Bibliography of In-House and Contract Reports, Supplement 17

Jean R. Diaz
E. James Books
Karen Carroll

September 1991

Approved for public release; distribution is unlimited.

U.S. Army Corps of Engineers
Engineer Topographic Laboratories
Fort Belvoir, Virginia 22060-5546
Destroy this report when no longer needed.  
Do not return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The citation in this report of trade names of commercially available products does not constitute official endorsement or approval of the use of such products.
This is Supplement 17 to the ETL Bibliography of In-House and Contract Reports. This supplement provides author and title indexes, abstracts, and AD numbers for the 1989, 1990, and 1991 additions to the continuing bibliography. It also contains a complete title index designed to be used in conjunction with the 17 published bibliographies and refers to them by year and number.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>v</td>
</tr>
<tr>
<td>REPORTS (Abstracts)</td>
<td>1</td>
</tr>
<tr>
<td>PAPERS</td>
<td>33</td>
</tr>
<tr>
<td>INDEXES</td>
<td></td>
</tr>
<tr>
<td>Titles</td>
<td>37</td>
</tr>
<tr>
<td>Corporate Authors</td>
<td>40</td>
</tr>
<tr>
<td>Personal Authors</td>
<td>41</td>
</tr>
<tr>
<td>AD Numbers</td>
<td>42</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>43</td>
</tr>
<tr>
<td>Titles (1953 - 1991)</td>
<td></td>
</tr>
</tbody>
</table>
PREFACE

This is Supplement 17 to the report titled, "Bibliography of In-House and Contract Reports" AD-877 653L; Supplement 1, AD-890 066L; Supplement 2, AD-905 548L; Supplement 3, AD-B005 275L; Supplement 4, AD-B010 642L; Supplement 5, AD-B019 966L; Supplement 6, AD-055 468; Supplement 7, AD-A068 744; Supplement 8, AD-A084 111; Supplement 9, AD-A099 803; Supplement 10, AD-A113 006; Supplement 11, AD-A128 400; Supplement 12, AD-A141 778; Supplement 13, AD-A160 607; Supplement 14, AD-A173 750; Supplement 15, AD-A195 953; and Supplement 16, AD-A215 154. It is a continuing bibliography of reports prepared by and for the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia. This bibliography includes reports that were published from 1 October 1989 through 1 October 1991.

Reports with AD numbers can be purchased by Department of Defense agencies from the Defense Technical Information Center; other agencies and individuals can purchase copies from the National Technical Information Service, Springfield, Virginia 22161-2171. Reports with a "B" in the AD number are limited in distribution to U.S. Government agencies unless permission for release is granted from the controlling office. Reports are available on an interlibrary loan from the Scientific and Technical Information Center, U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia 22060-5546.

Colonel David F. Maune, EN, was Commander and Director, and Mr. Walter E. Boge was Technical Director of the Engineer Topographic Laboratories during the report preparation.
THE AUTONOMOUS LAND VEHICLE (ALV) PROGRAM
SEVENTH QUARTERLY REPORT
March 1988

Edited by:
Gustav R. Hoyer
Martin Marietta Astronautics Group

Keywords: Autonomous Land Vehicle, Image Understanding, Computer Vision, Unmanned Vehicles, Artificial Intelligence, Robotic Combat Vehicles, Robotics

During this quarter, we finalized our hardware and software testing and integration activities in preparation for the November 5, 1987 Autonomous Land Vehicle (ALV) demonstration. In hardware integration developments, we completed the installation and check out of the Warp systolic array processor and the Local Attitude Reference System (LARS). In software development activities, we finalized the integration of all software components that, in totality, comprise the 1987 ALV Computer Software Configuration Item (CSCI), which is, in Department of Defense software requirements specification terminology, the formal name for our 1987 computer software architecture. After fine-tuning the demonstration software configuration, we performed a series of pre-demonstration test runs to verify our readiness for the November 5 performance date. Following this, we placed the demonstration software CSCI under formal configuration management control.

HOURLY AND DAILY PRECIPITATION FREQUENCIES
FOR THE UNITED STATES
December 1988

Ruth L. Wexler

Keywords: Hourly Precipitation, Daily Precipitation, Short-Term Rainfall, Precipitation Models, Computer Programs

This report presents daily and hourly precipitation probabilities for an extensive network of stations throughout the United States, from special summaries of observations obtained over the decade 1951-1960. When data are in the format of cumulative percent frequency per precipitation rate, the daily and hourly distributions each form a fairly regular progression, per P/D or P/H, respectively (P = total precipitation, D = days, H = hours). The resultant models, in the form of succinct tables, graphs, or computer programs, provide a ready means for recovering the original observations, or estimating any selected precipitation rate for a wide spectrum of precipitation regimes in the United States, or elsewhere. The models, which serve as a check on data errors, or weather modification, also indicate to the engineer preferred areas for testing particular equipment. The methodology for the comparison among stations (or countries) of the actual short-term precipitation distributions, given only routine climatic data, should be highly useful for assessing more accurately a host of factors, as: soil moisture, trafficability, water supply crop yields, or possible malfunction of electronic equipment. The greatest advantage of the result is that they may be utilized for estimating short-term precipitation in data sparse localities.
Phase II of the program shifted away from annual system demonstrations to the use of the ALV as a "national testbed" for the purpose of hosting various experiments in autonomous land navigation technology. In hardware installation, integration and test activities, minor modifications were made to the vehicle's on-board computer hardware. We developed a new LNS navigation processor interface board, continued testing the Local Attitude Reference System (LARS), acquired a doppler radar ground speed sensor, developed a new architecture plan for real-time system development and sensor integration, introduced improved hardware documentation, and made mechanical improvements to the vehicle's mobility platform. In software developments, we continued to develop and test our prototype perception and reasoning (planning) software configuration for offroad navigation and finding the road from offroad. Our test activities on the ALV were primarily focused on documenting our vehicle hardware configuration; acceptance tests of the RF communications system; road checks of the vehicles handling characteristics following the installation of new automotive components; experimenting with our prototype perception and reasoning offroad software; validating our evolving concepts for offroad navigation; and perfecting our vehicle teleoperation hardware and software components and procedures. We also conducted several nighttime tests in preparation for future nighttime on and offroad experiments.
During this quarter, our activities primarily focused on validating our evolving concepts for off-road navigation; continued experiments with our prototype off-road software architecture; correcting performance problems in our off-road software; and perfecting our vehicle teleoperation hardware and software components and procedures. In hardware installation and integration activities, minor modifications were made to the vehicle’s on-board hardware. We installed a more capable video switch, modified the vehicle’s control unit board, modified the Bendix LNS, and installed a new stereo camera system to support the Mars Rover program. In software developments, activities centered on the continued testing and refinement of our prototype perception and reasoning (planning) software configuration for off-road navigation and finding the road from off-road. We performed a number of software development tasks needed to support various hosted experiments on the ALV. We continued our research in video/range sensor fusion and inverse perspective algorithm comparison, developed a perception processing approach based on a 3-D vehicle model using the Warp, and developed a prototype multispectral image classification methodology using neural networks on the Warp. Our test activities concentrated on performance testing of the hardware installations made and supporting various experiments on the ALV testbed. These included our own off-road autonomous navigation tests, data collection for Advanced Decision Systems and Carnegie-Mellon University (CMU), and experiments by CMU and the Martin Marietta Mars Rover program. Our program staff representative made a coordination visit to the Jet Propulsion Laboratory (JPL) to determine their intentions and requirements regarding future experiments.
RESEARCH IN KNOWLEDGE-BASED VISION TECHNIQUES FOR THE AUTONOMOUS LAND VEHICLE PROGRAM
FINAL ANNUAL REPORT
August 1989

Editors: Contributions by:
R. Nevatia W. Franzen G. Medioni
K. Price S. Gazit S. Peng
P. Saint-Marc

University of Southern California DACA76-85-C-0009

Keywords: Autonomous Land Vehicle, Motion Analysis, Target Detection and Description, Knowledge-Based Vision

This report describes our research activities for the period of June 1, 1988 through May 31, 1989, and along with the previous annual reports it constitutes the "Final Technical Report." The researchers basic approach to detecting and tracking motion is to extract and match features, such as lines and regions, from a sequence and to generate motion estimates from these. Presented are: one report on spatio-temporal analysis for tracking edges through very closely spaced sequences; a report on matching edge-based contours using edges from multiple scales with low resolution guiding high resolution matches; and an analysis of estimating 3-D motion and structure of moving objects with uniform acceleration.
DEVELOPMENT OF AN INTEGRATED MOBILE ROBOT SYSTEM
AT CARNEGIE MELLON UNIVERSITY
July 1989

Steven Shafer
William Whittaker
Carnegie Mellon University

Keywords: Strategic Computing, Machine Vision, Autonomous Land Vehicle

This report describes progress in development of an integrated mobile robot system at the Carnegie Mellon Robotics Institute from July 1987 to June 1988. The program includes a broad agenda of research in the development of mobile robot vehicles, focused on the NAVLAB computer-controlled van. In the year covered by this report, we addressed major issues in both hardware and software for autonomous mobile robots.

* Evolution of NAVLAB Vehicle. We built the NAVLAB mobile robot vehicle in our previous work under this contract, by outfitting a commercial truck chassis with computer-controlled drive and steering controls and a set of on-board computer workstations. The NAVLAB serves as a mobile navigation laboratory that allows researchers to interact intensively with the system during testing and execution. This year has seen a continued evolution and improvement of the NAVLAB mechanism, sensors, controller, and Virtual Vehicle interface to higher-level planning and perception software.

* Evolution of the CODGER Blackboard. Last year, as part of this research program, we designed and implemented the CODGER Blackboard system for robot perception and reasoning on a distributed collection of processors. This year, in response to our experience in using CODGER for mobile robot control, we have upgraded it to deal with geometric models and uncertainty in perception and map data.

* Experiments With the Driving Pipeline. To control the NAVLAB and Terregator mobile robot vehicles, we developed the Driving Pipeline architecture last year for coordinating road following, obstacle avoidance, and vehicle motion control. In our ongoing research, we have performed numerous experiments with this system that demonstrates its value.

This hardware and software is the basis for the New Generation System (NGS) for robot vision and navigation, which integrates many independent technologies to produce an integrated mobile robot system.
FEASIBILITY OF A REDUCED POWER-CONSUMPTION MAGNETOMETER FOR USE IN A DIGICOMP LENSATIC COMPASS
August 1989

George Hsu
Timothy Joel Hawks

Precision Navigation Incorporated

Keywords: DIGICOMP, Digital Compass

This report summarizes the Small Business Innovative Research (SBIR) Phase I research effort performed by Precision Navigation, Incorporated, for the U.S. Army Engineer Topographic Laboratories’ DIGICOMP project. The feasibility of using Precision Navigation’s proprietary magnetometer and clinometer technologies in a battery-powered, handheld, tilt-compensated digital compass replacement for the standard issue Army M2 compass has been successfully assessed. The magnetometer and clinometer technologies have proven to be low-power and accurate enough for use in a battery-powered, tilt-compensated compass system. During the research effort, the magnetometer sensor was extensively characterized and optimized for linearity, zero-drift, and power consumption.
This report describes research performed during the period May 1988-May 1989 under DARPA support. The report contains discussion of four main topics:

1. On-going research on visual navigation, focusing on a system named RAMBO, for the study of robots acting on moving bodies.

