Final Report. January 1974. 104p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

DOT-TSC-UMTA-73-15, VII
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME VII
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-198
UMTA-MA-06-0031-73, VII
DOT-TSC-375
Final Report. January 1974. 52p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

Volume VII covers the measurements of the broadband conelectrical environment existing on each of the PRT "hot" and neutral A.C. power lines prior to the installation and operation of any of the systems. These data will provide a baseline for use in establishing the relative increase in EMI levels associated with PRT system operation.

Data obtained under this effort will enable an evaluation of whether or not existing or potential EMI levels might affect the normal operation of the PRT systems. Such interference could conceivably contribute to breakdown, malfunctions, or safety problems associated with the automated equipment utilized by the PRT systems in performing normal functions.

DOT-TSC-UMTA-73-15, VIII
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEM AT "TRANSPO® 72"
VOLUME VIII – DASHAVEYOR SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-199
UMTA-MA-06-0031-73, VIII
DOT-TSC-375
Final Report. January 1974. 36p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

Volumes VIII through XI cover the measurements of the broadband conducted noise present on the A.C. power lines feeding the Personalized Rapid Transit (PRT) systems at Dulles Airport with each system operating individually.

DOT-TSC-UMTA-73-15, IX
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEM AT "TRANSPO® 72"
VOLUME IX – FORD SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-200
UMTA-MA-06-0031-73, IX
DOT-TSC-375
Final Report. January 1974. 30p.

Personal Rapid Transit-Communications;
Radio Frequency Interference

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-73-15, X
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME X – MONOCAB SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-201
UMTA-MA-06-0031-73, X
DOT-TSC-375
Final Report. January 1974. 30p.

Personal Rapid Transit-Communications; Radio Frequency Interference

DOT-TSC-UMTA-73-15, XI
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME XI – TTI SYSTEM
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-202
UMTA-MA-06-0031-73, XI
DOT-TSC-375
Final Report. January 1974. 28p.

Personal Rapid Transit-Communications; Radio Frequency Interference

DOT-TSC-UMTA-73-15, XII
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO® 72"
VOLUME XII
National Scientific Laboratories, Inc.
Earl E. Jamison.
PB-233-203
UMTA-MA-06-0031-73, XII
DOT-TSC-375
Final Report. January 1974. 130p.

Personal Rapid Transit-Communications; Radio Frequency Interference

Volume XII covers the measurement of the broadband conducted noise present on the A.C. power lines feeding the Personalized Rapid Transit (PRT) systems with all four systems operating individually.

DOT-TSC-UMTA-73-18
EVALUATION OF THE MONITOR-CTA AUTOMATIC VEHICLE MONITORING SYSTEM
Transportation Systems Center.
Harold G. Miller, William M. Basham.
PB-231-533
UMTA-MA-06-0024-74-I
Final Report. March 1974. 142p.

Automatic Vehicle Monitoring

In June 1972 the Urban Mass Transportation Administration requested that the Transportation Systems Center of DOT perform an evaluation of the CTA (Chicago Transit Authority) Monitor-Automatic Vehicle Monitor (AVM) system.

The results of the evaluation show that until present system technical deficiencies have been corrected, the system cannot be considered to be fully operational. From the cost analysis it is concluded that this system appears to be a good public investment.

DOT-TSC-UMTA-74-3
DEVELOPMENT OF AN ACOUSTIC RATING SCALE FOR ASSESSING ANNOYANCE CAUSED BY WHEEL/RAIL NOISE IN URBAN MASS TRANSIT
Bolt Beranek and Newman Inc.
T. J. Schultz.
PB-231-363
UMTA-MA-06-0025-74-2
DOT-TSC-644
Interim Report. February 1974. 62p.

Noise-Rapid Transit

This report has been prepared under the Urban Rail Noise Abatement Project sponsored by the Urban Mass Transportation Administration, Office of Research and Development. The Transportation Systems Center acts as Systems Manager on behalf of UMTA in directing this effort as part of the Rail Supporting Technology Program.

A number of recent studies of the impact of train noise on the community are reviewed. From this information and the results of other noise-annoyance studies, a scale for rating the annoyance of urban transit system operators and patrons, as well as the surrounding community, caused by wheel/rail noise is recommended. In general, the peak A-weighted sound-pressure level for the given exposure should be used, with an additional 5 dB if there are pure tones present (squeal). If in comparing the different kinds of train noise (squeal, impact, wheel roar, etc.) the total exposure is to be assessed, an additional term, 10 log T, should be added to the mean peak noise (where T is the total exposure in seconds during any 24-hour period).

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-74-4
AVAILABILITY ANALYSIS OF DUAL MODE SYSTEMS
Transportation Systems Center.
Charles R. Toye.
PB-232-953
UMTA-MA-06-0029-74-1
Final Report. April 1974. 23p.

Dual Mode Systems-Availability

The availability calculation of a complex ground automated transportation system such as that described in the Phase III scenario of the Urban Mass Transportation Administration (UMTA) dual mode transit program is most understandable when expressed in terms of the fraction of system time lost due to either passenger or vehicle delays. This involves both system reliability and maintainability, including the number of system failures per time interval, their effects, and corrective action times required to avoid vehicle delays.

The analytical procedures presented herein define a method of evaluating the effects of failures in a complex dual mode system based on a "worst" case steady state analysis. The computed result is an availability figure of merit and not an absolute prediction with associated confidence levels of system availability. The advantage of this procedure is that it avoids the use of a dynamic network traffic flow simulation which is both costly and time-consuming.

DOT-TSC-UMTA-74-5, I
ASSESSMENT OF DESIGN TOOLS AND CRITERIA FOR URBAN RAIL TRACK STRUCTURES, VOLUME I – AT-GRADE TIE-BALLAST TRACK
Battelle-Columbus Laboratories.
Robert H. Prause, Howard C. Meacham, et al.
PB-233-016
UMTA-MA-06-0025-74-3
DOT-TSC-563
Final Report. April 1974. 250p.

Track Design

This report presents the results of a critical review of the technical factors which govern the design and performance of at-grade tie-ballast track for urban rail systems. The assessment of current design practice is based on a review of the literature and discussions with experienced track design personnel. The evaluation includes design loads and the criteria for selecting rail size, tie size and spacing, ballast depth, and subgrade parameters. The major track problems identified were rail joints, rail wear and noise on curves, rail fasteners, and rail corrugation. Detailed technical evaluations were made to determine those areas where the track design procedures are inadequate. The report includes detailed information for the engineering design of track and recommendations for both short and long-range program plans for future research pertaining to the improvement of track performance. Volume II of this two volume report, entitled "At-Grade Slab Track", gives similar results for at-grade concrete slab track construction.

DOT-TSC-UMTA-74-5, II
ASSESSMENT OF DESIGN TOOLS AND CRITERIA FOR URBAN RAIL TRACK STRUCTURES
VOLUME II. AT-GRADE SLAB TRACK
Battelle-Columbus Laboratories.
Howard C. Meacham, Robert H. Prause, John Waddell.
PB-233-017
UMTA-MA-06-0025-74-4
DOT-TSC-563
Final Report. April 1974. 90p.

Track Design

This report presents the results of a critical review of the technical factors which govern the design and performance of at-grade slab track for urban rail systems. The assessment of current design practice is based on a review of the literature and discussions with experienced track design personnel. The evaluation includes descriptions of slab structures now in use in four countries, followed by review of design and analysis procedures used to characterize the subgrade and its support characteristics; the reinforced concrete slab itself, and the subgrade-support system. With a few exceptions, most of the work reported in the literature is based on highway or runway applications, where the mechanism of load transfer into the slab is completely different than in a rail support slab. Further research on the mechanisms of load transfer from rail fasteners into a reinforced concrete slab is needed, and the newly developed finite element approach appears well-suited. Continued study of settlement and failure criteria is needed for soil and base materials subjected to cyclic loading. The relative merits of various types of reinforced concrete slabs for example, pre-stress or post-stress considerations and joints are recommended for further study.

DOT-TSC-UMTA-74-6
PREDICTION AND CONTROL OF RAIL TRANSIT NOISE AND VIBRATION – A STATE-OF-THE-ART ASSESSMENT
Cambridge Collaborative, Inc.
J. E. Manning, R. G. Cann, J. J. Fredberg.
PB-233-363
UMTA-MA-06-0025-74-5
DOT-TSC-643
Interim Report. April 1974. 254p.

Noise-Rapid Transit

A systems manager for the Urban Mass Transportation Administration's Rail Supporting Technology Program, the Transportation Systems Center has undertaken research in rail transit noise abatement. As part of this effort, this report contains the results of a critical review of current technology for the prediction and control of urban rail transit noise and vibration, with primary emphasis on the parameters affecting propagation paths. Specifically included are tools for the prediction of wayside noise and vibration adjacent to both at-grade and elevated transit track, groundborne noise propagation from subway tunnels, and noise in cars and in stations. In addition, several noise and vibration control techniques are evaluated including resilient rail fasteners, floating slabs, noise barriers, elevated structure enclosures, structural damping, and acoustical treatment of stations and tunnels. Specific recommendations are made for areas requiring further research and development. Two of these areas, elevated structure noise and groundborne vibration from tunnels, have been selected for continued investigation under this contract.

DOT-TSC-UMTA-74-7
WHEEL/RAIL NOISE AND VIBRATION CONTROL
Bolt Beranek and Newman, Inc.
Paul J. Remington, et al.
PB-237-012
UMTA-MA-06-0025-73-15
DOT-TSC-644
Interim Report. May 1974. 176p.

Noise-Rapid Transit

Reported here are the interim results of a program under the UMTA Urban Rail Supporting Technology Program to develop a basic understanding of urban transit wheel/rail noise generation for application to the evaluation and improvement of wheel/rail noise control devices. The report critically reviews existing analytic models and related experimental findings for the wheel/rail dynamic system and for the three categories of wheel/rail noise generation: squeal, impact, and roar. The limitations found result in recommendations for the remaining work required. A compilation is presented of existing or promising wheel/rail noise control devices, their acoustic and nonacoustic effects. The relative severity of the three noise categories is compared by examining wayside noise data from numerous transit systems and railroads around the world, and by using a scale recommended here for rating urban transit wheel/rail noise, i.e., the peak A-weighted sound pressure level to which the receiver of interest is exposed. Squeal produces the most annoying noises followed closely by impact and roar. Lastly, methodology is presented for assessing the non-acoustic performance of wheel/rail noise control devices. The method is applied to an example in which it is assumed that resilient wheels are installed on all New York City Transit Authority cars.

DOT-TSC-UMTA-74-8
SAFETY AND CRASHWORTHINESS OF DUAL MODE VEHICLES
Transportation Systems Center.
Albert E. Brown, Herbert Weinstock, John N. Rossettos
UMTA-MA-06-0029-74-4
Final Report. May 1974. 35p.

Dual Mode Systems-Safety

Particular features of Dual Mode System (DMS) safety are reviewed together with the degree of safety that is expected of such systems. Some of the inherent advantages and disadvantages of DMSs in this regard, are also outlined. Possible categories of vehicle safety are defined to aid in developing measures of collision survivability in terms of human tolerance.

The available analytical tools for crashworthiness prediction are discussed, and the type of parameter studies that can be performed with computer programs of simplified simulation models are suggested. The importance of energy absorption devices and impact energy management concepts is emphasized so that optimum design conditions can be attained. Finally, a review is made of some biomechanics dynamic models useful for the assessment of injury potential.

DOT-TSC-UMTA-74-9
BRAKING SYSTEM INTEGRATION IN DUAL MODE SYSTEMS
Transportation Systems Center.
Jeffrey J. Bowe.
PB-237-747
UMTA-MA-06-0029-74-2
Final Report. May 1974. 29p.

Dual Mode Systems-Braking

An optimal braking system for Dual Mode is a complex product of vast number of multivariate, interdependent parameters that encompass on-guideway and off-guideway operation as well as normal and emergency braking.

Details of, and interrelations among on-guideway and off-guideway operations will be considered. The influences on the braking system of the digital or analog inputs from the command and control system will be analyzed. Included

also will be a study of the interplay of headway, velocity, acceleration and jerk values, within passenger comfort limits, and the role of such interactions on the sizing and design of the brake mechanism, whether of drum, disc, skid, or other mechanical type; or of traction motor, LIM, or other electrical type. The actuation system, air or hydraulic, and its time constants are also factors. The impact of anti-skid devices and their servo aspects, upon the braking system will be presented. The problems and payoffs of energy dissipation as direct heat, as heat from electrical resistive elements, or as electric power from a regenerative system will also be included as parameters of significance in a conceptual n-dimensional matrix.

DOT-TSC-UMTA-74-10
SURVEY OF PRT VEHICLE MANAGEMENT ALGORITHMS
Transportation Systems Center.
Arthur S. Priver.
PB-238-942
UMTA-MA-06-0031-74-13
Final Report. September 1974. 100p.

Personal Rapid Transit

This document summarizes the results of a literature survey of state of the art vehicle management algorithms applicable to Personal Rapid Transit Systems (PRT).

The surveyed vehicle management algorithms are organized into a set of five major component subcategories: network routing, merge control, empty vehicle management, station management, and blocked segment management. This classification scheme enables the comparison and description of algorithms in common terms.

One intent of the survey was to form a data base for system designers and users. Another intent was to use the results of the survey to aid in designing a simulation model to evaluate and develop PRT vehicle management algorithms.

DOT-TSC-UMTA-74-11
A BIBLIOGRAPHY ON THE DESIGN AND PERFORMANCE OF RAIL TRACK STRUCTURES
Battelle-Columbus Laboratories
Robert H. Prause, Helen C. Pestel, Ronald H. Melvin.
PB-238-127
UMTA-MA-06-0025-74-7
DOT-TSC-563
Final Report. September 1974. 148p.