2. Development and implementation of parallel algorithms for image processing and computer vision on the Connection Machine and the Butterfly.

3. Development of parallel heuristic search algorithms on the Butterfly that have linear speedup properties over a wide range of problem sizes and machine sizes.

4. Development of Connection Machine algorithms for matrix operations that are key computational steps in many image processing and computer vision algorithms.

This research has resulted in twelve technical reports, and several publications in conferences and workshops.
DYNAMIC IMAGE INTERPRETATION FOR AUTONOMOUS VEHICLE NAVIGATION
FINAL REPORT
August 1989

Edward M. Riseman
Allen R. Hanson

University of Massachusetts

Keywords: Scene Interpretation, Spatial Reasoning, Sensor Motion

This report presents the results of the Dynamic Image Interpretation for the Autonomous Vehicle Navigation project for the time period February 26, 1985 through July 12, 1989. The purpose of the project is to develop algorithms and tools to enable a robotic ground vehicle to navigate autonomously through realistic landscapes. In this final annual report, we summarize our accomplishments in constructing robust algorithms used for vehicle navigation as well as tools that have been developed to more efficiently utilized these algorithms.

BIBLIOGRAPHY OF IN-HOUSE AND CONTRACT REPORTS
SUPPLEMENT 16
October 1989

Annemarie Black
E. James Books
Karen Carroll

Keywords: Bibliography, Scientific Reports

This is Supplement 16 to the ETL Bibliography of In-House and Contract Reports. This supplement provides author and title indexes, abstracts, and AD numbers for the 1987, 1988 and 1989 additions to the continuing bibliography. It also contains a complete title index designed to be used in conjunction with the 16 published bibliographies and refers to them by year and number.
State-of-the-art, electronic, non-impact digital multicolor printers and recorders and scanners are reviewed in this technical note. A review of the various non-impact technologies (ink jet, laser xerography, electrostatic, thermal transfer, ion deposition, Cycolor, and laser color photography) are also presented. Also discussed are three types of radiant energy sensors (photomultipliers, photodiodes and CCD’s) used for scanning full color imagery. In addition, halftone dot and continuous tone reproduction are explained and discussed.
AN EVALUATION OF THE ERDAS IMAGE PROCESSING SYSTEM AND ITS POTENTIAL ROLE IN THE DIGITAL TOPOGRAPHIC SUPPORT SYSTEM
December 1989

John E. Anderson

Keywords: Image Processing, Remote Sensing, Geographic Information Systems (GIS), Multispectral Imagery

The evaluation of the Earth Resource Data Analysis System (ERDAS) image processing system was initiated as part of the softcopy exploitation work unit in the Data Base Development Branch of the Topographic Developments Laboratory at ETL. The work unit's main goal is to advise on the feasibility of integrating an image processing capability into the Digital Topographic Support System (DTSS). ERDAS is a commercially available image processing package which was selected as the test-bed for the evaluation. ERDAS was selected based upon three major criteria formulated at the beginning of the project: (1) Semi-powerful, user-friendly, interactive image processing capability, (2) Compatibility with the ARC/INFO geographic information system chosen by DTSS, and (3) VAX/VMS host compatibility. A fourth element, not cited, was cost.

The test-bed system consists of a 386/20 personal computer, Mitsubishi color monitor, polygon digitizing tablet, and ERDAS 7.3 version software running under a DOS 3.31 host. All image processing functions relevant to military terrain analysis were explored using acquired SPOT panchromatic and multi-spectral imagery over Fort Hood, Texas. These functions included image display, correction, spectral and spatial enhancement, roam/zoom, training field selection, supported supervised and unsupervised classification algorithms, and annotation and colorization of final images. Other features explored were special image algebraic routines including IHS to RGB, image warping or "geo-referencing", and 3-D image capabilities using elevation data.

The results of this evaluation have demonstrated that with few inexpensive upgrades to the DTSS PAWS configuration, an ERDAS or ERDAS-like image processing capability will greatly enhance the detail and accuracy of terrain and mobility products. This improvement will enable battlefield commanders to "see" the battlefield and to make more timely and accurate tactical decisions.
AUTOMATED SEGMENTATION AND EXTRACTION OF AREA TERRAIN FEATURES
FROM RADAR IMAGERY

January 1990

Pi-Fuay Chen
Richard A. Hevenor

Keywords: Radar Image, Feature Extraction, Texture, Segmentation, Bayes Classifier, Region Growing, Edge Enhancement

An automated method for segmenting and extracting certain area terrain features from Synthetic Aperture Radar (SAR) imagery is presented. First, the input radar image is edge-enhanced by passing it through a Sobel operator in order to obtain the required edges for further processing. The unwanted noise, both from the original image source and from the edge operation, is reduced with a low-pass filter. The next step is a region growing process in which pixels of similar gray values in the filtered image are grouped and merged together. A method of selecting an optimum threshold that is essential for region growing is described. The pixels in the image after the region growing operation are further grouped into exactly four different categories, each with its own gray value. The four categories of pixels are then finally classified as water, fields, forests, or urban areas depending upon their gray values. A texture measurement scheme and a Bayes classifier are also incorporated into this effort for verifying the classification results.
THREE APPROXIMATE METHODS FOR ESTIMATING THE BEST SUBSET
OF GPS SATELLITES FOR SATELLITE POSITION CALCULATIONS
February 1990

Michael A. Crombie

Keywords: Spatial Position Accuracy, Global Positioning System (GPS), Position Dilution of Precision (PDOP)

Three methods approximating the best subset of four or five of N observable GPS satellites to be used for
calculating spatial positions are evaluated. Position Dilution of Precision (PDOP) is used as the measure of
effectiveness. Three GPS constellations are considered. The user spatial positions are taken from circular orbits
ranging from 100 to 2400 nautical miles above the earth and from orbital inclinations ranging from 0 degrees to
90 degrees in 15 degree increments.

KNOWLEDGE-BASED VISION TECHNIQUES TASK B: TERRAIN AND
OBJECT MODELING RECOGNITION - EXECUTIVE SUMMARY
February 1990

Daryl T. Lawton, et. al.

Keywords: Model Based Vision Systems, Landmark Recognition, Perceptual Processing, Spatial Reasoning,
Navigation, Autonomous Land Vehicle Systems, Image Understanding, Image Understanding Software
Environments, Object-oriented Programming.

This report describes the Knowledge-Based Vision Techniques Task B: Terrain and Object Modeling Recognition
project. Its primary objective has been to develop terrain and object autonomous land vehicle. This is fundamental
for the eventual operation of concealed autonomous robots in complex outdoor environments. Our work has been
organized into three major areas which correspond to the three volumes of this report. "Autonomous Systems for
Navigation and Terrain Recognition" (Volume I) is concerned with terrain recognition and map building for an
outdoor robot. This involves using limited a priori terrain maps to interpret imagery obtained from a vehicle and
also how to build a usable representation of terrain from a freely moving vehicle with no a priori terrain information
and also possessing limited recognition capabilities. "Tech Base Vision Research" (Volume II) involves basic
research and development in several areas critical for eventual incorporation on an outdoor robot. This includes
new approaches to perceptual processing, geometric modeling, inference, and the architecture of model-based vision
systems. "Image Understanding Software Environments" (Volume III) concerns the software environments we have
developed to support image understanding research and technical transfer to integrative applications such as the
autonomous land vehicle project. This executive summary presents an overview and critical processing results for
the work in all three volumes.
KNOWLEDGE-BASED VISION TECHNIQUES TASK B:
TERRAIN AND OBJECT MODELING RECOGNITION - VOLUME I:
AUTONOMOUS SYSTEMS FOR NAVIGATION AND TERRAIN RECOGNITION
February 1990

Daryl T. Lawton, et. al.

Advanced Decision Systems

Keywords: Landmark Recognition, Qualitative Reasoning, Navigation, Spatial Representation, Model Based Vision Systems, Perceptual Grouping and Organization, Path Planning, Road Following, Object Recognition, Autonomous Land Vehicle Systems

This volume, "Autonomous Systems for Navigation and Terrain Recognition", presents a model-based vision system and a theory of spatial representation for navigation and terrain recognition by an autonomous land vehicle. This first involves techniques to generate and match predicted image structures from a priori terrain grid data. These predictions are used to direct perceptual processes to find structures such as road regions, horizon lines, terrain patch discontinuities, and anomalies using object models. This has been successfully applied to data from the Martin Marietta ALV Test Site. We then present a new theory of spatial representation called Qualitative Navigation. This allows for navigation using locally coupled scene descriptions called viewframes without use of a global coordinate system. An exploring robot can then build maps and navigate without a priori terrain information while utilizing limited object recognition capabilities and landmarks with potentially very large positional uncertainty. We extensively tested qualitative navigation in simulations of a mobile robot and developed techniques for viewframe extraction and matching. These techniques used a generic terrestrial scene model which includes several constraints on the formation of perceptual structures based upon the relative direction of gravity, the horizon line determined by the orientation to the immediate ground plane, and the projected egocentric directions from the observer on this plane.
This volume, "Tech Base Vision Research", describes research in several areas of computer vision necessary for the development of autonomous vehicles and general machine vision systems. The volume is organized into the areas of (1) perceptual processing, (2) shape and object representations, and (3) prototype image understanding systems. The research in perceptual processing has been organized into three areas: perceptual organization of extracted image structures; segmentation using texture and color to form environmentally meaningful image regions; and multi-level stereo. The work in shape descriptions and object representations is part of an integrated attempt to combine generalized cylinder representations, which are used to describe complex objects, with perceptually based predictions and model-based inference for an integrated machine vision system. Two particular model-based vision systems have been developed using these representations. MOBI was created early in the project as a vision system for a robot which could successfully navigate and build maps, in real-time, of indoor environments consisting of walls, hallways, doors and rooms. It served as a catalyst to develop the SUCCESSOR system which combines all of the research described in this volume in modeling, perceptual organization, and inference in the framework of a general and extendible model based vision system.
This volume, "Image Understanding Software Environments," presents our work in developing software environments for image understanding research and applications. This work was initially motivated to support internal developments and to expedite technical transfer from ADS to the autonomous land vehicle system integrators. We have developed two different image understanding (IU) environments, Power Vision and View/Shark, and an exploratory prototype on the MAC II. The Power Vision environment was developed on the Symbolics LISP machine. It defines a basic architecture for IU software environments in terms of a small number of modular components and programming constructs which are built around objects commonly used in image understanding such as images, curves, regions, junctions, and groups. Algorithms are developed using these objects and a language called DEFIU for writing code and manipulating defined objects in terms of local neighborhood-level operations. Shark and View were developed to produce a machine independent image understanding environment. Shark is a CommonLISP/CLOS-based toolkit for building user interfaces. View is a CLOS-based set of image understanding constructs which is completely object-oriented and makes extensive use of the inheritance of CLOS to achieve abstraction and user-specific extendibility. We ported the CommonLISP-based IU environment onto the Apple Mac II series of personal computer workstations. Note: This abstract was summarized for this bibliography.
This report describes research performed by the Digital Mapping Laboratory at Carnegie Mellon University on the analysis of aerial images of built-up areas during the first year of the Contract. This research can be divided into three major parts: (1) extracting road networks from images; (2) detecting and delineating buildings; and (3) basic research to support extraction of the above features. Previous work in large-scale spatial databases and in knowledge-based systems for scene interpretation is described. Research results performed under this Built-Up Area Feature Extraction contract are described. New research in road network extraction is discussed. New work in the use of structural analysis to hypothesize and verify buildings using monocular cues in complex imagery is also discussed. Finally, the current state of research including successes, failures, and goals for the second year continuation are described.

This report describes research performed by the Digital Mapping Laboratory at Carnegie Mellon University on the analysis of aerial images of built-up areas during the second year of the Contract. During this year we have built on previous research, in road network extraction and in the detection and delineation of buildings using monocular analysis, accomplished during the first year of this research contract. We have expanded our research in monocular analysis to include the detailed analysis of shadows. Our shadow analysis research has resulted in three techniques for the interpretation of monocular imagery: building prediction, grouping of related building hypotheses, and building hypothesis verification. In addition, we have implemented a technique to acquire estimates of building heights using the length of cast shadows.
A PROGRAMMING ENVIRONMENT FOR PARALLEL VISION ALGORITHMS
FINAL TECHNICAL REPORT
April 1990

Christopher Brown
University of Rochester
Keywords: Butterfly Computer, Parallel Processors, Computer Vision

Under this contract, the University of Rochester developed and disseminated papers, ideas, algorithms, analysis, software, applications, and implementations for parallel programming environments for computer vision and for vision applications. The work has been widely reported and highly influential. The most significant work centered on the Butterfly Parallel Processor, the MaxVideo pipelined parallel image processor, and the development of the real-time computer vision laboratory. For the Butterfly, the Psyche multi-model operating system was developed and the CONSUL autoparallelizing compiler was designed. Much basic and influential performance monitoring and debugging work was completed, resulting in working systems and novel algorithms. There was also significant research in systems and applications using other parallel architectures in the laboratory, such as the MaxVideo parallel pipelined image processor. The University of Rochester developed a heterogeneous parallel architecture involving pipelined MIND parallelism and integrated it with a robot head.

PARALLEL ALGORITHMS FOR COMPUTER VISION
FINAL REPORT
April 1990

Tomaso Poggio
Massachusetts Institute of Technology
Keywords: Computer Vision, Parallel Algorithms, Connection Machine

The main effort in this project has been directed towards the development of an integrated vision system - the Vision Machine - based on a parallel super computer. The core of the vision Machine is in fact a set of parallel algorithms for visual recognition and navigation in an unstructured environment. The present version of the Vision Machine has been demonstrated to process images in close to real time by: (1) computing first several low-level cues, such as edges, stereo disparity, optical flow, color and texture; (2) integrating them to extract a cartoon-like description of the scene in terms of the physical discontinuities of surfaces; and (3) using this cartoon in a recognition stage, based on parallel model matching. In addition to the development of the parallel algorithms, their implementation and testing, we have also done substantial work in several areas that are very closely related. These include: (1) design and fabrication of VLSI circuits to transfer some of the software algorithms to potentially cheap and fast hardware; (2) initial development of techniques to synthesize by learning vision algorithms; and (3) several projects involving autonomous navigation of small robots.
DEVELOPMENT OF AN INTEGRATED MOBILE ROBOT SYSTEM
AT CARNEGIE MELLON UNIVERSITY
DECEMBER 1989 FINAL REPORT
May 1990

Steve Shafer
William Whittaker

Carnegie Mellon University

Keywords: Mobile Robot System

This report describes progress in development of an integrated mobile robot system at the Robotics Institute at Carnegie Mellon University from July 1988 to December 1989. This research was sponsored by the Defense Advanced Research Projects Agency and monitored by the US Army Engineer Topographic Laboratories. This program pursued a broad agenda of research in the development of mobile robot vehicles, and focused on the NAVLAB computer-controlled van. In the period covered by this report, July 1988 to December 1989, we addressed major software issues for mobile robot vehicles:

* Evolution of the CODGER Blackboard and the Driving Pipeline Architecture
* Kinematic Path Planning for Wheeled Vehicles.

This software is central to the New Generation System (NGS) for robot vision and navigation, which combines many independent technologies to produce an integrated mobile robot system.

THE LANDFORMS OF GRANITIC ROCKS: AN ANNOTATED BIBLIOGRAPHY
May 1990

Judy Ehlen

Keywords: Granite, Landforms, Process, Fractures, Weathering

This bibliography addresses the study of granite landforms throughout the world from a variety of different perspectives. It summarizes the content of more than 150 papers and books. The subjects addressed include theories of origin for the respective landforms, the weathering processes acting upon these landforms, and the composition, texture and structure (mainly jointing) of granitic rocks as they relate to landform development.
AUTOMATED EXTRACTION OF AIRPORT RUNWAY PATTERNS FROM RADAR IMAGERY
June 1990

Richard A. Hevenor
Pi-Fuay Chen

Keywords: Radar Image Feature Extraction, Computer Vision, Edge Enhancement, Connected Component

A method is presented to extract linear terrain features from Synthetic Aperture Radar imagery. An input radar image is smoothed with an edge-preserving smoothing operation. Edge detection is performed using a Sobel operator, and both the magnitude and directional images are computed. The edges are then strengthened using several iterations of a relaxation operation in which both the magnitude image and the directional image are updated with each iteration. The output of the relaxation operation is a binary edge image, which is then thinned. A connected components routine is then run in which two passes through the image are used to provide a unique label for each connected component. The connected components related only to the runway pattern are then extracted by computing certain properties of each component. A border-following algorithm is then used to follow only the outermost borders and give each of the pixels on an outermost border a maximum brightness value. A tracking algorithm is used to change the binary image array into a set of Freeman chain codes, which serve as the input to a line-forming routine that uses a standard polygon approximation algorithm. Experimental results on a real synthetic aperture radar image are presented.

AUTOMATIC LINE NETWORK EXTRACTION FROM AERIAL IMAGERY OF URBAN AREAS THROUGH KNOWLEDGE BASED IMAGE ANALYSIS
August 1989

Dr. H. Kazmierczak

Forschungsinstitut fur Informationsverarbeitung/Mustererkennung

Keywords: Image Processing, Structural Pattern Recognition, Blackboard Oriented Symbolic Processing, Knowledge Based Image Analysis, Image Understanding, Aerial Imagery, Urban Areas

Different methods for automatic detection of line objects applied to aerial images to extract streets from urban scenes are investigated. First, test results achieved from two existing methods of low level iconic image processing by stream following (line tracking) and structured parallel operations (image filtering, feature extraction) are given. Second, a medium level iconic image processing method developed for edge and area segmentation is described and results from image segmentation are presented symbolically. Then two preliminary approaches of high level symbolic processing by knowledge based blackboard oriented structure analysis are tested. One is originating with preprocessing by low level edge filtering, the other by medium level area segmentation. First results from the image understanding method for street network extraction are presented.
ETAK NAVIGATOR MODIFICATION FINAL REPORT
October 1990

Dr. Walter B. Zavoli
Gene E. Bloch
Etak, Inc.

Keywords: Etak Navigator; Dead Reckoning; Electronic Map Display; Digital Map Display; Vehicle Navigation; Off-Road Navigation; UTM Conversion

Etak modified its land vehicle navigation device, the Navigator, for test and evaluation by the U.S. Army Engineer Topographic Laboratories. The Navigator is a low-cost off-the-shelf commercial device that exhibits accurate navigation along with a highly useful electronic map display. The device uses a combination of dead reckoning and map matching. As part of this contract, Etak found that it could create the necessary maps from DMA 1:50,000 scale source material, to an accuracy of 50 meters, and that the Navigator could input and display vehicle positions and waypoints in UTM coordinates. In almost 1400 km of drive testing in Fort Hood, Texas, the modified Navigator showed that as a dead-reckoning device it is accurate to 2% of distance traveled, while its map-matching algorithms gives the Navigator performance comparable to that of an absolute navigation device with an average error of 50 meters. This navigation device demonstrates useful performance for certain classes of Army vehicles. Other vehicles may require more robust and hence more costly devices. It is suggested that digital map displays like that of the Navigator could be a useful standard presentation device for all Army vehicle navigation.

ASSISTANT FOR SCIENCE AND TECHNOLOGY ANALYSIS (ASTA)
August 1990

Thomas L. Adams

Keywords: Radar User Interface, Model-Based Reasoning

ASTA (Assistant for Science and Technology Analysis) provides analytical support for the S&T radar analyst. ASTA automates many of the typical calculations the analyst must perform, maintains consistency, integrates external databases and radar models and provides an easy to use graphical user interface. ASTA provides expert guidance in the analysis of radar systems, accepting values for system attributes, either directly from analyst entry or from the integrated databases, and incrementally infers high-level operational system attributes. The ASTA knowledge base is comprised of hundreds of radar facts, fundamental properties, and heuristic rules used by the rule-based inference engine. The basic inference capability is augmented by many information management tools including a graphical explanation system. ASTA employs a graphical, window-based user interface designed to present radar information in a form familiar to radar analysts.
ETL-0571

COOPERATIVE AUTONOMOUS AGENTS TESTBED
FIRST ANNUAL REPORT
August 1990

Charles Dolan
David Payton
Karel Zikan

Hughes Research Laboratories

Keywords: Planning, Autonomous Agents, Transportation Planning

Efforts during the first year of the contract were concentrated on developing a mathematical formalism for resupply planning. The formalism not only allows efficient plans to be constructed, but also allows those plans to be internalized plans (i.e., flexible plans). Internalized plans allow re-supply agents to be opportunistic in a changing environment. The formalism is based on expressing the re-supply problem as a flow of commodities on a graph. An economic analogy allows the re-supply agents to act as if they were self-serving agents while still accomplishing the global goals.