Track Design

This bibliography was prepared as part of the Rail Supporting Technology Program being sponsored by the Rail Programs Branch of the Urban Mass Transportation Administration. It is based on the reference material that was used to evaluate the technical factors which govern the design and performance of at-grade track structures for urban rail systems. While most of the reference material that has been included is directly related to track used for railroad, rail rapid transit and light rail transportation, there are some additional references on related topics such as rail vehicle dynamics, soil mechanics, stress analysis, etc. However, this bibliography does not include a comprehensive review of these related topics.

This survey includes much of the published literature on track design, track loading, ballast, wood and concrete cross ties, rail and rail fasteners. It also includes considerable material on track problems such as rail wear and corrugation, rail defects, rail joints and track degradation.

The formal literature search for this bibliography covered the time period from about 1963 to 1973. The principal sources were the National Technical Information Service (NTIS) file of government reports, Engineering Index, and the Applied Science and Technology Index. Earlier references were identified from the Railroad Research Information Service (RRIS) computerized data base and bibliographies prepared by the RRIS and the Association of American Railroads.

DOT-TSC-UMTA-74-12
POWER AND PROPULSION CHARACTERISTICS OF THE DULLES TRANSPO® '72 PERSONAL RAPID TRANSIT VEHICLES
Transportation Systems Center.
Frank L. Raposa, Wendell E. Phillips, Jr.
PB-245-027/AS
UMTA-MA-06-0031-75-2
Final Report. July 1975. 116p.

Personal Rapid Transit-Propulsion; Thyristors

The Power and Propulsion Characteristics of the four different PRT vehicles demonstrated at Transpo® '72 are determined by using analytical descriptions, manufacturers' data, and the test data from the Post-Transpo® '72 Test Program. A comparative analysis of the four systems is presented. The performance features necessary to adequately describe each vehicle's power and propulsion characteristics are also discussed.

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-74-13
NOISE ASSESSMENT AND ABATEMENT IN RAPID TRANSIT SYSTEMS, REPORT ON THE MBTA PILOT STUDY
Transportation Systems Center.
L. G. Kurzweil, R. Lotz, E. G. Apgar.
PB-238-113
UMTA-MA-06-0025-74-8
Final Report. September 1974. 122p.

Massachusetts Bay Transportation Authority; Noise-Rapid Transit

As Systems Manager for the Urban Rail Supporting Technology Program sponsored by the Rail Programs Branch of the Urban Mass Transportation Administration, the Transportation Systems Center is conducting an effort in Urban Rail Noise Abatement. A portion of this effort, described herein, is concerned with the assessment of noise and of the potential for noise abatement on existing U. S. transit properties. A methodology is described for assessing the noise climate and for selecting the combination of abatement techniques which reduces the existing noise to user specified levels for minimum cost. This methodology, developed in a pilot study of the Massachusetts Bay Transportation Authority (MBTA) rapid transit lines, takes into account the large number of interrelated acoustic and economic considerations present in rail transit systems. The various noise receivers include riders and operating personnel in cars and stations, and individuals in the wayside community. Noise sources include several types of wheel-rail noise, propulsion, power pick-up, auxiliary equipment and braking noise. Noise propagation paths include airborne and structureborne components establishing both direct and reverberant sound fields in tunnels, stations, transit cars, and communities. In the pilot application to the MBTA, minimum-cost noise control options were determined for noise level goals in the range 75 to 90 dBA.

DOT-TSC-UMTA-74-14
TEST AND EVALUATION OF AN EDDY CURRENT CLUTCH/BRAKE PROPULSION SYSTEM
Mobility Systems & Equipment Company.
George J. Adams.
PB-242-686
UMTA-MA-06-0027-74-2
DOT-TSC-357
Final Report. February 1975. 98p.

Eddy Current Clutch

This report covers the Phase II effort of a program to develop and test a 15 hp eddy-current clutch propulsion system. Included in the Phase II effort are the test and evaluation of the eddy-current clutch propulsion system on board a test vehicle. The test vehicle was designed and built to be compatible with an existing monorail track and was instrumented for the conduct of the test program.

DOT-TSC-UMTA-74-15
URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM FISCAL YEAR 1973 YEAR END SUMMARY
Transportation Systems Center.
Ronald J. Madigan.
PB-238-602
UMTA-MA-06-0025-74-9
Final Report. October 1974. 64p.

Track Geometry Measurement; Noise-Rapid Transit; State-of-the-Art-Car; Tunnels-Construction; Rapid Transit Cars-Crashworthiness

The Urban Rail Supporting Technology Program, being conducted for the Department of Transportation Urban Mass Transportation Administration (UMTA) is described for the 1973 Fiscal Year period. Major areas covered include program management, technical support, and application engineering, facilities development, test and evaluation and technology development. Specific technical discussion covers track geometry measurement, UMTA facilities development at the High Speed Ground Test Center at Pueblo, Colorado, rail car test and evaluation, especially of the State-of-the-Art-Car (SOAC) and of Boston's MBTA Green Line, instrumentation for data acquisition and processing, noise abatement methodology, and tunneling and crashworthiness studies.

DOT-TSC-UMTA-74-16, I
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER VOLUME I: PROGRAM DESCRIPTION AND TEST SUMMARY
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-244-747, PB-244-746-SET
UMTA-MA-06-0025-75-1
DOT-TSC-580
Final Report. September 1975. 92p.

State-of-the-Art Car

This six-volume report presents the technical methodology, data samples, and results of tests conducted on the SOAC on the Rail Transit Test Track at the High Speed Ground Test Center in Pueblo, Colorado during the period April to

July 1973. The UMTA-sponsored Urban Rail Supporting Technology Program, for which TSC is Systems Manager, emphasizes three major development task areas: facilities, technology and test program. Test Program development comprises three sub-areas: vehicle testing, ways and structures testing and track geometry measurement. The objective of the SOAC program is to demonstrate the current state of the art in rail rapid transit vehicle technology, with passenger convenience and operating efficiency as primary goals. The objectives of the Engineering Test program are to provide a set of SOAC engineering data and to further develop the methodology for providing transit vehicle comparisons. These objectives were met with the presentation of the test results in this report and the incorporation of the refinement of the testing methodology into the General Vehicle Test Plan, GSP-064.

DOT-TSC-UMTA-74-16. II
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER
VOLUME II: PERFORMANCE TESTS
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-244-748, PB-244-746-SET
UMTA-MA-06-0025-75-2
DOT-TSC-580
Final Report. September 1975. 160p.

State-of-the-Art-Car

DOT-TSC-UMTA-74-16. III
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER
VOLUME III: RIDE QUALITY TESTS
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-244-749, PB-244-746-SET
UMTA-MA-06-0025-75-3
DOT-TSC-580
Final Report. September 1975. 250p.

State-of-the-Art-Car; Rapid Transit-Ride Quality

DOT-TSC-UMTA-74-16. IV
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER
VOLUME IV: NOISE TESTS
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-244-750, PB-244-746-SET
UMTA-MA-06-0025-75-4
DOT-TSC-580
Final Report. September 1975. 126p.

State-of-the-Art Car; Noise-Rapid Transit

DOT-TSC-UMTA-74-16. V
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER
VOLUME V: STRUCTURAL, VOLTAGE, AND RADIO FREQUENCY INTERFERENCE TESTS
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-244-751, PB-244-746-SET
UMTA-MA-06-0025-75-5
DOT-TSC-580
Final Report. September 1975. 88p.

State-of-the-Art-Car; Radio Frequency Interference

DOT-TSC-UMTA-74-16. VI
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER
VOLUME VI: SOAC INSTRUMENTATION SYSTEM
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-244-752, PB-244-746-SET
UMTA-MA-06-0025-75-6
DOT-TSC-580
Final Report. September 1975. 120p.

State-of-the-Art Car

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-74-16. VII
SOAC – STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER VOLUME VII: POST-REPAIR TESTS
Boeing Vertol Company.
George W. Neat, Raymond Oren, Editors.
PB-252-337, PB-244-746-SET
UMTA-MA-06-0025-75-7
DOT-TSC-580
Final Report. April 1976. 214p.

State-of-the-Art Car

This document presents the test results for the State-of-the-Art Car Post-Repair Engineering Test Program conducted at the DOT High-Speed Ground Test Center, Pueblo, Colorado, from March 18 to 29, 1971. The SOAC has been developed under UMTA's Urban Rapid Rail Vehicle and Systems Program to enhance the attractiveness of rapid rail transportation to the urban traveler.

The test data continuity between the original HSGTC Engineering Tests and the Post-Repair Test was established. Test data of variations from the original data have not been significant in terms of overall vehicle performance.

DOT-TSC-UMTA-75-1. I
WHEEL/RAIL NOISE AND VIBRATION VOLUME I: MECHANICS OF WHEEL/RAIL NOISE GENERATION
Bolt Beranek and Newman Inc.
Paul J. Remington, Michael J. Rudd, Istvan L. Ver.
PB-244-514
UMTA-MA-06-0025-75-10
DOT-TSC-644
Final Report. May 1975. 212p.

Reported here are the final results of a project under the UMTA Urban Rail Supporting Technology Program to develop a basic understanding of urban transit wheel/rail noise control measures. Analytical models of impedance, response, radiation efficiency, and directivity of wheels and rails are presented and compared with field and laboratory measurements. Analytical formulas for the prediction of noise in the three general categories of wheel/rail noise - squeal, impact, and roar - are presented and verified by comparison with laboratory measurements as well as field measurements using a small steel-wheeled personal rapid transit vehicle on a test track. In general, the agreement between the predictions and the measurements is adequate to verify the formulas, although uncertainties in the wheel/rail stick-slip curve and significant variations in roughness across the faces of wheels and rails (measured by a device developed during the program) lead to some uncertainties in the squeal and roar predictions, respectively. A number of new devices for the control of wheel/rail noise are suggested and a number of old techniques are evaluated in light of new information generated during this program. Lastly, testing techniques are suggested for reproducibly evaluating wheel/rail noise control measures. The report is divided into two volumes. The first deals with the theory of wheel/rail noise generation and the second deals with applying the theory to the control of wheel/rail noise.

DOT-TSC-UMTA-75-1. II
WHEEL/RAIL NOISE AND VIBRATION VOLUME II: APPLICATIONS TO CONTROL OF WHEEL/RAIL NOISE
Bolt Beranek and Newman Inc.
Paul J. Remington, Michael J. Rudd, Istvan L. Ver.
PB-244-515
UMTA-MA-06-0025-75-11
DOT-TSC-644
Final Report. May 1975. 170p.

Noise-Rapid Transit

DOT-TSC-UMTA-75-2
DATA ANALYSIS AND INSTRUMENTATION REQUIREMENTS FOR EVALUATING RAIL JOINTS AND RAIL FASTENERS IN URBAN TRACK
Battelle-Columbus Laboratories.
Robert H. Prause, Harold D. Harrison.
PB-253-041
UMTA-MA-06-0025-75-8
DOT-TSC-563
Final Report. February 1975. 160p.

Track Structures

This report was prepared as part of the Rail Supporting Technology Program sponsored by the Office of Research and Development, Rail Programs Branch, of the Urban Mass Transportation Administration. Rail fasteners for concrete ties and direct fixation and bolted rail joints have been identified as key components for improving track performance. However, the lack of statistical load data limits the development of improved design criteria and evaluation tests. This report evaluates the data required for design, laboratory tests, and for the development and verification of analytical models of fastener and joint performance. Available track instrumentation is reviewed for fulfilling these requirements, and functional specifications have been developed for improved tie plate load cells and instrumented wheels. Also included are recommendations for data analysis

and data processing procedures and test site selection criteria needed to plan and conduct comprehensive measurement programs.

DOT-TSC-UMTA-75-3
PERFORMANCE EVALUATION OF AN AIR-LEVITATED, AIR-PROPELLED, PASSIVE VEHICLE PERSONAL RAPID TRANSIT SYSTEM
Uniflo Systems Company.
Charles H. Smoot, Editor.
PB-244-454
UMTA-MA-06-0031-75-1
DOT-TSC-367-Mod 1
Final Report. June 1975. 124p.

Tracked Air Cushion Vehicle; Personal Rapid Transit

An eight-passenger Uniflo vehicle was tested to 30 ft./sec. on enclosed guideway through curved straight and switch sections.

The following parameters were measured:

- ride quality, as 3 axis acceleration
- Noise emission as perceived by passengers and in area near guideway
- vehicle acceleration and service braking
- switch response time
- levitation air flow and power requirements
- propulsion air flow and power requirements
- performance and reliability between -20°F and +90°F

Performance highlights included:

- ride quality approximates goals in UMTA's HPPRT Program
- noise near guideway substantially better than HHPRT goals
- noise in vehicle meets HPPRT goals above 1,000 Hz and improvement at lower frequencies is feasible
- safe and reliable switching with 150 millisecond switching time
- power requirements at 50 ft./sec. cruise currently at 0.21 kwh per seat mile, and can be reduced below 0.12 kwh per seat mile
- consistent performance and safety independent of weather
- established practicality of field adjustable guideway alignment.

DOT-TSC-UMTA-75-5
A COMPARISON OF METHODS FOR EVALUATING URBAN TRANSPORTATION ALTERNATIVES
Transportation Systems Center.
Leonard Bronitsky and Joseph Misner.
PB-245-057
UMTA-MA-06-0053-74-1
Final Report. February 1975. 62p.

Urban Transportation-Planning; Transportation-Systems Analysis

The objective of this report was to compare five alternative methods for evaluating urban transportation improvement options: unaided judgemental evaluation, cost-benefit analysis, cost-effectiveness analysis based on a single measure of effectiveness, cost-effectiveness analysis based on multiple measures of effectiveness, and scoring function methods. Each method was assessed within the framework of eight methodological criteria relating to the three major concerns of feasibility, reviewability, and relevancy. The following conclusions were drawn: (1) the judgemental method is satisfactory in several important respects, but its subjectivity and lack of specificity might create difficulties in a federal review of the local decision process; (2) of the systematic evaluation methods, cost-effectiveness analysis based on multiple measures of effectiveness poses the fewest difficulties in simultaneously serving the local and federal purposes.

DOT-TSC-UMTA-75-7
URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM FISCAL YEAR 1974 YEAR END SUMMARY
Transportation Systems Center.
Ronald J. Madigan.
PB-241-239
UMTA-MA-06-0025-75-9
Final Report. March 1975. 102p.

Track Geometry-Measurement; Noise-Rapid Transit; Rapid Transit Cars-Crashworthiness; Tunnels-Construction

The Urban Rail Supporting Technology Program, managed by the DOT Transportation Systems Center for the Urban Mass Transportation Administration, is described for the 1974 fiscal year period. Major areas include program management, technical support and application engineering, facilities development, test and evaluation, and technology development. Specific technical discussion includes track measurement systems; UMTA facilities development at the DOT High Speed Ground Test Center*, Pueblo, Colorado;

*The former High Speed Ground Test Center (HSGTC), Pueblo, CO, referred to herein, has, since 1974 been officially designated the Transportation Test Center (TTC).

rail car test and evaluation; instrumentation for data acquisition and processing; noise abatement technology; tunneling; and car crashworthiness studies.

DOT-TSC-UMTA-75-9. I
CONSTRUCTION MONITORING OF SOFT GROUND RAPID TRANSIT TUNNELS – VOLUME I: A DEFINITION OF NEEDS AND POTENTIAL DEVELOPMENTS
Parsons, Brinckerhoff, Quade & Douglas and
Soil and Rock Instrumentation, Inc.
Birger Schmidt, C. John Dunnicliff.
PB-241-536
UMTA-MA-06-0025-74-13. I
DOT-TSC-661
Final Report. November 1974. 194p.

Tunnels-Construction

The Urban Mass Transportation Administration (UMTA) Tunneling Program concentrates its efforts on reducing tunneling costs, minimizing environmental impact and enhancing safety as it applies to the planning, organization, design, construction and maintenance cycles of rapid transit tunnels in the urban environment. This study investigates construction monitoring of rapid transit tunnels in soft ground.

Soft ground tunnel construction monitoring has the potential to reduce construction costs, safety hazards and environmental impacts. Monitoring can diagnose face stability and ground movement problems, and allow appropriate preventive or remedial action. Monitoring provides data for prediction of ground movements and allows the compilation of useful legal documentation. Such data are also required for improving design and prediction methods.

Monitoring practices now in use do not usually allow full utilization of the data for the project from which they were gathered. Deficiencies in present practices are pointed out, and a systematic approach to monitoring is presented. Information presented will aid owners, designers, specification writers and instrumentation engineers. A computer program for data storage, interpretation and retrieval is proposed. An interim quality control specification for instrumentation procurement is presented, and instrumentation hardware improvements are suggested.

DOT-TSC-UMTA-75-9. II
CONSTRUCTION MONITORING OF SOFT GROUND RAPID TRANSIT TUNNELS – VOLUME II: APPENDIXES
Parsons, Brinckerhoff, Quade & Douglas and
Soil and Rock Instrumentation, Inc.
Birger Schmidt, C. John Dunnicliff.
PB-241-537
UMTA-MA-06-0025-74-13. II
DOT-TSC-661
Final Report. November 1974. 116p.

Tunnels-Construction

DOT-TSC-UMTA-75-10
ANALYSIS OF POSITION ERROR HEADWAY PROTECTION
Alden Self-Transit Systems Corporation.
Robert E. Whitten.
PB-244-552
UMTA-MA-06-0031-75-3
DOT-TSC-421
Interim Report. July 1975. 108p.

Personal Rapid Transit-Headways

An analysis is developed to determine safe headway on PRT systems that use point-follower control. Periodic measurements of the position error relative to a nominal trajectory provide warning against the hazards of overspeed and unexpected stop. A computer program has been developed to model these hazards for arbitrary safety system design parameters.

The results of computer runs indicate that the critical hazard on the main guideway is unexpected stop of a preceding car; on a station entry deceleration ramp, it is overspeed of a following car. The deceleration ramp headways are larger and are more sensitive to system parameters than are the main guideway headways.

Typical headways are five seconds on a 30 mph main guideway and 16 seconds on a deceleration ramp for state-of-the-art system parameters. With advanced system parameters and emergency decelerations applicable to well supported, seated passengers, required headways are 2.5 seconds on the main guideway and 3.5 seconds on the deceleration ramp.

DOT-TSC-UMTA-75-11
HEADWAY SEPARATION ASSURANCE SUBSYSTEM (HSAS)
Alden Self-Transit Systems Corporation.
Robert T. Evans and Kenneth Cowes.
PB-244-667
UMTA-MA-06-0031-75-4
DOT-TSC-421
Final Report. July 1975. 118p.

Personal Rapid Transit-Headways

The design, fabrication, test and evaluation of a Headway Separation Assurance Subsystem (HSAS) operated at 8-1/3 seconds headway on a 9-3/4 mph guideway is presented. Included hardware and software packages are applicable, with minimum modification, to any PRT system, allowing economical full scale installation.

System design studies and guideway tests show the HSAS capability of operation at 2-1/2 seconds headway on a 30 mph guideway.

DOT-TSC-UMTA-75-12. I & II
SYSTEMS ANALYSIS OF RAPID TRANSIT UNDERGROUND CONSTRUCTION
UMTA-MA-06-0025-74-11. I & II

See DOT-TSC-OST-75-8, I & II for complete documentation.

DOT-TSC-UMTA-75-13
NOISE PREDICTION MODELS FOR ELEVATED RAIL TRANSIT STRUCTURES
Cambridge Collaborative, Inc.
J. E. Manning, D. C. Hyland, J. J. Fredberg, N. Senapati.
PB-244-509
UMTA-MA-06-0025-75-12
DOT-TSC-643
Final Report. August 1975. 250p.

Noise-Rapid Transit

This report presents the theoretical development of a model for the prediction of noise radiated by elevated structures on rail transit lines. It is one of three reports prepared by Cambridge Collaborative under the UMTA Urban Rail Supporting Technology Program, dealing with noise and vibration control for urban rail transit track and elevated structures. The model described here allows for the prediction of both the vibration transmission between elements of the structure and the resulting noise radiation from each major structural element, in terms of design parameters for the different elements. Thus the potential effectiveness of various alternative methods for noise control can be evaluated. Results of a field study of three different types of elevated structure on the MBTA Rapid Transit System are also summarized. These results support the validity of the prediction model. The engineering application of the prediction model is discussed in another report.

DOT-TSC-UMTA-75-14
THE AVAILABILITY SIMULATION OF AGT SYSTEMS
Transportation Systems Center.
Charles R. Toye.
PB-247-061
UMTA-MA-06-0048-75-3
Final Report. February 1975. 32p.

Dual Mode Systems-Availability

This report discusses the analytical and simulation procedures that were used to evaluate the effects of failure in a complex dual mode transportation system based on "worst" case steady-state condition. The computed results are an availability figure of merit and not an absolute prediction with associated confidence confidence levels of system availability. The advantage of this procedure is that it avoids the use of a dynamic network traffic flow simulation which is both costly and time-consuming.

The availability calculation of a complex ground-automated transportation system such as that described in the urban deployment scenario of the Urban Mass Transportation Administration (UMTA) dual mode transit program is most understandable when expressed in terms of the friction of system time lost due to either passenger or vehicle delays. This involves both system reliability and maintainability, including the number of system failures per time interval, their effects, and corrective action times required to avoid vehicle delays.

In a dual mode transportation system, vehicles are capable of operating on conventional streets in a manual mode, and also, on specially constructed guideways in a completely automated mode.

The objective of this dual mode program is to combine the best automated transit such as the Personal Rapid Transit (PRT) system currently being demonstrated in Morgantown, West Virginia with the best aspects of modern bus technology. The dual mode concept combines two methods of operation; a driver-operated mode on surface streets of highways and an automated mode of fixed guideways.

The analytical and simulation approach taken encompasses fault tree and failure mode and effect analyses. The novel aspect of this approach is the use of the Monte Carlo tech-

nique to determine the physical location of failed vehicles in the system (on or off the guideway, in station berths, or at various merge/demerge sectors).

DOT-TSC-UMTA-75-15
A SURVEY OF PROPULSION SYSTEMS FOR HIGH CAPACITY PERSONAL RAPID TRANSIT
Alexander Kusko, Inc.
Thorleif Knutrud.
PB-250-581
UMTA-MA 06-0048-75-2
DOT-TSC-203/DOT-TSC-965
Final Report. July 1975. 110p.

Personal Rapid Transit-Propulsion

The high-capacity personal rapid transit (HCPRT) system must operate with very short headways. To achieve safe operation at these headways, the propulsion system should meet certain unconventional requirements. They include:

1) reversible thrust capabilities,
2) short response time,
3) peak thrust exceeding three times nominal thrust

These requirements were determined by analysis, computer simulations, and data provided by DOT/TSC. Five propulsion systems capable of meeting these requirements have been surveyed in this report. As background to the survey, several vehicle resistance curves were calculated for a "baseline" vehicle with assumed dimensions and weight. Four types of vehicle suspension methods were considered.

DOT-TSC-UMTA-75-16
GENERAL VEHICLE TEST PLAN (GVTP) FOR URBAN RAIL TRANSIT CARS
Boeing Vertol Company.
George W. Neat, Robert Lotz, Robert Kasameyer, Raymond Oren, Peter F. Brown.
PB-250-575/AS
UMTA-MA-06-0025-75-14
DOT-TSC-580
Final Report. September 1975. 344p.

Rapid Transit-Cars

The General Vehicle Test Plan provides a system for general vehicle testing and for documenting and utilizing data and information in the testing of urban rail transit cars. Test procedures are defined for nine categories: 1) Performance; 2) Power Consumption; 3) Power System Interaction; 4) Adhesion; 5) Ride Roughness; 6) Passenger Compartment Noise; 7) Community Noise; 8) Simulated Revenue Service; 9) Structure Dynamics. The procedures can be adapted to any vehicle in the general class of urban rail vehicles. They are derived from testing on UMTA's Rail Transit Test Track in Pueblo, Colorado. In addition, these procedures can be modified for use on other urban rail tracks as required.

Specifications are included for instrumentation required to implement the tests. Data processing and analysis requirements are defined by specifying standard output formats for the parameters of interest.

DOT-TSC-UMTA-75-17
VIBRATION PREDICTION MODEL FOR FLOATING-SLAB RAIL TRANSIT TRACK
Cambridge Collaborative, Inc.
J. E. Manning, D. C. Hyland, and G. Tocci
PB-245-638/AS
UMTA-MA-06-0025-75-13
DOT-TSC-643
Final Report. August 1975. 142p.

Noise-Rapid Transit

This report presents the theoretical development of a model to predict the vibration reduction by floating-slab tracks in subway tunnels. Data from a field study of a floating-slab track in New York City are also presented. The report is one of three reports prepared by Cambridge Collaborative under the UMTA Urban Rail Supporting Technology Program, dealing with noise and vibration control for urban rail transit track and elevated structures. The theoretical model described here allows for the prediction of the force transmissibility—the ratio of the amplitudes of the force on the tunnel floor and the force on the rail. Data from the field study support the use of a simple single-degree-of-freedom oscillator for predicting the vibration reduction due to the particular floating slab track that was studied. The theoretical model developed here allows predictions to be made for a more general case

DOT-TSC-UMTA-75-18
AUTOMATED GUIDEWAY GROUND TRANSPORTATION NETWORK SIMULATION
Transportation Systems Center.
Charles R. Toye.
PB-246-758
UMTA-MA-06-0048-75-1
Final Report. August 1975. 60p.

Dual Mode Systems

This report discusses some automated guideway management problems relating to ground transportation systems and provides an outline of the types of models and algorithms that could be used to develop simulation tools for evaluating system performance. The system management problems related to the routing and scheduling of both passengers and vehicles, as well as to control strategies such as synchronous and quasi-synchronous. The simulation outline provides background material for model descriptive, functional requirements, and simulation structure that can be used in future development activities.

DOT-TSC-UMTA-75-19
CRASHWORTHINESS ANALYSIS OF THE UMTA STATE-OF-THE-ART CARS
Boeing Vertol Company.
Edward Widmayer, A. E. Tanner, Robert Klump.
PB-247-230
UMTA-MA-06-0025-75-15
Final Report. October 1975. 204p.

State-of-the-Art Car;
Rapid Transit-Cars-Crashworthiness

An engineering assessment of the crashworthiness of the UMTA State-of-the-Art Car (SOAC) has been conducted for the Urban Mass Transit Administration under the technical direction of the Transportation Systems Center by the Boeing Vertol Company as part of a program to provide safer transportation to urban rail vehicles. Crash dynamics and crashworthiness methodology based on post-yield energy absorption characteristics and a "weighted acceleration" severity index has been applied. A review of the applicable static test data and crash damage has been conducted to provide a basis for the substantiation of the assumptions in the analysis. Sensitivity studies have been conducted to show the effect of car buff strength, passenger relative velocity, passenger spacing, and cushioning on casualties as defined by the severity index. Major gains in injury reduction through improved internal cushioning are indicated. The prevention of car penetration by override is treated. The SOAC collision dynamics model is validated by comparison to the SOAC-gondola accident of August 11, 1973, and by comparison to a nonlinear finite element mathematical simulation of the SOAC in crash conditions. SOAC crashworthiness is assessed. Studies have been conducted leading to improved crashworthiness of the SOAC. Conclusions are presented and recommendations are made for further crashworthiness research.