ETL-0572

VISION-BASED NAVIGATION AND PARALLEL COMPUTING
SECOND ANNUAL REPORT
August 1990

Larry S. Davis
Daniel DeMenthon
Thor Bestul

University of Maryland

Keywords: Autonomous Navigation, Artificial Intelligence, Computer Vision, Search, Parallel Processing

This report summarizes the research performed during the period May 1989 through May 1990, the first year of the contract period. The focus of the research program is visual navigation, with an emphasis on the use of massively parallel algorithms to support basic navigational tasks in vision and planning. The first section describes research performed on a project called RAMBO. (RAMBO is an acronym for Robot Acting on Moving BODies). The project attempts to develop and integrate Connection Machine algorithms for low-level vision, intermediate level vision and visual planning to allow a mobile robot to pursue (in simulation) a moving three dimensional target through space in order to maintain visual contact with points on the surface of the target. The next section describes our past year’s work on cross-country navigation. We first describe massively parallel algorithms for route planning in digital terrain maps. Then we describe our research on the problem, and present new methods. The last section presents brief descriptions of other research projects whose results were reported under this contract during the past year.
HYPERSPECTRAL SIGNATURES (400 to 2500 nm) OF VEGETATION, MINERALS,
SOILS, ROCKS, AND CULTURAL FEATURES:
I. LABORATORY AND FIELD MEASUREMENTS
December 1990

Melvin B. Satterwhite
J. Ponder Henley

Keywords: Reflectance, Hyperspectral, Spectra, Vegetation, Soil Rocks, Catalog, Spectroradiometric, Arid, Semiarid

The objective of this catalog was to document the visible near-infrared reflectance spectra (400-2500 nm) of vegetation, soils, rocks, and man-made materials, and to provide information about their unique physical and chemical properties. Spectra were taken of representative samples of a particular plant species of soil type and selected conditions so that a specific feature could be evaluated. Seasonal differences in vegetation spectra were measured for tree, shrub, herbaceous, and grass species. Soils having different textures and moisture potentials were measured. These spectra summarize results of ongoing research in different environments, although many of the field spectra were taken in semiarid and arid environments.

AUTOMATED SAR CHANGE DETECTION FOR COMBAT SUPPORT PHASE I (U)
December 1990

Tim Patterson
Advanced Decision Systems (ADS)

Keywords: Synthetic Aperture Radar (SAR), Morphological Filtering, Image Registration, Change Detection

The objective of this project is to design and develop a computer system for automatic change detection using synthetic aperture radar (SAR) to support the timely collection of tactical battlefield intelligence. The system will also report significant changes in the terrain with an emphasis on obstructions to vehicle movement. This Phase I effort has built a breadboard change detection system that has been tested on operational battlefield imagery. Preliminary test results show improvement over current vehicle detection techniques by more than an order of magnitude.
WHAT IS A HILL? AN ANALYSIS OF THE MEANING OF GENERIC TOPOGRAPHIC TERMS
January 1991

Robert R. Hoffman

Keywords: Aerial Photo Interpretation, Psychology of Perception, Artificial Intelligence, Terrain Description

This report is part of the effort to generate artificial intelligence systems for aerial photo interpretation. Such a system requires symbolic definitions of generic topographic terms, especially if the system is to interact with a human operator. The author analyzes the meanings of terms such as "hill," "plain," and "terrace," and adjectival descriptors such as "blocky," "rugged," and "large." A review of literature on topography, geomorphology, and terrain analysis reveals that generic topographic terms occur frequently in descriptions of terrain, especially those intended to communicate the perceptual form of terrain. Yet such concepts—rooted in perception, judgement, and experience—are rarely defined. A terrain analysis data base of over 1,000 propositions about the knowledge of expert aerial photo interpreters was analyzed to extract and categorize approximately 100 generic terms and 250 generic descriptors. The author’s approach to defining these terms is based on concepts from ecological optics and the psychology of perception. The definitions themselves are built on concepts from the literature of terrain analysis and topography. This study has implications for practicing terrain analysts and aerial photo interpreters, as well as for the field of artificial intelligence. It suggests some new methods for describing terrain and some clarifications of traditional terminology.

ADRIES PROTOTYPE SYSTEM DEVELOPMENT PROGRAM (1986-1990)
June 1990

Gil Ettinger Rick Chester Tom Shaffer
Tod Levitt Tom Esselman Mike Black

Advanced Decision Systems

Keywords: Synthetic Aperture Radar (SAR), Signal Processing, Knowledge-Based Systems, Artificial Intelligence, Parallel Computer Processing, Distributed Computer Processing

The Advanced Digital Radar Imagery Exploitation System (ADRIES) program has undertaken the design and development of automated techniques to aid in the interpretation and analysis of multiple resolution synthetic aperture radar (SAR) imagery of military land scenes. This report summarizes the accomplishments achieved during the four years of the program. The program culminated in the development of the Intelligent Tactical Screener (INTACTS) system, and end-to-end image exploitation prototype system that integrates context and terrain reasoning to identify complex military forces in viewed scenes. It is the first system to define means of using and combining multiple knowledge sources supporting image exploitation in a uniform and coherent paradigm that achieves high efficiency and accuracy through a hierarchical reasoning process.
The ADRIES program is a three-year, multiple contractor research effort aimed at the development and demonstration of technology to support the automation of tasks required to effectively exploit multiple resolution digital radar imagery. The research focuses on techniques for exploiting Advanced Synthetic Aperture Radar (ASARS) imagery. ADRIES has three major objectives: First, to develop technology in support of automating the image exploitation process. This objective is not limited to image processing, but includes knowledge engineering, distributed processing, and other applicable areas. Second, to develop the Sensor National Testbed (SNTB). The SNTB is a collection of sequential and parallel computer architectures, and associated software, providing a research environment for exploring parallel processing for image understanding. Third, to demonstrate the applicability of the ADRIES program to a real world problem. This final report describes only the latest version of the SAIC contribution to the ADRIES software/hardware system. These contributions include: Spot Mode Detection, Other Source Analysis, Region Database, Image Database, Communication and System Services, and the Executive Controller software components. During this second year, the work at SAIC delved into three general areas: software and integration support for the INTACTS demonstration; continued development of the SNTB; and test and evaluation planning on the completed INTACTS system.

Science Applications International Corporation

Keywords: Synthetic Aperture Radar, Artificial Intelligence, Signal Processing, Parallel Computer Processing, Knowledge-Based Systems, Distributed Computer Processing

The ADRIES program is a three-year, multiple contractor research effort aimed at the development and demonstration of technology to support the automation of tasks required to effectively exploit multiple resolution digital radar imagery. The research focuses on techniques for exploiting Advanced Synthetic Aperture Radar (ASARS) imagery. ADRIES has three major objectives: First, to develop technology in support of automating the image exploitation process. This objective is not limited to image processing, but includes knowledge engineering, distributed processing, and other applicable areas. Second, to develop the Sensor National Testbed (SNTB). The SNTB is a collection of sequential and parallel computer architectures, and associated software, providing a research environment for exploring parallel processing for image understanding. Third, to demonstrate the applicability of the ADRIES program to a real world problem. This final report describes only the latest version of the SAIC contribution to the ADRIES software/hardware system. These contributions include: Spot Mode Detection, Other Source Analysis, Region Database, Image Database, Communication and System Services, and the Executive Controller software components.
The research on the contract dealt with image understanding applications to both navigation and recognition. Thirteen technical reports were issued on the contract during this period referred to by numbers in brackets in the remainder of the report. Research on navigation was concerned with the following specific topics which are discussed in further detail in this report: (a) analysis of superimposed moving patterns [1, 2]; (b) path and motion planning [5, 13]; (c) structure from motion [6]; (d) motion uncertainty [8]; (e) motion illusions [11]; and (f) motion recovery in the presence of discontinuities [12]. Recognition research was concerned with: (g) recognition of compact shapes by energy function minimization [3]; (h) learning of invariant shape properties [4]; (i) slant-insensitive shape descriptors [7]; and (j) edge detection [9] and line fitting [10].
KNOWLEDGE-BASED VISION TECHNIQUES FOR THE AUTONOMOUS LAND VEHICLE PROGRAM - FOURTH ANNUAL REPORT
December 1990

Martin A. Fischler
Robert C. Bolles
SRI International

The goal of this research is to develop techniques for automatically acquiring and representing knowledge about complex cultural and natural environments for such purposes as intelligence analysis, planning, navigation, and manipulation. Our research strategy is to (1) develop representations and techniques for storing (or incrementally learning) semantic and geographic information about a specific geographic area to permit both mission planning and knowledge-based interpretation of sensed data, (2) develop representations for natural and manmade objects, (3) develop techniques to predict distinctive features of these objects that can be used to identify them, and (4) develop techniques for building three-dimensional descriptions of an environment from data gathered by range or intensity sensors moving through this environment. In this report we describe our progress and plans in these areas.

A COMPARISON OF SOILS FROM TWENTYNINE PALMS, CALIFORNIA AND SAUDI ARABIA
January 1991

Judy Ehlen
J. Ponder Henley

Keywords: Soils: Twentynine Palms, CA and eastern Saudi Arabia, Sieve Analysis, Soil Moisture, Spectral Reflectance, Soil Color

Soil samples collected at Twentynine Palms, California, and eastern Saudi Arabia were analyzed for particle size distribution, moisture content, spectral reflectance characteristics and soil color. The results of the comparison show that, overall, the Twentynine Palms samples are finer grained than the eastern Saudi Arabian samples. Soil moisture in both sets of samples is low. The samples from eastern Saudi Arabia contain quantities of calcite and gypsum not found in the Twentynine Palms samples. The spectral reflectance of the soils from eastern Saudi Arabia is overall higher than that for the Twentynine Palms soils, and shows variations in infrared reflectance due to chemical differences that are not seen in the Twentynine Palms soils.
VEXCEL Corporation’s Phase I SBIR research effort for ETL concentrated on the feasibility of creating the primary tools for the prototype development in Phase II of a digital change detection work station. This system is intended to be capable of detecting long-term (6 months to 1 year) and/or seasonal changes from all-source imagery. The system is intended to be hosted on a SUN-4 platform operating under a UNIX/C software environment. The emphasis of the present Phase I effort was on the two major technical challenges for the development of such a system: precision image registration and robust change detection and analysis. Most of this effort was directed toward automated SAR-optical image registration and automated change cuing experiments. Change cuing is an initial step in change detection for identifying regions where possible change events may have occurred. The automated registration and cuing efforts were successful over the data sets tested. The data sets did not contain appreciable terrain-induced distortions. Theoretical improvements for algorithms are recommended for addressing such terrain-induced registration complications in Phase II.

NEURAL NETWORKS FOR OBJECT DETECTION USING ALL-SOURCE IMAGERY
February 1991

Fusion of information from multiple sources is a key ingredient in many decision-making processes. This fusion often benefits from hierarchical decision-making which analyzed the data at various levels of abstraction. This report describes a system for performing fusion with a hierarchy of neural networks to provide this abstraction capability. The fusion system is demonstrated by extracting natural and man-made features from synthetic aperture radar (SAR) and optical imagery. The system is designed to be extensible to a much wider range of feature types and to other types of input data, including data from other types of sensors and collateral data. The uniqueness of the sensor fusion system lies in the efficient use of appropriately tailored neural networks, combining different paradigms to perform different tasks.
NEW METHODS OF CHANGE DETECTION USING MULTISPECTRAL DATA
May 1991

Charles Sheffield
Gil Richardson
Earth Satellite Corporation

This report discusses the final phase of a project to develop multispectral change detection methods with emphasis on human activities. Two new algorithms were developed and tested: a Spectral/Spatial Classifier and a Feature Vector Spectral Classifier. The Spectral/Spatial method appears to be a powerful new tool. The Feature Vector results were inconclusive.