DOT-TSC-UMTA-75-20
PROCEEDINGS: TSC WORKSHOP ON ATTITUDINAL SURVEYS FOR TRANSPORTATION PLANNING AND EVALUAT'ON
Transportation Systems Center.
Mary D. Stearns.
PB-248-898
UMTA-MA-06-0049-75-1
Final Report. November 1975. 40p.

Urban Transportation-Planning

The major conclusions of the Workshop on Attitudinal Surveys for Transportation Planning and Evaluation held at the Transportation Systems Center on January 30, 1975 are presented.

The Workshop participants, including transportation planners, transit system operators, market researchers, and social scientists, assessed the practical utility of attitudinal survey techniques for transportation planning and evaluation.

These proceedings summarize participants' opinions on the possible roles for attitudinal surveys in transportation planning and evaluation. The proceedings also evaluate attitudinal survey applications and attitude measurement issues in terms of their current usage in transportation contexts.

A list of Workshop participants is included in the report appendix.

DOT-TSC-UMTA-75-21. I
AN ASSESSMENT OF THE CRASHWORTHINESS OF EXISTING URBAN RAIL VEHICLES. VOLUME I: ANALYSES AND ASSESSMENTS OF VEHICLES, CHAPTERS 1 THROUGH 7
Calspan Corporation.
R. J. Cassidy and D. J. Romeo.
PB-249-142; PB-249-141/SET
UMTA-MA-06-0025-75-16. I
DOT-TSC-681
Final Report. November 1975. 206p.

Rapid Transit-Cars-Crashworthiness

The crashworthiness of existing urban rail vehicles (passenger cars) and the feasibility of improvements in this area were investigated by Calspan Corporation under contract to the Transportation Systems Center of the U. S. Department of Transportation in its role as systems manager for the Urban Mass Transportation Administration's Urban Rail Supporting Technology Program. Both rail-car structural configurations and impact absorption devices were studied. From

this work, recommendations for engineering standards for urban rail vehicles will be developed.

This final report issued under the crashworthiness effort covers:

1. The development of analytical tools to predict passenger threat--environment during collision.
2. Criteria for predicting passenger injury due to train collisions.
3. An application of injury criteria and analytic models to predict passenger injuries resulting from collisions of trains that represent existing construction types.
4. A preliminary investigation of applying impact absorption devices to transit vehicles.
5. A design study of car structural configurations for improved impact energy management.
6. A review of engineering standards for Urban Rail Car Crashworthiness.

DOT-TSC-UMTA-75-21. II
AN ASSESSMENT OF THE CRASHWORTHINESS OF EXISTING URBAN RAIL VEHICLES. VOLUME II: ANALYSES AND ASSESSMENTS OF VEHICLES, CHAPTERS 8 THROUGH 12 AND APPENDIXES AND REFERENCES
Calspan Corporation.
R. J. Cassidy and D. J. Romeo.
PB-249-143, PB-249-141/SET
UMTA-MA-06-0025-75-16. II
DOT-TSC-681
Final Report. November 1975. 178p.

Rapid Transit-Cars-Crashworthiness

DOT-TSC-UMTA-75-21. III
AN ASSESSMENT OF THE CRASHWORTHINESS OF EXISTING URBAN RAIL VEHICLES. VOLUME III: TRAIN-COLLISION MODEL, USERS' MANUAL
Calspan Corporation.
D. J. Segal.
PB-247-230, PB-249-141/SET
UMTA-MA-06-0025-75-16. III
DOT-TSC-681
Final Report. November 1975. 66p.

Rapid Transit-Cars-Crashworthiness

DOT-TSC-UMTA-75-22
RAIL TRANSIT SYSTEM COST STUDY
Thomas K. Dyer, Inc.
T. K. Dyer, W. K. Hale, F. A. Ingalls, R. B. Whelan.
PB-254-627
UMTA-MA-06-0025-76-3
DOT-TSC-808
Final Report. January 1976. 120p.

Rapid Transit-Costs; Light Rail Transit Systems; Railroads-Commuter

The Transportation Systems Center serves as Systems Manager for the Rail Supporting Technology Program of the Urban Mass Transportation Administration. One task under this program has been to assess the costs of constructing, operating and maintaining three kinds of urban rail systems: light rail, rapid rail and commuter rail.

Cost data from several North American and European transit authorities were collected and analyzed. These data, together with the recent experience of the Consultant in several transit construction projects, served as the basis of the cost projections. Factors influencing appreciable cost variations in construction and operations were reviewed and included as criteria for cost projections.

DOT-TSC-UMTA-75-23
MORGANTOWN PERSONAL RAPID TRANSIT LONGITUDINAL CONTROL SYSTEM DESIGN SUMMARY
Boeing Aerospace Company,
Automated Transportation Systems Div.
Robert P. Lang.
PB-256-139
UMTA-MA-06-0048-75-4
DOT-TSC-994
Final Report. December 1975. 158p.

Personal Rapid Transit

Experience with the longitudinal control system used on each vehicle in the Morgantown Personal Rapid Transit System has shown that nonlinearities and variations in control system parameters can significantly affect performance if such characteristics are not adequately considered in the system design. A design summary is provided that documents this experience and emphasizes the important analysis and hardware design problems encountered. The performance capability of the final design is computed on the basis of analysis and test results. A description of the detailed nonlinear analytical model developed is included for possible use in future studies. Potential system improvements are

described that may be the objects of future research and development.

This report was generated in support of the Automated Guideway Transit Technology program of the Office of Research and Development of the Urban Mass Transportation Administration.

DOT-TSC-UMTA-75-24
A COMPUTER MODEL FOR SIZING RAPID TRANSIT TUNNEL DIAMETERS
UMTA-MA-06-0025-75-18

See DOT-TSC-OST-75-49 for complete documentation.

DOT-TSC-UMTA-75-25
HANDICAPPED AND ELDERLY VERTICAL MOVEMENT ASSESSMENT STUDY
Transportation Systems Center.
Ronald Kangas, Robert Mar..., David Glater, Charles Cofield, John Bottari.
PB-252-516
UMTA-MA-06-0047-75-1
Final Report. February 1976. 106p.

Handicapped and Elderly

This report discusses seven types of vertical movement devices for potential use in older fixed rail urban mass transit facilities. These devices could facilitate increased usage of transit facilities by physically handicapped and elderly persons.

The study concentrates on the technical and cost considerations in the implementation and utilization of various standard (e.g., elevators, escalators, moving walks) and non-standard (e.g., inclined stairlifts, stair climbing wheel chairs) vertical movement devices in three basic station designs found in the older transit systems of the United States.

Cost comparisons showed that in a hypothetical situation the unit cost per device per installation per station indicated that the installation of non-standard devices represented a lower total cost. However, station surveys indicated that some of the non-standard vertical movement devices could not be installed in stairwells or existing stations because of severe space limitations. In other instances, local or state safety ordinances and regulations would restrict the use of the non-standard devices in station stairwells.

The general conclusion is that each station has its own unique character and access/egress problems which restrict or enhance the implementation of specific types of vertical movement devices. Hence, the determination of the option which is technically most effective for a given station must await the results of a detailed architectural study of the station.

DOT-TSC-UMTA-75-28
URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM FISCAL YEAR 1975 YEAR END SUMMARY
Transportation Systems Center.
Ronald J. Madigan.
PB-250-447/AS
UMTA-MA-06-0025-75-17
Final Report. December 1975. 96p.

Noise-Rapid Transit; Rapid Transit-Cars; Track Geometry-Measurement; Tunnels-Construction

The Urban Rail Supporting Technology Program is described for the 1975 fiscal year period. The program is managed by the DOT Transportation Systems Center for the Urban Mass Transportation Administration, Office of Research and Development, Rail Technology Division. Important areas include program management, technical support and applications engineering, facilities development, test and evaluation, and technology development. New projects were started in all important areas.

Specific technical discussion includes: Technical Support and Applications Engineering, the Crashworthiness of Vehicles, Advanced Concept Train, and Rail Transit System Costs; Facilities Development, Permanent Track Power, Catenary, Wheel Truing Machine, and Track Scale; Test and Evaluation, State-of-the-Art Car testing and Revenue Service Demonstration, the testing of existing Revenue Service Vehicles, testing on the UMTA RTTT (Energy Storage Car Gas-Turbine/Electric cars, Standard Light Rail Vehicle, Track Geometry Measurement System, and General Vehicle Test System); Technology Development, Noise Abatement, and Tunneling.

DOT-TSC-UMTA-76-1
SERVICE AND METHODS DEMONSTRATION – ANNUAL REPORT
Transportation Systems Center.
P. Benjamin, R. Casey, C. Cofield, C. Heaton, D. Kendall, J. Misner and H. Simkowitz.
PB-251-325
UMTA-MA-06-0049-75-2
Annual Report. November 1975. 252p.

Transportation Systems-Innovations; Handicapped and Elderly; Demand Responsive Transportation; Bus Transit; Urban Transportation-Planning

This report contains a description of the Service and Methods Demonstration Program. Transit demonstration projects undertaken in previous years are reviewed. Recently completed and current demonstration projects are described and project results from similar demonstrations are compared. The comparisons are made by grouping projects according to the program objectives addressed: (1) decrease transit travel time, (2) increase transit reliability, (3) increase transit coverage, (4) increase transit vehicle productivity, and (5) improve the mobility of transit dependents. Demonstrations are categorized as either experimental, i.e., those intended to develop and test concepts to the point where they merit widespread use, or exemplary, i.e., those conducted to achieve more widespread diffusion of proven concepts and techniques.

Independent activities carried out in support of the demonstrations are described, such as the development of evaluation guidelines and improved methodologies for demonstration evaluation, analytical studies in support of the development of experimental demonstrations, and case studies of independent local innovations. Information dissemination mechanisms and activities intended to facilitate more widespread knowledge of effective approaches to improving transit are discussed.

The Appendix contains a detailed description of each demonstration project including the objectives, history, status, results, evaluation and conclusions.

DOT-TSC-UMTA-76-3. I
SUBSURFACE EXPLORATION METHODS FOR SOFT GROUND RAPID TRANSIT TUNNELS
VOLUME I: SECTIONS 1 - 6 AND REFERENCES
Parsons, Brinckerhoff, Quade and Douglas, and Soil and Rock Instrumentation, Inc.
Birger Schmidt, Bruno Matarazzi, C. John Dunnicliff, and Stephen Alsup
PB-258-343
UMTA-MA-06-0025-76-1
Final Report. April 1976. 202p.

Tunnels-Construction

The objectives of the Urban Mass Transportation Administration (UMTA) Tunneling Program are to lower subway construction costs and reduce construction hazards and damage to the environment. Some measure of each of these objectives for bored tunnels and deep excavations can be achieved through a more detailed knowledge of the subsurface and of how changes in soil types or characteristics will affect construction.

This study assesses subsurface exploration methods with respect to their ability to provide adequate data for the construction of rapid transit, soft-ground bored and cut-and-cover tunnels.

Geophysical and other exploration tools not now widely used in urban underground construction are investigated, their potential is discussed, and performance specifications and ideas for future development are presented. The effect of geotechnical variations or construction costs is modeled, and the effect of the prior knowledge of variations is estimated. Requirements for the best methods of site investigation, including preliminary designs, specifications, cost estimates, and development plans, are formulated.

DOT-TSC-UMTA-76-3. II
SUBSURFACE EXPLORATION METHODS FOR SOFT GROUND RAPID TRANSIT TUNNELS
VOLUME II: APPENDIXES A-F
Parsons, Brinckerhoff, Quade and Douglas, and Soil and Rock Instrumentation, Inc.
Birger Schmidt, Bruno Matarazzi, C. John Dunnicliff, and Stephen Alsup.
PB-258-344
UMTA-MA-06-0025-76-2
Final Report. April 1976. 146p.

Tunnels-Construction

DOT-TSC-UMTA-76-5. I
SMALL CITY TRANSIT CHARACTERISTICS: AN OVERVIEW
Transportation Systems Center.
Donald Kendall, Joseph Misner, Mary Stearns, Robert Waksman.
PB-251-501
UMTA-MA-06-0049-76-1
Final Report. March 1976. 44p.

Demand Responsive Systems

This report is based on information and operating data from thirteen small community transit systems which were studied as part of a larger project on small community transit and its potential. It summarizes organizationa, institutional, and operational aspects of the case studies and contains an analysis of some of the relationships among service, cost and community response. Hypotheses are offered regarding the types of trips which are served, the cost

and service trade-offs which are relevant when choosing between fixed-route and demand-responsive modes of operation, the critical variables such as labor agreements and maintenance arrangements which affect operating costs, the level of subsidy which may be anticipated, and the trade-offs between single-ride fares and transit passes as a means of fare collection. A number of conclusions are offered which bear on these topics, but the uniqueness of each community situation is stressed as an often dominant factor.

The thirteen communities used for this study are: Amherst, Massachusetts; Ann Arbor, Michigan; Bremerton, Washington; Chapel Hill, North Carolina; East Chicago, Indiana; El Cajon, California; Eugene/Springfield, Oregon; Evansville, Indiana; Merced, California; Merrill, Wisconsin; Sudbury, Massachusetts; Westport, Connecticut; Xenia, Ohio.

These studies are covered in reports UMTA-MA-06-0044-76-2 through -14, respectively.

DOT-TSC-UMTA-76-5. II
SMALL CITY TRANSIT—AMHERST, MASSACHUSETTS FREE-FARE, STUDENT OPERATED TRANSIT IN A UNIVERSITY COMMUNITY
Transportation Systems Center.
Robert Casey, Willa Michener.
PB-251-502
UMTA-MA-06-0049-76-2
Final Report. March 1976. 20p.

Fares-Free; Bus Transit

Amherst, Massachusetts, is an illustration of a free-fare transit service serving a university campus.

DOT-TSC-UMTA-76-5. III
SMALL CITY TRANSIT—ANN ARBOR, MICHIGAN PILOT DIAL-A-RIDE PROJECT IN A SECTOR OF THE CITY
Transportation Systems Center.
Willa Michener, Robert Waksman.
PB-251-503
UMTA-MA-06-0049-76-3
Final Report. March 1976. 12p.

Demand Responsive Systems; Fares-Prepaid

Ann Arbor, Michigan, is an illustration of a pilot dial-a-ride project implemented to test the feasibility of a coordinated dial-a-ride/fixed-route service.

DOT-TSC-UMTA-76-5. IV
SMALL CITY TRANSIT—BREMERTON, WASHINGTON PRIVATELY OPERATED SUBSCRIPTION BUS SERVICE TO AN INDUSTRIAL SITE
Transportation Systems Center.
Donald Kendall, Joseph Misner.
PB-251-504
UMTA-MA-06-0049-76-4
Final Report. March 1976. 8p.

Bus Transit

Bremerton, Washington, is an illustration of a privately operated, profit-making subscription bus service.

DOT-TSC-UMTA-76-5. V
SMALL CITY TRANSIT—CHAPEL HILL, NORTH CAROLINA, PUBLIC TRANSIT SERVING A UNIVERSITY AND TOWN
Transportation Systems Center.
Robert Casey.
PB-251-505
UMTA-MA-06-0049-76-5
Final Report. March 1976. 20p.

Bus Transit; Fares-Prepaid

Chapel,Hill, North Carolina, is an illustration of a public transit service providing a high level of service for a town its size and a good example of a cooperative arrangement between a town and a resident university.

DOT-TSC-UMTA-76-5. VI
SMALL CITY TRANSIT—EAST CHICAGO, INDIANA FREE-FARE TRANSIT IN A HIGH DENSITY, INDUSTRIALIZED AREA.
Transportation Systems Center.
Joseph Misner.
PB-251-506
UMTA-MA-06-0049-76-6
Final Report. March 1976. 12p.

Bus Transit; Fares-Free

East Chicago, Indiana, is an illustration of a free-fare service operating in a high density area. The transit service was devised with a minimum of help from professional consultants, and without sophisticated routing, scheduling, or marketing plans.

DOT-TSC-UMTA-76-5. VII
SMALL CITY TRANSIT—EL CAJON, CALIFORNIA CITY-WIDE SHARED RIDE TAXI SERVICE
Transportation Systems Center.
Robert Casey, Grant Paul.
PB-251-507
UMTA-MA-06-0049-76-7
Final Report. March 1976. 20p.

Demand Responsive Systems; Taxis

El Cajon, California, is an illustration of a shared ride taxi service.

DOT-TSC-UMTA-76-5. VIII
SMALL CITY TRANSIT—EUGENE/SPRINGFIELD, OREGON. EXTENSIVE COUNTY WIDE TRANSIT COVERAGE
Transportation Systems Center.
Donald Kendall, David Reed.
PB-251-508
UMTA-MA-06-0049-76-8
Final Report. March 1976. 16p.

Bus Transit

Eugene/Springfield, Oregon is an illustration of a fixed-route transit service with extensive county-wide coverage.

DOT-TSC-UMTA-76-5. IX
SMALL CITY TRANSIT—EVANSVILLE, INDIANA
Transportation Systems Center.
Joseph Misner.
PB-251-509
UMTA-MA-06-0049-76-9
Final Report. March 1976. 12p.

Bus Transit

Evansville, Indiana, is an illustration of a transit service in which a large percentage of operating costs are obtained from fare-box revenues.

DOT-TSC-UMTA-76-5. X
SMALL CITY TRANSIT—MERCED, CALIFORNIA DIAL-A-RIDE TRANSIT IN AN AGRICULTURAL COMMUNITY
Transportation Systems Center.
Leonard Bronitsky, Donald Kendall.
PB-251-510
UMTA-MA-06-0049-76-10
Final Report. March 1976. 20p.

Demand Responsive Systems

Merced, California, is an illustration of dial-a-ride transit service with a relatively low operating cost.

DOT-TSC-UMTA-76-5. XI
SMALL CITY TRANSIT—MERRILL, WISCONSIN POINT DEVIATION SERVICE IN A RURAL COMMUNITY
Transportation Systems Center.
Joseph Mergel.
PB-251-511
UMTA-MA-06-0049-76-11
Final Report. March 1976. 16p.

Bus Transit.

Merrill, Wisconsin, is an illustration of an innovative point-deviation transit service.

DOT-TSC-UMTA-76-5. XII
SMALL CITY TRANSIT—SUDBURY, MASSACHUSETTS A SHORT-LINED SUBURBAN TRANSIT SERVICE
Transportation Systems Center.
Joseph Mergel.
PB-251-512
UMTA-MA-06-0049-76-12
Final Report. March 1976. 12p.

Bus Transit; Fares-Prepaid

Sudbury, Massachusetts, is an illustration of an over-extended fixed-route transit service which was rather short-lived.

URBAN MASS TRANSPORTATION ADMINISTRATION

DOT-TSC-UMTA-76-5. XIII
SMALL CITY TRANSIT—WESTPORT, CONNECTICUT COMPREHENSIVE TRANSIT SERVICE IN AN AFFLUENT SUBURBAN COMMUNITY
Transportation Systems Center.
Joseph Misner.
PB-251-513
UMTA-MA-06-0049-76-13
Final Report. March 1976. 20p.

Bus Transit; Fares-Prepaid

Westport, Connecticut is an illustration of a fixed-route transit service operating in an affluent suburban community.

DOT-TSC-UMTA-76-5. XIV
SMALL CITY TRANSIT—XENIA, OHIO A TRANSIT SERVICE FOR A REBUILDING CITY
Transportation Systems Center.
Robert Casey, Charles Cofield.
PB-251-514
UMTA-MA-06-0049-76-14
Final Report. March 1976. 16p.

Bus Transit

Xenia, Ohio, is an illustration of a transit service which evolved from a free-fare emergency service to a demonstration of para-transit services.

DOT-TSC-UMTA-76-5. XV
SMALL CITY TRANSIT—SUMMARY OF STATE AID PROGRAMS
Transportation Systems Center.
Robert Casey, Editor.
PB-251-515
UMTA-MA-06-0049-76-15
Final Report. March 1976. 112p.

Transportation-Financial Aid

This document presents a review of the financial and technical assistance that each state provides to communities of less than 200,000 population. In one section, state capital and operating assistance is examined. A separate section discusses the availability of technical and planning assistance. For all types of state assistance, administration procedures, funding strategies and sources, and interaction with UMTA requirements are presented. Data sheets and summary tables showing aid programs by state are presented in the Appendix.

DOT-TSC-UMTA-76-6, I
PRT IMPACT STUDY PRE-PRT PHASE VOLUME I – TRAVEL ANALYSIS
West Virginia University.
S. E. G. Elias, C. N. Redwine, G. K. Deshpande.
PB-254-481
UMTA-MA-06-0026-76/1, I
DOT-TSC-985
Final Report. March 1976. 90p.

Personal Rapid Transit; Modal Split; Travel-Surveys

This report describes the analysis performed on travel data collected for the Pre-PRT Impact Study. The data analyzed consist of travel behavior, travel patterns, model utilization and travel costs of various modes of travel in Morgantown before the revenue operation of the PRT in Morgantown.

The analysis resulted in estimates of travel by various subpopulations by automobile, university bus and city/county bus systems in Morgantown. Further analysis conducted yielded estimates of traffic flow between various activity centers in Morgantown. Trip generation, trip distribution and modal split were estimated for Morgantown PRT corridor travel before the revenue operation of the PRT. This analysis will serve as a baseline for comparison with Post-PRT travel analysis and will help in estimating the overall impact of PRT in Morgantown.

DOT-TSC-UMTA-76-6, II
PRT IMPACT STUDY PRE-PRT PHASE VOLUME II – DATA COLLECTION PROCEDURE AND CODING MANUAL
West Virginia University
S.E.G. Elias, C. N. Redwine, R. Trent, J. M. Rovelstad, A. K. Mallik, J. Pearce, G. K. Deshpande.
PB-254-482
UMTA-MA-06-0026-76/1, II
DOT-TSC-985
Final Report. March 1976. 162p.

Personal Rapid Transit; Modal Split; Travel-Surveys

This report describes the procedures utilized for collection of data on transportation demand and supply prior to the revenue operation of the Personal Rapid Transit (PRT) System in Morgantown, West Virginia. It is anticipated that similar data will be collected after the commencement of revenue operation, and that analysis of the two sets of data will be performed which will yield measures of the impact on the community of installing the PRT.

The bulk of the data described in this report was collected during the time period March through May, 1975. Most of the report is devoted to describing various surveys which were conducted to obtain information about travel patterns, attitudes, and demographic characteristics of residents of the Morgantown area. Several survey techniques were utilized, including telephone interview, bus on-board questionnaire, mailback questionnaire, home interview, and auto intercept survey. The report also discusses the collection of data reflecting the volume of transportation usage, such as traffic counts, bus ridership counts, and speeds of autos and buses. Also described are the costs of operating an automobile in Morgantown and costs and revenues of the bus systems operating in the Morgantown area. The report includes documentation of the format and codes used for placing the survey data on magnetic tape.

DOT-TSC-UMTA-76-6, III
PRT IMPACT STUDY PRE-PRT PHASE VOLUME III – FREQUENCY TABULATIONS FROM FOUR TRANSPORTATION-RELATED SURVEYS
West Virginia University.
C. N. Redwine.
PB-254-483
UMTA-MA-06-0026-76/1, III
DOT-TSC-985
Final Report. March 1976. 152p.

Personal Rapid Transit; Modal Split; Travel-Surveys

This report gives, without commentary, tabulations of survey responses which were collected in Morgantown, West Virginia, as part of a study to assess the impact of the installation of the Personal Rapid Transit (PRT) System. The surveys reported on here were taken prior to the passenger operation of the PRT. The tabulations arise from four separate surveys:

1) A Telephone-Interview Survey administered to persons riding within approximately a ten-minute walk of a PRT Station.
2) An On-Board Survey of riders of the West Virginia University Bus System.
3) An On-Board Survey of riders of the city and county bus systems on routes which might be impacted by the installation of the PRT.
4) A Mailback Survey of faculty and staff of West Virginia University.

This is the third of a series of three published volumes. Volume I: Travel Analysis; Volume II: Data Collection Procedure and Coding Manual; Volume III: Frequency Tabulation from Four Transportation-Related Surveys.

DOT-TSC-UMTA-76-8
EVALUATION GUIDELINES FOR SERVICE AND METHODS DEMONSTRATION PROJECTS
Transportation Systems Center.
Carla Heaton, Chester McCall, Robert Waksman.
PB-251-891
UMTA-MA-06-0049-76-16
Final Report. February 1976. 190p.

Urban Transportation-Planning

This document consists of evaluation guidelines for planning, implementing, and reporting the findings of the evaluation of Service and Methods Demonstration (SMD) projects sponsored by the Urban Mass Transportation Administration (UMTA). The objective of these guidelines is to foster consistency of evaluation philosophy and techniques, and comparability of results so as to improve the output of the UMTA demonstration program. In addition to describing procedures for developing and executing the evaluation of SMD projects, this document contains background information on the SMD Program, a general discussion of the demonstration evaluation process, and appendixes on survey techniques and statistical methodology.

Although these guidelines were prepared specifically for use in evaluating SMD projects, their potential applicability covers the evaluation of any type of transit innovation.

DOT-TSC-UMTA-76-11
IN-SERVICE PERFORMANCE AND COSTS OF METHODS FOR CONTROL OF URBAN RAIL SYSTEM NOISE. EXPERIMENTAL DESIGN
De Leuw, Cather & Co., and Wilson Ihrig & Assoc.
Michael C. Holowaty, Hugh J. Saurenman, Stanley M. Rosen.
PB-257-200
UMTA-MA-06-0025-76-4
DOT-TSC-1053
Interim Report. May 1976. 100p.

Noise-Rapid Transit

This report presents an experimental design for a project to evaluate four techniques for reducing wheel-rail noise on urban rail transit systems: (a) resilient wheels, (b) damped wheels, (c) wheel truing, and (d) rail grinding.

The design presents the project questions to be answered: (1) What reduction in noise can be achieved by the techniques, individually and in combinations? (2) What are the costs of the techniques?

The design gives data requirements for acoustic testing on the Southeastern Pennsylvania Transportation Authority

Market-Frankford Line, as well as requirements for collection of non-acoustic data covering all United States rapid transit systems. It prescribes methods for analysis of the data, means for drawing inferences to answer the questions posed, and formats for presentation.

The design requires that the findings of the completed study be presented in a manner such that the information can be used by transit system personnel who may not have a background in acoustics of cost analysis.

DOT-TSC-UMTA-76-12
ASSESSMENT OF DISRUPTIVE EFFECTS ASSOCIATED WITH URBAN TRANSPORTATION TUNNEL CONSTRUCTION
Abt Associates, Inc.
Peter C. Wolff and Peter H. Scholnick.
PB-256-848
UMTA-MA-06-0025-76-5
DOT-TSC-1018
Final Report. June 1976. 198p.