THERMAL INFRARED SPECTRA OF NATURAL AND MAN-MADE MATERIALS: IMPLICATIONS FOR REMOTE SENSING

John Eastes

Keywords: Thermal Infrared Spectra, Spectra of Natural Materials, Spectra of Manmade Materials, Remote Sensing

This report is a compilation of laboratory thermal infrared reflectance spectra recorded over various spectral ranges between 4000 and 400 cm\(^{-1}\) (2.5 - 25.0 micrometers) for natural and manmade materials of potential interest to both military and civilian sectors. Knowledge of the position and shape of significant spectral features as detected by remote spectrometers or spectral radiometers is necessary to discriminate between targets on the basis of either spectral emittance or reflectance. Many of the samples in this study display spectral features in either, or both of the 3- to 5- micrometer or the 8- to 14- micrometer regions of the spectrum in which terrestrial remote sensing is possible. Such information can be used to devise image enhancement strategies for data in hand or to design new instruments or experiments utilizing thermal multispectral data.
The Desert Processes Working Group:
Jack N. Rinker
Carol S. Breed
John F. McCauley (Emeritus)
Phyllis A. Corl

Keywords: In support of military operations, Army terrain analysts are frequently required to provide terrain information about an area, and to do so quickly. Examples of needed information include: location of engineering materials, potential ground water drilling sites, influence of the terrain on cross-country movement, potential for dust generation, potential for cover and concealment, and sites suitable for ambush and defilade. The task is not easy because of the lack of sources for detailed and reliable information. Such information is not yet available in data bases, nor in existing maps, and neither can it be obtained by computer analysis of digital imagery. It can, however, be derived by the manual, or "eyeball," evaluation of image patterns. Although airborne or satellite imagery is now available for most of the world, the translation of these image patterns into forms usable by the terrain analysts has not been done. To bridge this gap, for at least one climatic zone, the Desert Processes Working Group has developed this Remote Sensing Field Guide directed towards desert operations. Although developed for military uses, this guide can serve all who travel and work in desert regions.

Robert S. Rand

Keywords: A general Change Detection (CD) methodology is investigated that involves a hybrid mix of image processing, spectral transformation, and statistical pattern recognition techniques. The Hybrid Methodology attempts to combine various forms of supporting and conflicting evidence for change into a resulting change map. The approach involves differencing registered multiband scene pairs that have undergone a spectral transformation, generating threshold masks, and applying a classifier to the masked multiband scene pairs.
MULTISPECTRAL IMAGE MAPS FROM
LANDSAT THEMATIC MAPPER DATA
September 1991

Robert S. Rand
John E. Anderson
Donald A. Davis

Keywords: This report describes a capability to produce prototype 1:50,000 scale multispectral image maps using Landsat TM data. These image maps are in the standard UTM projection, contain imbedded 1,000 meter grid lines with labeled UTM coordinates, and can easily be used in conjunction with conventional military maps of the same scale. Annotation that gives the title of the standard DMA map of the area, the Landsat TM band combinations, as well as a bar scale and compass were also imbedded into the product.
ETL-SR-4

U.S. ARMY AVIATION DIGITAL TOPOGRAPHIC
DATA REQUIREMENTS FORECAST
May 1989

W. Craig Dubishar
Christian P. Moscoso

Keywords: Digital Terrain Data (DTD), Army Aviation, Data Requirements Forecast, Helicopters

This forecast consolidates information on the Digital Terrain Data requirements of the U.S. Army aviation community, assesses and analyzes the requirements, and identifies emerging issues. Special Operations Aircraft (SOA) is the primary near-term user of DTD, but the LHX program and simulation efforts will be the drivers for future requirements. It is anticipated that the majority of DTD manipulation and use will occur at the Ground Mission Planning System (GMPS), although DTD will also be used operationally for navigation and map display. Existing and planned DTD products from the Defense Mapping Agency (DMA) will satisfy the majority of aviation requirements. However, the aviation community has a need for additional Vertical Obstruction Data (VOD).

ETL-SR-5

PHASE I TACTICAL TERRAIN DATA (TTD)
PROTOTYPE EVALUATION

Jeffrey A. Messmore
Louis A. Fatale

Keywords: Digital Terrain Data, TTD Prototype, Terrain Analysis, Digital Topographic Data, ISO 8211, MiniTopo

This report documents the results of DoD's Phase 1 Tactical Terrain Data (TTD) Prototype Evaluation. The concept of Tactical Terrain Data as the data base to support joint land combat evolved from an initial Army requirement for digital topographic data (DTD) forwarded to DMA in October 1984. The evaluation community consisted of the respective Army, Navy and Air Force laboratories; the U.S. Army Engineer Topographic Laboratories (USAETL), the Naval Ocean Research and Development Activity (NORDA), and the Rome Air Development Center (RADC), as well as many tactical, test, training, and simulation systems and programs. The key aspects of the data set that were evaluated were: accuracy, resolution, content, and data structure. The report presents a set of conclusions and makes recommendations to the Defense Mapping Agency concerning the future direction of TTD production.
DIGITAL TERRAIN ELEVATION DATA RESOLUTION AND REQUIREMENTS STUDY - INTERIM REPORT
November 1990

James R. Ackeret

Keywords: Digital Terrain Elevation Data (DTED), Digital Terrain Data (DTD) requirements, Computer Image Generation (CIG), Resolution, Terrain Visualization, Terrain Classification, Threat Analysis, Line of Sight (LOS)

The DTED resolution requirement has been a controversial subject for many years among users of U.S. Army battlefield and simulator systems. The controversy has focused on the higher cost of producing high resolution DTED and the additional time required to produce a world-wide database at this resolution. The purpose of this study is to report the influence of DTED resolution on various terrain elevation applications. TRADOC Analysis Command, White Sands Missile Range, (TRAC-WSMR), also participated in this study by conducting an in-depth threat analysis. This interim report documents the results of the USAETL DTED resolution analysis and the TRAC-WSMR threat analysis for the determination of the most desirable DTED resolution for various Army tactical and simulation applications.

PDEF: A STANDARD FILE FORMAT FOR DATA INTERCHANGE
January 1991

Michael M. McDonnell

Keywords: Geographic Information System, Data Interchange, Spatial Data Storage, Data Exchange, Reformatting

This report explains a new method of encoding data in a set of files that allows advantages over current formats and methods. A new format is necessary because all current widely-available file formats retain restrictions (such as fixed field lengths) that are no longer necessary with modern programming languages. In particular, the ability to be parsed by FORTRAN programs was formerly an important requirements. The limitations of FORTRAN lead to file formats that are clumsy and difficult to work with. The proposed format has a simple syntax and flexible semantics. The format is efficient both for computers and people. It is efficient for computers because it makes use of the powerful parsing tools available for the C programming language. It is efficient for people because data descriptions are in a human-readable form and the content of a data file can be understood without a user’s manual. The bulk of this report is in appendixes which give illustrative examples. Examples are presented for raster, quadtree, and vector data formats since these formats are especially prevalent in spatial data systems, a specialty of the U.S. Army Engineer Topographic Laboratories. PDEF stands for Protean Data Exchange Format.
PAPERS

Ackeret, James R. See Lambert, Robin B.


Barr, Samuel. See Rinker, Jack N., Dr.


Bradley, John P. See Lambert, Robin B.


Brink, Anne. See Benton, John.


Cox, Thomas M., Jr. See Fosburgh, Bryn.

Davis, Donald A. See Anderson, John E.


Fatale, Louis A. See Lambert, Robin B.

Frodge, Sally L. See Lanigan, Carl A.


Joy, Richard T. See Lambert, Robin B.


Rose, Barbara G. See Lambert, Robin B.


Smith, Harold L. See Niles, Anthony R.


## TITLES

<table>
<thead>
<tr>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADRIES Prototype System Development Program (1986-1990)</td>
<td>23</td>
</tr>
<tr>
<td>Advanced Digital Radar Imagery Exploitation System (ADRIES) Annual Report</td>
<td>24</td>
</tr>
<tr>
<td>Assistant for Science and Technology Analysis (ASTA)</td>
<td>20</td>
</tr>
<tr>
<td>Automated Extraction of Airport Runway Patterns from Radar Imagery</td>
<td>19</td>
</tr>
<tr>
<td>Automated SAR Change Detection for Combat Support Phase I</td>
<td>22</td>
</tr>
<tr>
<td>Automated Segmentation and Extraction of Area Terrain Features From Radar Imagery</td>
<td>11</td>
</tr>
<tr>
<td>Automated Software System for Updating Digital Terrain Databases from All-Source Imagery, Phase I SBIR, An</td>
<td>27</td>
</tr>
<tr>
<td>Automatic Line Network Extraction from Aerial Imagery of Urban Areas Through Knowledge Based Image Analysis</td>
<td>19</td>
</tr>
<tr>
<td>Autonomous Land Vehicle (ALV) Program, Seventh Quarterly Report, The</td>
<td>1</td>
</tr>
<tr>
<td>Bibliography of In-house and Contract, Supplement 16</td>
<td>8</td>
</tr>
<tr>
<td>Built-up Area Feature Extraction: First Year Report</td>
<td>16</td>
</tr>
<tr>
<td>Built-up Area Feature Extraction, Second Year Technical Progress Report</td>
<td>16</td>
</tr>
<tr>
<td>Comparison of Soils from Twentynine Palms, California and Saudi Arabia, A</td>
<td>26</td>
</tr>
<tr>
<td>Cooperative Autonomous Agents Testbed, First Annual Report</td>
<td>21</td>
</tr>
<tr>
<td>Development of an Integrated Mobile Robot System at Carnegie Mellon University</td>
<td>5</td>
</tr>
</tbody>
</table>