Tunnels-Construction

Social, economic, and environmental impacts resulting from tunnels' being constructed for mass transportation purposes in urban areas are identified. A matrix is constructed identifying the locus of costs to affected groups by four kinds of casual agents: traffic interference, property takings, environmental disturbances, and utility disruptions. A separate matrix must be constructed for social, economic, and environmental costs. The cells of the matrix must be further expanded in order to pinpoint actual costs: variables must be identified for each affected group and each casual agent and measures for the variables determined. One row of the economic matrix and one row of the social matrix are expanded by way of example: economic costs to retail businesses and social costs to residents. The measurement and aggregation of impacts are then discussed. Four possible ways of lessening impacts are mentioned: good planning and institutional procedures, proper community relations, the use of advanced construction techniques, and the utilization of monetary compensation.

Two small case studies are included: the construction of the Waterfront station by WMATA in Washington, D. C. and the extension of the Picadilly Line in London to Heathrow Airport. Directions of possible future research are indicated.

DOT-TSC-UMTA-76-15
ASSESSMENT OF OPERATIONAL AUTOMATED GUIDEWAY SYSTEMS – AIRTRANS (PHASE I)
Transportation Systems Center.
Ronald Kangas, Michael Lenard, John Marino, J. Harry Hill.
PB-261-339
UMTA-MA-06-0067-76-1
Final Report. September 1976. 294p.

Automated Guideway Transportation; Airport Transportation Systems

This report presents the results of an evaluation study of AIRTRANS, a unique, automated guideway system located at the Dallas/Fort Worth Airport. AIRTRANS was designed to move passengers, employees, baggage, mail, trash and supplies. The newest and largest system of its type in the world, it comprises 13 miles of single lane guideway and 68 vehicles, and serves 53 stations at different points in the airport complex. The system is one of the first intra-airport transit systems conceived, designed and constructed as an integral part of the airport development.

The study, conducted with the cooperation of the Dallas/Fort Worth Regional airport and the Vought Corporation, was intended to codify the information and experience gained in the planning, development, implementation and initial operation of the system into an integrated body of knowledge from which those concerned with any phase of future, similar system planning and implementation could profit.

The assessment team found AIRTRANS an impressive accomplishment. As a pioneering project, AIRTRANS did not have an extensive data base to build on, and consequently some problems arose attributable to insufficient system planning, analysis, organization and specification, as well as optimism about schedules and component reliability. Considering this, AIRTRANS is impressive and commendable but it could be more efficient and effective and is being constantly improved towards these goals. The report provides information useful to planners, designers, developers and operators of automated transit systems for intra-airport and other applications.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

DOT-TSC-NASA-70-1
EARTH SURVEY BIBLIOGRAPHY: A KWIC INDEX OF REMOTE SENSING INFORMATION
Transportation Systems Center.
William I. Thompson, III.
N71-26398
February 1971. 265p.

Remote Sensing

This bibliography represents a collection of 1650 bibliographic citations on remote sensing of the physical characteristics of the Earth. This bibliography is intended to be used as a source document leading to additional information.

DOT-TSC-NA-71-5
LABORATORY EVALUATION OF FECKER AND LORAL OPTICAL IR PWI SYSTEMS
Transportation Systems Center.
Mark Gorstein, James N. Hallock, Maurice Houten, and Ian G. McWilliams.
N-72-13351
February 1971. 81p.

Aircraft-Collision Avoidance Systems; Pilot Warning Instruments

Flight hardware and a flight test evaluation of two Electro-Optical Pilot Warning Indicators, using a flashing xenon strobe and silicon detectors as cooperative elements, were prepared by the previous NASA group prior to the closure of ERC in June 1970. Several design deficiencies are pointed out. The present laboratory evaluation program, which provides the ideal environment for performing the most detailed studies of the PWI system, has corrected these faults which prevented the equipment from operating, and has calibrated the sensitivity of both systems in azimuth elevation and range.

DOT-TSC-NASA-71-6
ATMOSPHERIC TRANSMISSION HANDBOOK: A SURVEY OF ELECTROMAGNETIC WAVE TRANSMISSION IN THE EARTH'S ATMOSPHERE OVER THE FREQUENCY (WAVELENGTH) RANGE 3 kHz (100km) – 3,000 THz (0.1 μm)
Transportation Systems Center.
William I. Thompson, III.
N71-20121
February 1971. 300p.

Electromagnetic Wave Transmission

This handbook presents material on electromagnetic wave transmission in the earth's atmosphere with emphasis on earth-to-space paths up to January 1970. This type of information is needed in such varied fields as air pollution, astronomy, communications, earth resources, geodesy, meteorology, and navigation.

Part I presents basic background information dealing with transmission fundamentals, the properties of electromagnetic waves, the electromagnetic spectrum and the earth's atmosphere.

Part II is a guide to information on the transmission properties of the earth's atmosphere to electromagnetic radiation. A major feature of Part II is the listing of tables of contents of several books and major articles on atmospheric transmission.

Part III contains selected transmission information on the following observable quantities: refraction, absorption, and scattering.

Part IV is a bibliography to be published in a separate volume entitled Atmospheric Transmission Bibliography 1960-1969: A KWIC Index of Electromagnetic Wave Transmission in the Earth's Atmosphere Over the Frequency (Wavelength) Range 3 kHz (100 km) – 3,000 THz (0.1 μm). The bibliography covers the frequency regions: radio, microwave, infrared, visible, and ultraviolet. There is a listing of citations by local accession number, a key-word-in-context (KWIC) index or permuted title index, and an author index.

DOT-TSC-NASA-71-7
MILLIMETER-WAVE GENERATION WITH SPIRALING ELECTRON BEAMS
Transportation Systems Center.
Bernhard Kulke.
N72-13605
February 1971. 98p.

Electromagnetic Wave Generation

An investigation has been carried out of the feasibility of using the interaction between a thin, solid, spiraling electron beam of 10-20kV energy and a microwave cavity to generate watts of CW millimeter-wave power. Experimental results are given for several prototype devices operating at 9.4 GHz and at 94 GHz. Power outputs of 5W, and electronic efficiencies near 3%, were obtained at X-band, and moderate gain was obtained at 94 GHz. The small-signal theory gives a good fit to the X-band data, and the device behavior at 94 GHz is as expected from the given beam characteristics. The performance is limited chiefly by the velocity spread in the spiraling electron beam, and once this can be brought under

control, high-power generation of millimeter waves appears quite feasible with this type of device.

DOT-TSC-NASA-71-8
MULTI-SENSOR NAVIGATION SYSTEM DESIGN
Transportation Systems Center.
David Royal Downing.
March 1971. 138p.

Navigation Systems

This report treats the design of navigation systems that collect data from two or more on-board measurement subsystems and process this data in an on-board computer. Such systems are called Multi-Sensor Navigation Systems.

The design begins with the definition of the design requirements and a list of n sensors and c computers. A Design Procedure is then developed which automatically performs a systematic evaluation of the $(2^n-1) \times c$ candidate systems that may be formed. This procedure makes use of a model of the navigation system that includes sensor measurement errors and geometry, sensor sampling limits, data processing constraints, relative computer loading, and environmental disturbances. The performance of the system is determined by its terminal navigation uncertainty and dollar cost. The Design Procedure consists of three design options, three levels of evaluation, and a set of auxiliary data. By choosing from among the design options and the auxiliary data, the designer can tailor the Design Procedure to his particular application.

A design option is developed to answer each of the three following questions: (1) Which candidate system meets the system accuracy specification and has the lowest system cost? (2) For each sensor or computer chain, which is defined as the set of all systems containing that component, what is the system that satisfies the accuracy requirements and has the lowest cost? (3) Which systems satisfy the design accuracy requirements?

The system evaluation is accomplished using one optimal and two non-optimal techniques. The optimal performance evaluation uses the measurement schedule that minimizes the terminal uncertainty. A first-order optimization procedure is developed to determine this schedule. This uses optimal sampling logic derived by applying the maximum principle. One non-optimal analysis uses the idea that the addition of a sensor or the increase of the computer processing capability can not degrade the system's performance. The second non-optimal technique obtains approximate values of the system's accuracy by assuming measurement schedules that do not satisfy the processing constraint.

The procedure is applicable to a large class of air or space missions for which a nominal trajectory can be defined. To illustrate how the procedure would be used, the design of an aircraft navigation system for operation in the NE corridor is presented. This problem considers the configuration of a system starting with four candidate sensors and three candidate computers. The outputs from all three design options are presented and discussed.

DOT-TSC-NASA-71-9
METALLIZATION FAILURES
Transportation Systems Center.
Rosemary Beatty
N72-13390
May 1971. 116p.

Metallization Failure; Integrated Circuit Failure

Metallization-related failure mechanisms are a major cause of integrated circuit failures under accelerated stress and field operation conditions. Industry's approach has been, (1) a better understanding of the aluminum system, now the most widely used material, and (2) evaluation of alternative metal systems.

The newer and more complex multilevel metallization systems require low temperature deposition techniques and critical etching-through methods due to smaller geometry and closer spacing.

Aluminum metallization offers many advantages, but also has limitations. Alternative materials are being considered for large scale integrated arrays. This survey defines the merits and restrictions of metallization systems in current usage and those under development. Although no specific recommendations are made references can be drawn from the data presented. The advanced state of beam lead technology is apparent.

DOT-TSC-NASA-71-10
EVALUATION OF NONDESTRUCTIVE TENSILE TESTING
Transportation Systems Center.
J. J. Bowe & S. M. Polcari.
N72-31231
May 1971.

Nondestructive Tests; Semiconductor Devices-Tests

This report presents the results of a series of experiments performed in the evaluation of nondestructive tensile testing of chip and wire bonds. Semiconductor devices

were subjected to time-temperature excursions, static-load life testing and multiple pre-stressing loads to determine the feasibility of a nondestructive tensile testing approach. The report emphasizes the importance of the breaking angle in determining the ultimate tensile strength of a wire bond, a factor not generally recognized nor implemented in such determinations.

DOT-TSC-NASA-71-12
OPTICAL COMMUNICATIONS AND DETECTION SYSTEM
Transportation Systems Center.
R. E. Buck, R. Gagnon, L. M. Jordan, S. Karp, E. T. Leonard and S. J. Morin.
Final Report. August 1971. 101p.

Atmospheric Measurement; Optical Communications

The two milestones of the program (1) development of a high quantum efficiency 1.06 micron photomissive surface and (2) narrow pulse propatation in the earth's atmosphere at 0.63 microns were completed.

Item 1 was completed in a contract award.

Item 2 was completed to the extent permitted by the weather conditions in that only two foggy days were encountered during the three month period.

The clear air measurements indicated that: pulse broadening in the atmosphere is less than 20 picoseconds or a coherence bandwidth in excess of 50 GHz; aperture averaging appears to progress with the square of the collector diameter for large diameters; statistics of aperture averaged signals remain log normal.

The measurements from one foggy day indicate: no pulse broadening was observed in fogs with ¼ mile visibility although a 20 dB loss was encountered; no return from multiple scattering could be observed to a 4 degree field of view with a 20 dB dynamic range in the detector; no Doppler broadening greater than 1 KHz was observed with optical thickness as high as 4.

DOT-TSC-NASA-71-13
MEASUREMENTS OF TRANSATMOSPHERIC ATTENUATION STATISTICS AT THE MICROWAVE FREQUENCIES: 15, 19 and 34 GHz
Transportation Systems Center.
G. G. Haroules, W. E. Brown, III, G. J. Bishop.
June 1971. 42p.

Electromagnetic Wave Transmission;
Atmospheric Measurement

Attenuation statistics resulting from a twelve month observation program are presented. The sun is used as a source of microwave radiation. The dynamic range of atmospheric attenuation measurement capability is in excess of 30 dB. Solar radiation characteristics with amplitude variations of a few percent are easily measured, while at the same time provision is made to accommodate a 10 dB range above the quiet sun level if major solar flare activity occurs. The solar phenomenon was extracted from the data since it is not an objective of the measurement program. A discussion and analysis of the measurement technique is presented in support of the experimental data.

DOT-TSC-NASA-72-1
FLIGHT TEST EVALUATION AND ANALYSIS OF AN OPTICAL IR PWI SYSTEM
Transportation Systems Center.
C. O. Phillips, P. A. Concannon, D. Brandel and E. Meyer.
N73-12463
Final Report. June 1972. 45p.

Aircraft-Collision Avoidance Systems;
Pilot Warning Instruments

This report documents the flight test results of the optical infrared (IR)Pilot Warning Instrument (PWI) system conducted by the Transportation Systems Center as part of an FAA/NASA PWI development program. The test program is described and the flight test data presented. The data is analyzed and used to calibrate a model that is developed to characterize the system performance. The cumulative probability of detection versus range for a given system threshold is calculated and compared with the PWI performance specification defined by the Collision Prevention Advisory Group (COPAG). The comparison indicates that the Optical IR PWI system tested met the COPAG specifications for a detection likelihood of 95% for a 1 nmi range for an appreciable fraction of the testing time. Even under the worst testing conditions encountered, the range at which this detection likelihood occurred was sufficiently large to demonstrate feasibility and to recommend a continuation of the development effort for this approach. A series of recommendations for improving system performance and obtaining additional information needed to characterize that performance are included.

DOT-TSC-NASA-72-2
L-BAND ORTHOGONAL-MODE CROSSED-SLOT ANTENNA AND VHF CROSSED-LOOP ANTENNA
Boeing Company.
Tryggvi Olsson and Brian P. Stapleton.
N73-20237
DOT-TSC-130
Final Report. August 1972.

Aircraft-Antennas

A low-gain, circularly polarized, L-band antenna; a low-gain, lineraly polarized, L-band antenna; and a low-gain, circularly polarized, upper hemisphere, VHF satellite communications antenna intended for airborne applications are described in this report. The text includes impedance and antenna radiation pattern data, along with physical description of the construction of the antennas.

DOT-TSC-NASA-75-1
PHOTOGRAPHIC FILM IMAGE ENHANCEMENT
Transportation Systems Center.
J. L. Horner.
Final Report. July 1975. 58p.

Photography

A series of experiments were undertaken to assess the feasibility of defogging color film by the techniques of Optical Spatial Filtering. A coherent optical processor was built using red, blue, and green laser light input and specially designed Fourier transformation lenses. An array of spatial filters was fabricated on black and white emulsion slides using the coherent optical processor. The technique was first applied to laboratory white-light fogged film (Kodak No. 5386 Ectachrome), and the results were successful. However, when the same technique was applied to some original Apollo X radiation-fogged color negatives, the results showed no similar restoration. Examples of each experiment are presented and possible reasons for the lack of restoration in the Apollo films are discussed.

CONTRACTOR REPORTS

Only those reports which were not assigned DOT-TSC Report Numbers are listed here. All other contractor reports are listed under their sponsoring agencies.

DOT-TSC-50
NORTH ATLANTIC SATELLITE ATC CENTER STUDY FINAL REPORT
International Business Machines Corporation.
PB-204-862
DOT-TSC-50
Final Report. April 1971. 297p.
Air Traffic Control-Satellite

A study of present oceanic ATC methods leads to the conclusion that ATC in the North Atlantic should continue to be used on an organized track concept in those areas where traffic densities are high. However, there is clearly a need to improve communications in the North Atlantic area, and a satellite system can provide both communications and surveillance services. The satellite oceanic control center (SOCC) described is highly automated. In implementing such a system it appears desirable initially to use surveillance data derived from the inertial navigation system (INS) and transmitted via data link to the control center. Subsequently, independent surveillance data could be implemented by a two-satellite tone ranging scheme, with the aircraft transponding encoded pressure altitude. The implementation data provided for the proposed SOCC includes data flow paths, sizing analysis, facility design, and staging plan.

DOT-TSC-93-1
MODELING OF V/STOL NOISE IN CITY STREETS
Massachusetts Institute of Technology,
Department of Mechanical Engineering
Richard H. Lyon, Lalit Pande, Wayne A. Kinney.
PB-211-953
DOT-TSC-93
November 1971. 49p.

Noise-Aircraft; Noise-Models; STOL Aircraft

The goals of this work were two-fold. First, to develop modeling techniques that will be helpful in studying a variety of noise propagation problems. These involve not only aircraft sources, but also surface traffic (automobiles, trucks, and rail vehicles) as well. The second and more narrow goal is the application of these modeling techniques to a specific problem, the propatation of V/STOL aircraft noise into an urban area.

Two particular flight-path-street-configuration situations were examined, using a 1:32 scale for the laboratory model. A steady-state aerodynamic noise source was used to simulate flyover noise. A second source for generating sound pulses was used for ray-tracing diagnoses.

The propagation effects of streets and buildings, which cause sound levels to differ from that in open flat terrain, are lumpted together into a "Transmission Gain (TG)". A major part of the work reported here is the experimental evaluation of TG for various model configurations, flight paths, and microphone locations.

DOT-TSC-98
MARITIME SERVICES SATELLITE SYSTEM DEFINITION STUDY
Automated Marine International.
B. A. Mendoza, D. C. Lawson, G. P. Heckert, J. D. Luse.
PB-204-860
DOT-TSC-98
Final Report. August 1971. 388p.

Maritime Communication-Satellite; Satellites-Maritime

This report reviews the requirements for voice and data communications to and from merchant ships at sea, for the period through 1980, and concludes that a global coverage satellite system of three synchronous satellites, each with a 10 voice-channel capacity, will meet forecast requirements provided that a disciplined demand access scheme is implemented. The present spacecraft technology is reviewed and certain critical spacecraft subsystem design criteria are assessed. The shipboard terminal is reviewed in detail, and the basic design constraints are established. The report concludes that an independent maritime satellite communications system is not only feasible with today's technology but inevitable, and that final definition and design of appropriate hardware should be undertaken at once.

DOT-TSC-103-71-1
ANALYSIS OF TERMINAL AIR TRAFFIC CONTROLLER FUNCTIONS
Aerospace Systems, Inc.
R. B. Noll, J. J. Scully, R. W. Simpson and J. Zvara
DOT-TSC-103
Final Technical Report. May 1971. 2 vols.

Human Factors-Air Traffic Control; Air Traffic Control-Computer Systems

Air traffic controller functions in the terminal area are described for both the second generation (present system) and

third generation (ARTS) air traffic control (ATC) system. Logan International Airport, Boston, Massachusetts and Atlanta Airport, Atlanta, Georgia, represent the second and third generations, respectively. Controller position functions are briefly described, and a detailed presentation of controller duties and responsibilities at each position is given for the selected ATC facilities.

Operational sequence narratives and diagrams are presented for typical single thread events of each facility. Real-life operational sequence diagrams are presented for each control position at Atlanta.

Areas of potential improvement in ATC are discussed briefly. Operational position profiles and operational sequence diagrams for an advanced system are derived from similar material and for the third generation system. A Runway Schedule Display is proposed as a potential area of investigation.

Supplementary material is presented describing the alphanumeric display of ARTS I at Atlanta and the computer inputs by which the controller interfaces with ARTS I.

DOT-TSC-131-3
AIRSPACE CONTROL ENVIRONMENT SIMULATOR – FINAL REPORT
Raytheon Company.
F. Benham, A. Hatch, S. Kass.
DOT-TSC-131
Final Report. December 1971. 233p.

Air Traffic Control · Computer Systems

The Airspace Control Environment Simulator is a software system designed to operate within a PDP-10 computer in conjunction with a DDP-516/ADDS-900 graphic display system. Its purpose is to provide the capability to conduct interactive experiments to explore the feasibility of new concepts for ATC automation. The simulation system design is described and operating procedures are provided for those who may wish to use the system. Complete program listings, principally in FORTRAN, are provided.

DOT-TSC-141-1
STUDY OF THE PERFORMANCE REQUIREMENTS OF A VORTEX MONITORING SYSTEM – FINAL REPORT
Raytheon Company, Advanced Development Laboratories.
Roger W. Goff
DOT-TSC-141
March 1972. 133p.

Aircraft-Wake Vortices

This study involved four basic task items. The first was a general review of the characteristics of trailing vortex wakes. The second task item involved the generation of envelopes showing the expected vortex drift for the Boeing 747 and 727 aircraft. The third task item was an investigation of the environmental factors with which a vortex monitoring system would interact. The final task item was the application of the vortex drift data and operational usage considerations to the investigation of the performance requirements for a vortex monitoring system.

DOT-TSC-142-1
A SYSTEMATIC STUDY OF SUPERSONIC JET NOISE
Massachusetts Institute of Technology,
Department of Aeronautics and Astronautics.
Jean F. Louis.
PB-211-954
DOT-TSC-142
Final Report. December 1971. 64p.

Noise-Aircraft; Supersonic Aircraft-Noise

The purpose of this work is to study the acoustic fields associated with two different nozzle configurations; a rectangular and a circular. Both nozzles are designed with the same exit Mach number and have an identical momentum and energy flux.

The other main aim of this study is to establish scaling laws of supersonic jet noise. A shock tube is a very versatile apparatus for such an analysis. A short test time allows the use of a heat sink nozzle and eliminates the use of an anechoic chamber. So far tests have been made in the range of 1000-5000°R, for different levels of expansion and an exit Mach number of 2.7. In comparing the two nozzles, it is found that the rectangular nozzle is indeed quieter than the circular nozzle. The low acoustic efficiency of the overexpanded rectangular jet is related to a rapid deceleration of the jet through a system of strong shocks. At high temperature, this effect is not observed because an important density ratio exists across the shear layer which becomes very unstable due to the Taylor instability. For both the circular and rectangular nozzle, the effect of temperature showed an

increase in the directivity angle at high temperature which is correlated to an increase in eddy convective velocity, rather than refraction due to density gradients, which seems to play a secondary role.

The low temperature overexpanded jet showed a difference of about 2.6 db in the OPWL between the two nozzles. However, at this condition, for the rectantular nozzle, a difference of 8 db between the maximum and ninimum noise direction is observed.

DOT-TSC-167-(6)
A SCALE MODEL AIRCRAFT & ANTENNA PATTERN TEST PROGRAM
Diamond Antenna & Microwave Corp.
William J. McCabe.
PB-225-965
DOT/TSC-167
November 1971. 111p.

Aircraft-Antennas

This final report describes the program activity, coordinate systems, axes of rotation, and electromagnetic radiation patterns measured for flush mounted circularly polarized slot antennas installed in a 1/10th scale model of a Convair 880 aircraft. Pattern coverage was measured for five (5) locations of the antenna elements in the fuselage using a circularly polarized transmitting antenna. Polarization ratios were measured for a zenith pointing antenna over a 45° conical sector about the zenith direction $\theta = 0°$. The model aircraft construction and the antenna elements are also described. Punched paper binary coded tapes are attached as a separate package, and the tape punched hole schematic is described herein.

DOT-TSC-171-1
DEVELOPMENT OF METHODS FOR PREDICTING AIRLOADS ON TACV CONFIGURATIONS DUE TO STRONG CROSS-WIND GUSTS
Kaman AviDyne.
J. Ray Ruetenik and Garabed Zartarian.
DOT-TSC-171
Interim Report. March 1972. 106p.

Tracked Air Cushion Vehicle

Equations for predicting the transient side force and yawing moment on TACV cars due to a strong side gust are developed. The protection afforded by side rails is estimated. The equations account for transient slender-body effects and growth of vortices on the lee side. For a vehicle speed of 150 mph, the analysis indicates a side gust of 60 mph would produce a transient peak in side force of 1x the steady-state value for the first car to 4.3x for the third car. An unresolved uncertainty of a factor of two in predicting the steady-state side force on TACV models in wind-tunnel tests with a moving ground plane is attributed to flow effects between the vehicle bottom and the ground plane.

Because of questions regarding ground-plane simulation in wind-tunnel tests, effect of side rails on gust airloads, and the airloads due to passing trains, the feasibility of developing a facility for measuring forces and moments on moving models is explored. It is concluded that a laboratory facility with a 25-30 ft. track for testing 1-ft. length models at 100 fps would provide useful data; principal development problems would be associated with model-support vibration and model-balance measurement. A larger facility with a 120-140 ft track for testing 4-5 ft length models would provide good Reynolds-number simulation, readily met model guideway tolerance requirements and greater ease of measurement.

DOT-TSC-188-1
PWI TEST AND DEVELOPMENTAL RESOURCE UTILIZATION
Intermetrics, Incorporated.
Neal A. Carlson, Peter A. Grundy, H. R. Morth, E. M. Copps, J. H. Flanders.
PB-212-495
DOT-TSC-188
Final Report. November 1971. 228p.

Aircraft-Collision Avoidance Systems;
Pilot Warning Instruments

This report documents a study performed for TSC in support of its test and evaluation program for optical-infrared PWI systems, the primary objectives of the study being to assess the utility of existing test facilities and evaluation tools, and to identify the need for modifications or additions to these. The major physical characteristics of the Fecker and Loral PWI systems are described, and an analytic model presented for the incident radiant power received by the PWI device, including atmospheric transmission effects. The laboratory, ground, and flight test programs for optical-TR PWI systems conducted by TSC and (earlier) NASA/ERC are examined, including the objectives, test equipment and procedures, data analysis, and results of each. The utility of cockpit simulation facilities is assessed, in particular the TSC and MIT GAT-1's and the CDG slide projection system sponsored by FAA. The CASTE digital computer program for simulating PWI performance in selected air traffic environments is evaluated and modifications suggested. The results of a survey of PWI-related research are discussed and areas for further work noted. Finally, a status summary of the

available IWI facilities and tools is provided, and the major conclusions and recommendations of the study is presented.

DOT-TSC-188-2
PWI SYSTEMS SURVEY
Intermetrics Incorporated.
James H. Flanders, Peter A. Grundy, Neal A. Carlson.
PB-212-496
DOT-TSC-188
Final Report. November 1971. 156p.

Pilot Warning Instruments;
Aircraft-Collision Avoidance Systems

This survey report presents a compilation, classification, and review of 176 documents related to PWI and CAS research and development. The selection of documents emphasizes those published from 1968 to the present, although earlier significant documents are included. Subject categories include: CAS System References; PWI System References; Proceedings and Literature Searches; Facilities and Programs; and Atmospheric Physics. A multi-dimensional classification code for CAS and PWI systems is developed and applied to candidate systems revealed during the survey. Written reviews of documents vary from a few lines to 2 or 3 pages, and are grouped according to subject.

DOT-TSC-194-1
ANALYSIS OF POTENTIAL NOISE SOURCES OF TRACKED AIR CUSHION VEHICLES (TACV)
Bolt Beranek and Newman, Inc.
E. K. Bender, R. E. Hayden and H. H. Heller
DOT-TSC-194
July 1971. 104p.

Tracked Air Cushion Vehicle-Noise;
Linear Induction Motor; Noise-Rapid Transit

This report presents an evaluation of the principal sources of noise from tracked air cushion vehicles (TACVs). The study is based on analysis of and laboratory experiments on existing TACVs and rapid transit systems.

Measurements of two French TACV systems were conducted, one a 44-passenger prototype suburban vehicle propelled by a linear induction motor (LIM), and the second an 80-passenger intercity vehicle powered by a gas turbine and shrouded pusher propeller.

Noise levels from a slider current-collection system were also obtained through measurements of the noise and vibration of a third-rail contact shoe on a rail rapid transit car.