37
<table>
<thead>
<tr>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Multicolor Recorders and Scanner - The Technology and the Equipment</td>
<td>9</td>
</tr>
<tr>
<td>Digital Terrain Elevation Data Resolution and Requirements Study - Interim Report</td>
<td>32</td>
</tr>
<tr>
<td>Dynamic Image Interpretation for Autonomous Vehicle Navigation, Final Report</td>
<td>8</td>
</tr>
<tr>
<td>ETAK Navigator Modification Final Report</td>
<td>20</td>
</tr>
<tr>
<td>Expert System for Minefield Site Prediction — Phase III</td>
<td>9</td>
</tr>
<tr>
<td>Feasibility of a Reduced Power-Consumption Magnetometer for Use in a Digicomp Lensatic Compass</td>
<td>6</td>
</tr>
<tr>
<td>Fractures In Rock: An Annotated Bibliography</td>
<td>11</td>
</tr>
<tr>
<td>Hourly and Daily Precipitation Frequencies for the United States</td>
<td>1</td>
</tr>
<tr>
<td>Hybrid Methodology for Detecting Cartographically Significant Features Using Landsat TM Imagery, A</td>
<td>29</td>
</tr>
<tr>
<td>Hyperspectral Signatures (400 to 2500 nm) of Vegetation, Minerals, Soils, Rocks, and Cultural Features: I. Laboratory and Field Measurements</td>
<td>22</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques for the Autonomous Land Vehicle Program - Fourth Annual Report</td>
<td>26</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B: Terrain and Object Modeling Recognition - Executive Summary</td>
<td>12</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B: Terrain and Object Modeling Recognition - Volume II: Tech Base Vision Research</td>
<td>14</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B: Terrain and Object Modeling Recognition - Volume III: Image Understanding Software Environments</td>
<td>15</td>
</tr>
<tr>
<td>Landforms of Granitic Rocks: An Annotated Bibliography, The</td>
<td>18</td>
</tr>
<tr>
<td>TITLE</td>
<td>PAGE</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Multispectral Image Maps From Landsat Thematic Mapper Data</td>
<td>30</td>
</tr>
<tr>
<td>Neural Networks for Object Detection Using All-Source Imagery</td>
<td>27</td>
</tr>
<tr>
<td>New Methods of Change Detection Using Multispectral Data</td>
<td>28</td>
</tr>
<tr>
<td>Parallel Algorithms for Computer Vision, Final Report</td>
<td>17</td>
</tr>
<tr>
<td>Perception for Outdoor Navigation, First Year Report</td>
<td>25</td>
</tr>
<tr>
<td>PDEF: A Standard File Format for Data Interchange</td>
<td>32</td>
</tr>
<tr>
<td>Phase 1 Tactical Terrain Data (TTD) Prototype Evaluation</td>
<td>31</td>
</tr>
<tr>
<td>Programming Environment for Parallel Vision Algorithms, Final</td>
<td>17</td>
</tr>
<tr>
<td>Technical Report, A</td>
<td></td>
</tr>
<tr>
<td>Remote Sensing Field Guide - Desert</td>
<td>29</td>
</tr>
<tr>
<td>Research in Knowledge-Based Vision Techniques for the Autonomous</td>
<td>4</td>
</tr>
<tr>
<td>Land Vehicle Program, Final Annual Report</td>
<td></td>
</tr>
<tr>
<td>Robust Image Understanding - Techniques and Applications, First</td>
<td>25</td>
</tr>
<tr>
<td>Annual Report</td>
<td></td>
</tr>
<tr>
<td>Thermal Infrared Spectra of Natural and Man-Made Materials:</td>
<td>28</td>
</tr>
<tr>
<td>Implications for Remote Sensing</td>
<td></td>
</tr>
<tr>
<td>Three Approximate Methods for Estimating the Best Subset of GPS</td>
<td>12</td>
</tr>
<tr>
<td>Satellites for Satellite Position Calculations</td>
<td></td>
</tr>
<tr>
<td>U.S. Army Aviation Digital Topographic Data Requirements Forecast</td>
<td>31</td>
</tr>
<tr>
<td>Vision-Based Navigation and Parallel Computing, First Annual Report</td>
<td>7</td>
</tr>
<tr>
<td>Vision-Based Navigation and Parallel Computing, Second Annual Report</td>
<td>21</td>
</tr>
<tr>
<td>What is a Hill? An Analysis of the Meaning of Generic Topographic</td>
<td>23</td>
</tr>
<tr>
<td>Terms</td>
<td></td>
</tr>
</tbody>
</table>
## CORPORATE AUTHORS

<table>
<thead>
<tr>
<th>NAME</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Decision Systems</td>
<td>12, 13, 14, 15, 20, 22, 23</td>
</tr>
<tr>
<td>Carnegie Mellon University</td>
<td>5, 16, 18, 25</td>
</tr>
<tr>
<td>Earth Satellite Corporation</td>
<td>28</td>
</tr>
<tr>
<td>Etak, Inc.</td>
<td>20</td>
</tr>
<tr>
<td>Forschungsinstitut fur Informationsverarbeitung/Mustererkennung</td>
<td>19</td>
</tr>
<tr>
<td>Hughes Research Laboratories</td>
<td>21</td>
</tr>
<tr>
<td>LNK Corporation</td>
<td>27</td>
</tr>
<tr>
<td>Martin Marietta Astronautics Group</td>
<td>1</td>
</tr>
<tr>
<td>Martin Marietta I&amp;CS</td>
<td>2, 3</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>17</td>
</tr>
<tr>
<td>PAR Government Systems Corporation</td>
<td>9</td>
</tr>
<tr>
<td>Precision Navigation Incorporated</td>
<td>6</td>
</tr>
<tr>
<td>Science Applications International Corporation</td>
<td>24</td>
</tr>
<tr>
<td>Space Computer Corporation</td>
<td>27</td>
</tr>
<tr>
<td>SRI International</td>
<td>26</td>
</tr>
<tr>
<td>University of Maryland</td>
<td>7, 21, 25</td>
</tr>
<tr>
<td>University of Massachusetts</td>
<td>8</td>
</tr>
<tr>
<td>University of Rochester</td>
<td>17</td>
</tr>
<tr>
<td>University of Southern California</td>
<td>4</td>
</tr>
<tr>
<td>Vexcel Corporation</td>
<td>27</td>
</tr>
<tr>
<td>NAME</td>
<td>PAGE</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Ackeret, James R.</td>
<td>32</td>
</tr>
<tr>
<td>Adams, Thomas L.</td>
<td>20</td>
</tr>
<tr>
<td>Anderson, John E.</td>
<td>10, 30</td>
</tr>
<tr>
<td>Bestul, Thor</td>
<td>7, 21</td>
</tr>
<tr>
<td>Black, Annemarie</td>
<td>8</td>
</tr>
<tr>
<td>Black, Mike</td>
<td>23</td>
</tr>
<tr>
<td>Bloch, Gene E.</td>
<td>20</td>
</tr>
<tr>
<td>Bolles, Robert C.</td>
<td>26</td>
</tr>
<tr>
<td>Books, E. James</td>
<td>8</td>
</tr>
<tr>
<td>Breed, Carol S.</td>
<td>29</td>
</tr>
<tr>
<td>Brown, Christopher</td>
<td>17</td>
</tr>
<tr>
<td>Carroll, Karen</td>
<td>8</td>
</tr>
<tr>
<td>Chen, Pi-Fuay</td>
<td>11, 19</td>
</tr>
<tr>
<td>Chester, Rick</td>
<td>23</td>
</tr>
<tr>
<td>Corl, Phyllis</td>
<td>29</td>
</tr>
<tr>
<td>Crombie, Michael A.</td>
<td>12</td>
</tr>
<tr>
<td>Curlander, J.</td>
<td>27</td>
</tr>
<tr>
<td>Davis, Donald A.</td>
<td>30</td>
</tr>
<tr>
<td>Davis, Larry S.</td>
<td>7, 21</td>
</tr>
<tr>
<td>DeMenthon, Daniel</td>
<td>7, 21</td>
</tr>
<tr>
<td>Dolan, Charles</td>
<td>21</td>
</tr>
<tr>
<td>Doughty, Jonathan W.</td>
<td>9</td>
</tr>
<tr>
<td>Downs, Anne L.</td>
<td>9</td>
</tr>
<tr>
<td>Dubishar, W. Craig</td>
<td>31</td>
</tr>
<tr>
<td>Eastes, John</td>
<td>28</td>
</tr>
<tr>
<td>Ehlen, Judy</td>
<td>11, 18, 26</td>
</tr>
<tr>
<td>Esselman, Tom</td>
<td>23</td>
</tr>
<tr>
<td>Ettinger, Gil</td>
<td>23</td>
</tr>
<tr>
<td>Fatale, Louis</td>
<td>31</td>
</tr>
<tr>
<td>Fischler, Martin A.</td>
<td>26</td>
</tr>
<tr>
<td>Franzen, W.</td>
<td>4</td>
</tr>
<tr>
<td>Gazit, S.</td>
<td>4</td>
</tr>
<tr>
<td>Gladden, James W.</td>
<td>9</td>
</tr>
<tr>
<td>Gupta, Naresh C.</td>
<td>27</td>
</tr>
<tr>
<td>Hanson, Allen R.</td>
<td>8</td>
</tr>
<tr>
<td>Harwood, David</td>
<td>7</td>
</tr>
<tr>
<td>Hawks, Timothy Joel</td>
<td>6</td>
</tr>
<tr>
<td>Henley, J. Ponder</td>
<td>22, 26</td>
</tr>
<tr>
<td>Heveron, Richard A.</td>
<td>11, 19</td>
</tr>
<tr>
<td>Hoffman, Robert R.</td>
<td>23</td>
</tr>
<tr>
<td>Hollandsworth, Stephen P.</td>
<td>9</td>
</tr>
<tr>
<td>Hoyer, Gustav R. (Editor)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Hsu, George</td>
<td>6</td>
</tr>
<tr>
<td>Kanade, Takeo</td>
<td>25</td>
</tr>
<tr>
<td>Kazmierczak, H., Dr.</td>
<td>19</td>
</tr>
<tr>
<td>Kober, W.</td>
<td>27</td>
</tr>
<tr>
<td>Lambird, Barbara A.</td>
<td>27</td>
</tr>
<tr>
<td>Lavine, David</td>
<td>27</td>
</tr>
<tr>
<td>Lawton, Daryl T.</td>
<td>12, 13, 14, 15</td>
</tr>
<tr>
<td>Levitt, Tod</td>
<td>23</td>
</tr>
<tr>
<td>McCauley, John F.</td>
<td>29</td>
</tr>
<tr>
<td>McDonnell, Michael M.</td>
<td>32</td>
</tr>
<tr>
<td>McKeown, David M. Jr.</td>
<td>16</td>
</tr>
<tr>
<td>Medioni, G.</td>
<td>4</td>
</tr>
<tr>
<td>Messmore, Jeffrey A.</td>
<td>31</td>
</tr>
<tr>
<td>Moscoso, Christian</td>
<td>31</td>
</tr>
<tr>
<td>Nevatia, R. (Editor)</td>
<td>4</td>
</tr>
<tr>
<td>Patterson, Tim</td>
<td>22</td>
</tr>
<tr>
<td>Payton, David</td>
<td>21</td>
</tr>
<tr>
<td>Peng, S.</td>
<td>4</td>
</tr>
<tr>
<td>Poggio, Tomaso</td>
<td>17</td>
</tr>
<tr>
<td>Price, K. (Editor)</td>
<td>4</td>
</tr>
<tr>
<td>Rand, Robert S.</td>
<td>29, 30</td>
</tr>
<tr>
<td>Rahavan, Srinivasan</td>
<td>27</td>
</tr>
<tr>
<td>Richardson, Gil</td>
<td>28</td>
</tr>
<tr>
<td>Rinker, Jack N.</td>
<td>29</td>
</tr>
<tr>
<td>Riseman, Edward M.</td>
<td>8</td>
</tr>
<tr>
<td>Rosenfeld, Azriel</td>
<td>25</td>
</tr>
<tr>
<td>Saint-Marc, P.</td>
<td>4</td>
</tr>
<tr>
<td>Satterwhite, Melvin B.</td>
<td>22</td>
</tr>
<tr>
<td>Shafer, Steven</td>
<td>5, 18</td>
</tr>
<tr>
<td>Shaffer, Tom</td>
<td>23</td>
</tr>
<tr>
<td>Sheffield, Charles</td>
<td>28</td>
</tr>
<tr>
<td>Stocker, A.</td>
<td>27</td>
</tr>
<tr>
<td>Thomas, J.</td>
<td>27</td>
</tr>
<tr>
<td>Thorpe, Charles</td>
<td>25</td>
</tr>
<tr>
<td>Wexler, Ruth L.</td>
<td>1</td>
</tr>
<tr>
<td>Whittaker, William</td>
<td>5, 18</td>
</tr>
<tr>
<td>Zavoli, Walter B. Dr.</td>
<td>20</td>
</tr>
<tr>
<td>Zikan, Karel</td>
<td>21</td>
</tr>
<tr>
<td>Zlotnick, Aviad</td>
<td>16</td>
</tr>
</tbody>
</table>
# AD Numbers