DOT-TSC-212-72-1
FUNCTIONAL ERROR ANALYSIS AND MODELING FOR ATC SYSTEM CONCEPTS EVALUATION
Aerospace Systems, Inc.
William C. Hoffman, Walter M. Hollister (MIT),
Robert W. Simpson (MIT).
PB-213-148/0
DOT-TSC-212
Final Report. May 1972. 98p.

Air Traffic Control-Models

A functional error analysis and modeling study of the air traffic control (ATC) system is described. The work was performed to support the ATC system concepts evaluation program of the Transportation Systems Center (TSC), which will be conducted on their Multi-Modal Transportation System Simulation. The dominant functional error sources in the ATC system are identified and models of these errors are developed for implementation in the TSC simulation. The models are constructed to be as realistic as possible without placing excessive computational requirements on their realization. The models were developed in four categories: target dynamics, air data system, navigation systems and surveillance systems. The simulation wind model was also improved. The performance of the altitude, airspeed and heading command loops in the target dynamics model were numerically verified by digital computer simulation.

DOT-TSC-235
HIGH LEVEL DATA COMMUNICATION CONTROL PROCEDURES FOR AIR TRAFFIC CONTROL, COMPUTER-TO-COMPUTER DATA INTERCHANGE
Honeywell, Inc.
Robert E. Huettner, Edward B. Tymann.
DOT-TSC-235
Final Report. September 1971. 56p.

Air Traffic Control-Computer Systems

This document defines link communication control procedures for ATC computer-to-computer data interchange, via point-to-point, full duplex communication links. These ATC control procedures have been developed to satisfy all requirements of the ATC computer data link environment, as established by ICAO ADIS Panel Working Groups 1 and 2.

These ATC control procedures are based on ISO draft proposal HDLC bit-oriented control procedures, but are not totally consistent with HDLC for reasons outlined in this document. The concept of balanced system operation is introduced as a basis for applying bit-oriented control procedures to the ATC system.

This document includes a complete definition of all required control procedure elements and also illustrates data transfer examples using ATC control procedures.

DOT-TSC-304-1
FOURTH GENERATION AIR TRAFFIC CONTROL STUDY – SUMMARY
Autonetics.
PB-212-174
DOT-TSC-304-I
Final Report. June 1972.

Air Traffic Control-Satellite

A study and analysis was conducted to extend the work of the Air Traffic Control Advisory Committee in defining a Fourth Generation Air Traffic Control System capable of safe and economical management of CONUS and oceanic air traffic in the post 1990 time period. The analysis considered several candidate systems capable of managing air traffic over a wide variety of operational conditions. The relative advantages and disadvantages of each were identified and compared with the Upgraded Third Generation Air Traffic Control System. Technology requirements for the new concepts were identified and a development plan established.

DOT-TSC-304-2
FOURTH GENERATION AIR TRAFFIC CONTROL STUDY – VOLUME II
Autonetics.
PB-212-175
DOT-TSC-304
Final Report. June 1972.

Air Traffic Control-Satellite

DOT-TSC-304-3
FOURTH GENERATION AIR TRAFFIC CONTROL STUDY – VOLUME III
Autonetics
PB-212-176
DOT-TSC-304
Final Report. June 1972.

Air Traffic Control-Satellite

DOT-TSC-304-4
FOURTH GENERATION AIR TRAFFIC CONTROL STUDY – VOLUME IV
Autonetics
PB-212-177
DOT-TSC-304
Final Report. June 1972.

Air Traffic Control-Satellite

DOT-TSC-306-1
STUDY AND CONCEPT FORMULATION OF A FOURTH-GENERATION AIR TRAFFIC CONTROL SYSTEM. VOLUME I – STUDY REPORT
Boeing Company, Commercial Airplane Group.
PB-212-178
DOT-TSC-145 and -306
Final Report. April 1972.

Air Traffic Control-Models

The operational concept, projected passenger demand, ATC system performance tradeoff data, and subsystem technological alternatives were evaluated to select the two most promising candidate systems for a fourth-generation (1995) ATC system. These two candidates and the upgraded third-generation system were then compared and a final recommended fourth-generation ATC system selected. The recommended system was described as to technology, implementation plan, and required research and development.

DOT-TSC-306-2
STUDY AND CONCEPT FORMULATION OF A FOURTH GENERATION AIR TRAFFIC CONTROL SYSTEM. VOLUME II: TECHNOLOGICAL ALTERNATIVES
Boeing Company, Commercial Airplane Group.
PB-212-179
DOT-TSC-145 and DOT-TSC-304.
Final Report. April 1972.

Air Traffic Control - Models

This document presents the results of studies of alternative subsystem approaches applicable to the Fourth Generation Air Traffic Control System. Equipment currently in operation, that planned for near future implementation, and various techniques proposed as possible future solutions to ATC requirements are included. Numerous ground-based and satellite-borne systems are discussed for providing the required navigation, surveillance, and communications functions. In addition the ground-based data processing and control equipment along with the required airborne equipment are treated.

These subsystem alternatives have been evaluated to provide a meaningful measure of their merits and where appropriate, future performance improvement levels have been postulated. This information forms the data base from which candidate ATC systems were selected as described in Volume IV – System Selection.

DOT-TSC-306-3
STUDY AND CONCEPT FORMULATION OF A FOURTH GENERATION AIR TRAFFIC CONTROL SYSTEM. VOLUME III: DEMAND AND TRADE STUDIES
Boeing Company, Commercial Airplane Group.
PB-212-180
DOT-TSC-145 and DOT-TSC-306
Final Report. April 1972.

Air Traffic Control-Models

Techniques and resulting data are developed in the areas of demand, data acquisition, traffic management, and communications. Each area is subdivided to reflect the geographical region of operation as oceanic, domestic enroute, terminal area, and airport. ATC performance tradeoff information is developed parametrically to encompass a wide range of possibilities for the 1995 time period.

Data are presented for STOL, CTOL, and SST/CTOL airplane mix configurations. Separation criteria to meet potential demands, resulting impact on safety, and required improvements for surveillance, navigation, procedure, and communications are included. The effect of airport and runway splits are discussed and parallel runway separation requirements are analyzed. Various mixes of voice and digital communications are considered. Principal computer models used in this study are discussed.

DOT-TSC-306-4
STUDY AND CONCEPT FORMULATION, FOURTH GENERATION AIR TRAFFIC CONTROL SYSTEM. VOLUME IV: SYSTEM SELECTION
Boeing Company, Commercial Airplane Group.
PB-212-181
DOT-TSC-145 and DOT-TSC-306
Final Report. April 1972.

Air Traffic Control-Models

This volume describes the methodology used in selecting a fourth generation Air Traffic Control System consistent with U. S. air transportation needs in 1995, and provides a summary of the results. It includes the derivation and use of the computerized evaluation model, including the computer program for its implementation; the cost model and supporting cost data; implementation plans; the initial and final system selection processes and results; and recommendations for further study.

DOT-TSC-306-5
STUDY AND CONCEPT FORMULATION OF A FOURTH-GENERATION AIR TRAFFIC CONTROL SYSTEM VOLUME V – RECOMMENDED RESEARCH AND DEVELOPMENT
Boeing Company, Commercial Airplane Group.
PB-212-182
DOT-TSC-145 and DOT-TSC-306
Final Report. April 1972. 170p.

Air Traffic Control-Models

Research and development needed to support the fourth-generation ATC system implementation is described in this volume. A methodology and program plan for operational concept evaluation, a requirements plan for a surface guidance system, and a testing and evaluation schedule for subsystem technical feasibility are described. Finally, the time phasing of system implementation is also discussed together with the basic criteria used in ATC implementation planning.

CONTRACTOR REPORTS

DOT-TSC-319-1
FIFTEEN-OH-ONE TO SIXTEEN-THIRTY TECHNICAL AND MANAGERIAL LESSONS FROM ONE EXPERIENCE IN INTRODUCING NEW TECHNOLOGY TO IMPROVE URBAN MASS TRANSPORTATION
Social Engineering Technology.
Charlton R. Price, D. Sam Scheele.
PB-213-488
DOT-TSC-319-1
Final Report. November 1972. 128p.

Rapid Transit-Cars

Acquiring 130 new, double-deck, self-propelled, electrically operated commuter rail cars numbered 1501 to 1630 is part of a five-year effort to improve service on the suburban lines in the South Chicago area operated by the Illinois Central Railroad. The introduction of the cars and other improvements are attempts to upgrade service in an existing system. In the course of this effort, experience has been acquired that can be useful both to systems that are being altered, and to totally new systems yet to be designed and developed.

This report deals with lessons learned and the insights or new ideas that emerged which may be useful for: (1) the further development of this particular system; (2) the conception, design, and development of similar systems elsewhere; (3) stimulation of designers and related systems; and (4) the practices of managers and planners responsible for improving urban mass transit services.

DOT-TSC-310-1
LIGHT RAIL TRANSIT SYSTEMS – A DEFINITION AND EVALUATION
Pennsylvania University
Vukan R. Vuchic.
PB-213-447
DOT-TSC-310
Final Report. October 1972. 128p.

Light Rail Transit Systems

Rail transit represents a family of modes ranging from light rail to regional rapid transit systems and it can be utilized in a number of different cities and types of applications.

Many European cities of medium size employ very successfully light rail mode for gradual upgrading of transit service into partially or fully separated high speed, reliable transit systems. Analysis of these cities shows that with population densities and auto ownership very similar to those in the United States cities, their transit systems offer a superior service and have much better usage than our cities.

Many modern features of light rail technology are not known in this country. Wider use of different rail systems, greatly increased transit financing, introduction of more qualified personnel into transit industry and improved transit planning and implementation procedures are recommended to close the gap in urban transportation between some more progressive European cities and their counterparts in this country.

DOT-TSC-315-1
USER'S MANUAL FOR THE PREDICTION OF ROAD TRAFFIC NOISE COMPUTER PROGRAM
Bolt Beranek and Newman, Inc.
U. J. Kurze, W. H. Levison, S. Serben.
PB-213-295
DOT-TSC-315
Final Report. May 1972. 138p.

Noise-Models; Noise-Traffic

This manual is a guide for using a computer program for prediction of noise from freely flowing road traffic. The program is written in FORTRAN IV for use on the IBM-7094 computer at the Transportation Systems Center.

The manual consists of four parts. In the introduction, the limitations of the computer model are described. In the second part, acoustical properties of the traffic and sound propagation model are developed, and the analytical expressions used in the computer program are described. The third part contains a description of the structure of the computer program, and of the detailed calculation procedures. The fourth part gives practical guidelines for use of the computer program.

DOT-TSC-369-1
SURVEY OF STRATOSPHERIC CHEMICAL DYNAMICS
Pressman Enterprises.
Jerome Pressman.
PB-213-126
DOT-TSC-369
Interim Report. April 1972. 83p.

Supersonic Aircraft-Emissions

A survey and critical evaluation of information pertaining to the natural stratospheric composition and chemical dynamics and to the perturbations that might be induced by the exhaust emissions of aircraft flying in the stratosphere.

DOT-TSC-369-2
PROBLEM AREAS OF STRATOSPHERIC CHEMICAL DYNAMICS
Pressman Enterprises.
Jerome Pressman.
PB-213-111/8
DOT-TSC-369
Interim Report. June 1972. 56p.

Supersonic Aircraft-Emissions

A report on recommendations identifying areas for further necessary study of natural stratospheric chemical dynamics and the perturbations that might be induced by the exhaust emissions of aircraft flying in the stratosphere.

DOT-TSC-369-3
SURVEY OF STRATOSPHERIC AIRCRAFT WAKE CHEMICAL DYNAMICS
Pressman Enterprises.
Jerome Pressman.
PB-213-114/2
DOT-TSC-369
Interim Report. July 1972. 56p.

Supersonic Aircraft-Emissions

A survey and critical evaluation of information pertaining to the stratospheric aircraft wake chemical dynamics including both the hydrodynamics and chemistry of the phenomenon.

DOT-TSC-496
A REVIEW OF OPERATIONAL URBAN TRANSPORTATION PLANNING MODELS
Peat, Marwick, Mitchell & Co.
PB-222-109
DOT-TSC-496
Final Report. April 1973. 242p.

Urban Transportation-Models
Urban Transportation-Planning

This study compares and evaluates operational or near operational urban transportation planning models from the viewpoints of theoretical structure, application experience, cost of operation, effectiveness, and the availability of the model for public use. The models are discussed in regard to the roles they play in the urban transportation planning process. The following categories of models are reviewed: demand, network, cost-benefit/impact, and land use.

The report has two main sections. First, the 19 models are categorized, cross referenced, and compared in the body of the text, where the total urban transportation planning process is discussed. Second, each model is reviewed in a self-contained summary in the technical appendixes.

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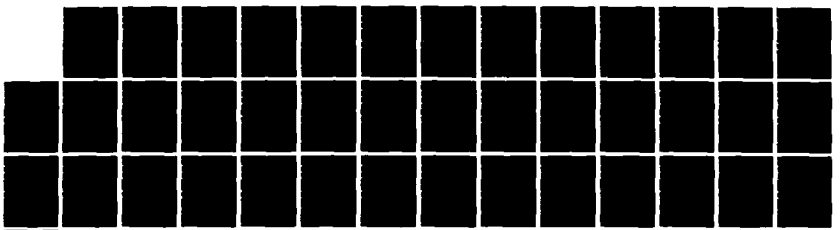

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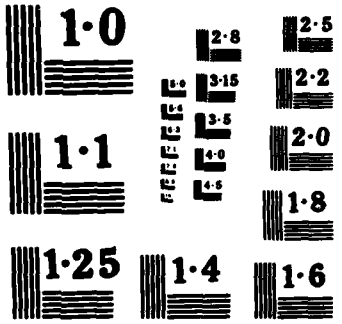
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