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>PAGE</th>
<th>NUMBER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD-A157 335L</td>
<td>24</td>
<td>AD-B156 491L</td>
<td>26</td>
</tr>
<tr>
<td>AD-A212 555</td>
<td>5</td>
<td>AD-B156 709L</td>
<td>22</td>
</tr>
<tr>
<td>AD-A213 172</td>
<td>8</td>
<td>AD-B157 116L</td>
<td>24</td>
</tr>
<tr>
<td>AD-A213 440</td>
<td>4</td>
<td>AD-B157 293L</td>
<td>31</td>
</tr>
<tr>
<td>AD-A214 481</td>
<td>7</td>
<td>AD-B157 299L</td>
<td>31</td>
</tr>
<tr>
<td>AD-A215 154</td>
<td>8</td>
<td>AD-B157 300L</td>
<td>31</td>
</tr>
<tr>
<td>AD-A216 516</td>
<td>9</td>
<td>AD-B157 301L</td>
<td>31</td>
</tr>
<tr>
<td>AD-A220 005</td>
<td>16</td>
<td>AD-B157 302L</td>
<td>31</td>
</tr>
<tr>
<td>AD-A220 006</td>
<td>16</td>
<td>AD-B157 337L</td>
<td>23</td>
</tr>
<tr>
<td>AD-A220 093</td>
<td>11</td>
<td>AD-B157 709L</td>
<td>20</td>
</tr>
<tr>
<td>AD-A220 380</td>
<td>12</td>
<td>AD-B158 172L</td>
<td>3</td>
</tr>
<tr>
<td>AD-A221 096</td>
<td>11</td>
<td>AD-B158 274L</td>
<td>2</td>
</tr>
<tr>
<td>AD-A221 486</td>
<td>17</td>
<td>AD-B158 326L</td>
<td>1</td>
</tr>
<tr>
<td>AD-A221 871</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A222 494</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A222 675</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A223 749</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A231 413</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A231 809</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A237 105</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A238 570</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A238 571</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A238 678</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A238 681</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A238 937</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A239 139</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A239 370</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A239 496</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A239 718</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A240 453</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A240 454</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A240 455</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A240 746</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-A244 855</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B139 032L</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B140 080L</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B141 402L</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B142 339L</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B142 340L</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B142 341L</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B142 342L</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B155 087L</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD-B155 495L</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX – TITLES

1953 - 1991
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of Cartometric Data</td>
<td>AD 810 496</td>
<td>1966</td>
</tr>
<tr>
<td>Acoustic-Ephemeris Time Determination and</td>
<td>ETL-RN-72-4</td>
<td>1972</td>
</tr>
<tr>
<td>Geocentric Stations Position from Photographs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of the Moon Against Stellar Background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acoustic-Optic Technology for Topographic Feature Extraction and</td>
<td>ETL-0256</td>
<td>1981</td>
</tr>
<tr>
<td>Image Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjunct Development Test II (DT II) of Position and</td>
<td>ETL-0217</td>
<td>1980</td>
</tr>
<tr>
<td>Azimuth Determining System AN/USQ-70</td>
<td>ETL-0218</td>
<td>1980</td>
</tr>
<tr>
<td>Acquisition and Evaluation of Thermal Standard Data</td>
<td>ETL-0577</td>
<td>1990</td>
</tr>
<tr>
<td>ADRIE Prototype System Development Program</td>
<td>ETL-0056</td>
<td>1975</td>
</tr>
<tr>
<td>(1986-1990)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Continuous Tone Plate and Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatible with Present Military Lithographic Reproduction Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and Practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Digital Radar Imagery Exploitation</td>
<td>ETL-0578</td>
<td>1990</td>
</tr>
<tr>
<td>Robust System (ADRIE) Annual Report</td>
<td>ETL-0579</td>
<td>1990</td>
</tr>
<tr>
<td>Advanced Digital Radar Imagery Exploitation System (ADRIE) Final</td>
<td>ETL-0295</td>
<td>1983</td>
</tr>
<tr>
<td>Advanced Edit System</td>
<td>ETL-0223</td>
<td>1980</td>
</tr>
<tr>
<td>Advanced Development Prototype (ADP) for the Quick Response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multicolor Printer (QRMP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Feature Symbolization for Three</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensional Views</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Methods for the Calibration of Metric Cameras</td>
<td>AD 706 870</td>
<td>1968</td>
</tr>
<tr>
<td>Advanced Radar Topographic Application</td>
<td>ETL-CR-73-2</td>
<td>1973</td>
</tr>
<tr>
<td>Advanced Satellite Hardware/Software System Study</td>
<td>ETL-0225</td>
<td>1980</td>
</tr>
<tr>
<td>Advanced Satellite Tracking Instrumentation Study</td>
<td>AD 882 2546</td>
<td>1968</td>
</tr>
<tr>
<td>Advanced Study of a Position and Azimuth Determining System (Final)</td>
<td>AD 848 369L</td>
<td>1968</td>
</tr>
<tr>
<td>Advanced Study of a Position and Azimuth Determining System (Addendum)</td>
<td>AD 861 446L</td>
<td>1969</td>
</tr>
<tr>
<td>Advanced Study of a Position and Azimuth Determining System (Supplement)</td>
<td>AD 640 238</td>
<td>1966</td>
</tr>
<tr>
<td>Advanced Techniques for the Reduction of Geodetic Secor</td>
<td>AD 664 744</td>
<td>1967</td>
</tr>
<tr>
<td>Observation (Final)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Techniques for the Reduction of Geodetic Secor</td>
<td>AD 140 062</td>
<td>1957</td>
</tr>
<tr>
<td>Observation (Supplement)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGFA Contour Film</td>
<td>AD 815 525L</td>
<td>1967</td>
</tr>
<tr>
<td>Airborne Positioning and Attitude Data</td>
<td>AD 815 526L</td>
<td>1967</td>
</tr>
<tr>
<td>Application Study, Phase I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airborne Positioning and Attitude Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applications Study, Phase II</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Air Photo Analysis, Photo Interpretation Logic, and Feature Extraction
ETL-0329 1984
Algorithms for Digital Terrain Data Modeling
ETL-0302 1982
All-Weather Mapping Contour Plotting Program
ETL-0382 1985
Alternative Theories of Inference in Expert Systems for Image Analysis
Altimeter, Surveying, 4500 Meters, 2-Meter Divisions
etl-0026 1975
Analog Graphic Processing for 3-D Terrain Displays, Profiles, and Elevation Layer Tints
ETL-CR-71-4 1971
Analog to Digital Converter to Digital Magnetic Recorder Interface
ETL-CR-74-5 1974
Analysis and Development of Digital Mapping System Software
Analysis and Development of Image Statistics and Redundancy Removal
Analysis and Simulation of Discrete Digital Image Matching
ETL-0278 1981
Analysis and Test Results of a Gyrocompass With Reduced Susceptibility to Shock, Vibration, and Motion
ETL-0501 1988
Analysis of Air Photo and Radar Imagery of Barro Colorado Island, Panama, An
ETL-0540 1989
Analysis of Interactive Image Cleansing Via Raster-Processing Techniques
ETL-0029 1982
Analysis of Edge Detection Algorithms on DIAL Elevation Data, An
Analysis of GEOS PC-1000 and SECOR Data
ETL-0371 1985
Analysis of Interactive Image Cleansing Via Raster-Processing Techniques
Analysis of LANDSAT Systems for Cartographic and Terrain Information (Report No. 9 in the ETL Series on Remote Sensing)
Analysis of Multispectral Scanner Data for Location of Sand and Gravel Deposits
Analysis of Radar Calibration Data (Final)
Analysis of Radar Calibration Data (Supplement)
Analysis of SECOR Data — Vol. I
Analysis of SECOR Data — Vol. II
Analysis of the Max-Min Texture Measure, An
Analysis, Storage and Retrieval of Elevation Data with Applications to Improve Penetration
ETL-0029 1982
ETL-0347 1983
ETL-0298 1982
ETL-0103 1977
AD 827 858L 1967
AD 836 943L 1968
AD 865 488L 1968
AD 865 489L 1969
ETL-0280 1982
ETL-0179 1979
AD 705 673 1970
Analytic Aerotriangulation: Triplets and Sub-Blocks Including Use of Auxiliary Data
Analytical Aerial Triangulation
1510-TR 1958
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical Aerial Triangulation Error Analysis</td>
<td>AD 271 442</td>
<td>1961</td>
</tr>
<tr>
<td>and Application of Compensating Equations to the General Block Triangulation and Adjustment Program (Interim)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analytical Aerial Triangulation Error Analysis</td>
<td>AD 401-689</td>
<td>1962</td>
</tr>
<tr>
<td>and Application of Compensating Equations to the General Block Triangulation and Adjustment Program (Final)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analytical Aerial Triangulation with Large Computer (Analytical Simultaneous Block Triangulation Technique)</td>
<td>34-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Analytical Aerial Triangulation with Small Computer</td>
<td>13-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Analytical Aerotriangulation Using Triplets in Strips</td>
<td>AD 668 683</td>
<td>1965</td>
</tr>
<tr>
<td>Analytical Photogrammetric Position System (APPS)</td>
<td>ETL-TR-74-2</td>
<td>1973</td>
</tr>
<tr>
<td>Analytical Photogrammetric Position System (APPS) to Support the Field Army</td>
<td>ETL-TR-74-4</td>
<td>1974</td>
</tr>
<tr>
<td>Apparent Temperature and Emissivity of Natural Surfaces at Microwave Frequencies</td>
<td>AD 872 878L</td>
<td>1970</td>
</tr>
<tr>
<td>Appendix III Narrative Report for Geoscience Overlays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application of a Feature Selection Technique to Samples of High Resolution Synthetic Aperture Radar Imagery</td>
<td>ETL-0330</td>
<td>1983</td>
</tr>
<tr>
<td>Application of a Phase Comparison Radiolocation System to Distance and Position Measurement over Mountainous and Desert Terrain</td>
<td></td>
<td>1957</td>
</tr>
<tr>
<td>Application of Artificial Intelligence to Radar Image Understanding</td>
<td>ETL-0387</td>
<td>1985</td>
</tr>
<tr>
<td>Application of Biorthogonal Filter Functions to Pattern Recognition and Feature Extraction</td>
<td>ETL-0222</td>
<td>1980</td>
</tr>
<tr>
<td>Application of Coriolis Force to Geodetic Measurements</td>
<td>AD 477 136</td>
<td>1965</td>
</tr>
<tr>
<td>Application of Hierarchical Data Structures to Geographical Information Systems</td>
<td>ETL-0301</td>
<td>1982</td>
</tr>
<tr>
<td>Application of Hierarchical Data Structures to Geographical Information Systems (Phase II)</td>
<td>ETL-0337</td>
<td>1983</td>
</tr>
<tr>
<td>Application of Hierarchical Data Structures to Geographical Information Systems (Phase III)</td>
<td>ETL-0376</td>
<td>1984</td>
</tr>
<tr>
<td>Application of Hierarchical Data Structures to Geographical Information Systems (Phase IV)</td>
<td>ETL-0411</td>
<td>1985</td>
</tr>
<tr>
<td>Application of Inertial Techniques to Surveying</td>
<td>AD 805 156</td>
<td>1966</td>
</tr>
<tr>
<td>Application of Image Sensing Arrays to Metrology, Detection and Instrumentation</td>
<td>ETL-0222</td>
<td>1980</td>
</tr>
<tr>
<td>Application of Image Sensing Arrays to Metrology, Detection and Instrumentation</td>
<td>ETL-CR-71-6</td>
<td>1970</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------</td>
<td>--------</td>
</tr>
<tr>
<td>Application of LORAC to Precision Terrestrial Line-Length Measurement and Position Fixing</td>
<td>AD 232 015</td>
<td>no date</td>
</tr>
<tr>
<td>Application of Scalar Renormalization to the Scattering of Electromagnetic Waves from a Three-Dimensionally Inhomogeneous Medium with Strong Dielectric Fluctuations</td>
<td>ETL-0020</td>
<td>1975</td>
</tr>
<tr>
<td>Applications of Advanced Accelerometers to Surveying and Geodesy I</td>
<td>AD 429 324L</td>
<td>1963</td>
</tr>
<tr>
<td>Applications of Advanced Accelerometers to Surveying and Geodesy II</td>
<td>AD 439 969L</td>
<td>1964</td>
</tr>
<tr>
<td>Approach to Model Formation Based on Formal Geometric Reasoning, An</td>
<td>ETL-0493</td>
<td>1988</td>
</tr>
<tr>
<td>Approach to the Evaluation of Strategies in Insurgency, An</td>
<td>AD 722 787</td>
<td>1968</td>
</tr>
<tr>
<td>APPS-IV Civil Works Data Extraction/Data Base Application Study (Phase I)</td>
<td>ETL-0310</td>
<td>1982</td>
</tr>
<tr>
<td>APPS-IV Civil Works Data Extraction/Data Base Application Study (Phase II)</td>
<td>ETL-0336</td>
<td>1983</td>
</tr>
<tr>
<td>ARK-1 Gyro Aiming Circle (Wild Heerbrugg Instruments, Inc.)</td>
<td>49-TR</td>
<td>1969</td>
</tr>
<tr>
<td>ARMIDOP/ZERO-DOP Positioning Technique</td>
<td>ETL-RN-71-2</td>
<td>1971</td>
</tr>
<tr>
<td>Army Tactical Terrain Data Requirements Forecast (FY87-FY93)</td>
<td>ETL-SR-1</td>
<td>1987</td>
</tr>
<tr>
<td>Army Terrain Information System</td>
<td>ETL-0050</td>
<td>1976</td>
</tr>
<tr>
<td>Artifact Removal in Frequency Domain Compressed Imagery</td>
<td>ETL-0233</td>
<td>1980</td>
</tr>
<tr>
<td>Artillery Survey System, Phase 1 — Study of Methods</td>
<td>AD 883 288L</td>
<td>1958</td>
</tr>
<tr>
<td>Aspects and Methods of Nonisotropic Land</td>
<td>ETL-RN-71-4</td>
<td>1971</td>
</tr>
<tr>
<td>Navigation Error Control Including Consideration of Topography</td>
<td>ETL-0291-1</td>
<td>1982</td>
</tr>
<tr>
<td>Assessment of Inertial Technology for Gravity Survey Applications</td>
<td>ETL-0303</td>
<td>1982</td>
</tr>
<tr>
<td>Assessment of Means for Determining Deflection of the Vertical</td>
<td>ETL-0570</td>
<td>1990</td>
</tr>
<tr>
<td>Assistant for Science and Technology Analyst (ASTA)</td>
<td>ETL-0046</td>
<td>1976</td>
</tr>
<tr>
<td>Associative Array Processing of Raster Scanned Data for Automated Cartography</td>
<td>ETL-0132</td>
<td>1977</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Associative Array Processing for Topographic Data Reduction</td>
<td>ETL-CR-74-1</td>
<td>1974</td>
</tr>
<tr>
<td>Associative Array Processing for Topographic Data Reduction, Final Report</td>
<td>ETL-CR-74-20</td>
<td>1974</td>
</tr>
<tr>
<td>Astrogateoedetic-Inertial Methods for Vertical Deflection Determination</td>
<td>ETL-0414</td>
<td>1985</td>
</tr>
<tr>
<td>Astronomical Attachment Azimuth Determination, Reflecting, for Transit or Theodolite</td>
<td>1374-TR</td>
<td>1954</td>
</tr>
<tr>
<td>ATF-Hadego Photocompositor Photolettering Machine</td>
<td>1414-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Atmospheric Refraction</td>
<td>TR-61-505</td>
<td>no date</td>
</tr>
<tr>
<td>Atmospheric Refraction for Satellite Photography</td>
<td>56-8B-1</td>
<td>1962</td>
</tr>
<tr>
<td>Autocorrelation of Control Points on 11-Band Multispectral Imagery</td>
<td>ETL-0473</td>
<td>1987</td>
</tr>
<tr>
<td>Automated Extraction of Airport Runway Patterns From Radar Imagery</td>
<td>ETL-0567</td>
<td>1990</td>
</tr>
<tr>
<td>Automated Feature Attribute Accessing From Map Text</td>
<td>ETL-0517</td>
<td>1988</td>
</tr>
<tr>
<td>Automated Industrial Feature Extraction from Synthetic Aperture Radar Imagery</td>
<td>ETL-0459</td>
<td>1987</td>
</tr>
<tr>
<td>Automated Processing of Geographic Information in Image Data Forms</td>
<td>ETL-0114</td>
<td>1977</td>
</tr>
<tr>
<td>Automated Route Finder for Multiple Tank Columns</td>
<td>ETL-0480</td>
<td>1987</td>
</tr>
<tr>
<td>Automated SAR Change Detection for Combat Support Phase I</td>
<td>ETL-0574</td>
<td>1990</td>
</tr>
<tr>
<td>Automated Segmentation and Extraction of Area Terrain Features From Radar Imagery</td>
<td>ETL-0554</td>
<td>1990</td>
</tr>
<tr>
<td>Automated Software System for Updating Digital Terrain Databases From All-Source Imagery, Phase I SBIR</td>
<td>ETL-0584</td>
<td>1991</td>
</tr>
<tr>
<td>Automated Technique for Measuring Built-Up Urban Areas from Map Graphics through Analog Image Processing</td>
<td>ETL-0012</td>
<td>1975</td>
</tr>
<tr>
<td>Automatic Contour Digitizer (ACD)</td>
<td>ETL-ETR-71-2</td>
<td>1971</td>
</tr>
<tr>
<td>Automatic Contouring Instrumentation</td>
<td>1488-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Automatic Control of Digital Stereo Correlation Methods</td>
<td>ETL-0356</td>
<td>1984</td>
</tr>
<tr>
<td>Automatic Correlation of USGS Digital Line Graph Geographic Features to GNIS Names Data</td>
<td>ETL-0426</td>
<td>1986</td>
</tr>
<tr>
<td>Automatic-electro Optical Satellite Triangulation System</td>
<td>RN-23</td>
<td>1967</td>
</tr>
<tr>
<td>Automatic Feature Extraction/Algorithm Testing</td>
<td>ETL-0410</td>
<td>1985</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>Automatic Feature Extraction: An Annotated Bibliography</td>
<td>ETL-0189</td>
<td>1979</td>
</tr>
<tr>
<td>Automatic Line Network Extraction From Aerial Imagery of Urban Areas Through Knowledge Based Image Analysis</td>
<td>ETL-0568</td>
<td>1989</td>
</tr>
<tr>
<td>Automatic Map Compilation System</td>
<td>AD 277 456</td>
<td>1962</td>
</tr>
<tr>
<td>Automatic Point Marking Measuring and Recording Instrument</td>
<td>AD 610 044</td>
<td>1964</td>
</tr>
<tr>
<td>Automatic Point Transfer Instrument</td>
<td>AD 834 230L</td>
<td>1968</td>
</tr>
<tr>
<td>Automatic Reseau Measuring Equipment (ARME)</td>
<td>ETL-0099</td>
<td>1976</td>
</tr>
<tr>
<td>Automatic Stereo Perception of Aerial Imagery by Means of Optical Correlation</td>
<td>AD 406 363</td>
<td>1962</td>
</tr>
<tr>
<td>Automatic Radar Feature Extraction System Using Descriptors</td>
<td>ETL-0533</td>
<td>1989</td>
</tr>
<tr>
<td>Automatic Type/Symbol-Placement Developments</td>
<td>ETL-TR-74-9</td>
<td>1975</td>
</tr>
<tr>
<td>Automation of Airborne Profile Recorder Data Reduction (Interim)</td>
<td>AD 805 562L</td>
<td>1966</td>
</tr>
<tr>
<td>Automation of Airborne Profile Recorder Data Reduction (Final)</td>
<td>AD 825 545L</td>
<td>1967</td>
</tr>
<tr>
<td>Autonomous Ground Vehicles: Control System Technology Development</td>
<td>ETL-0375</td>
<td>1984</td>
</tr>
<tr>
<td>Autonomous Land Vehicle</td>
<td>ETL-0413</td>
<td>1986</td>
</tr>
<tr>
<td>Autonomous Land Vehicle (ALV) Planning and Navigation System</td>
<td>ETL-0465</td>
<td>1987</td>
</tr>
<tr>
<td>Autonomous Land Vehicle 1st Quarterly Report, The</td>
<td>ETL-0430</td>
<td>1986</td>
</tr>
<tr>
<td>Autonomous Land Vehicle 2nd Quarterly Report, The</td>
<td>ETL-0436</td>
<td>1986</td>
</tr>
<tr>
<td>Autonomous Land Vehicle (ALV) Program, Sixth Quarterly Report, The</td>
<td>ETL-0483</td>
<td>1987</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Background Study and Selection Criteria</td>
<td>ETL-0154</td>
<td>1978</td>
</tr>
<tr>
<td>Analysis of MIL-STD-810C: Environmental Test Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backscattering of Electromagnetic Waves from a Slightly Rough Surface</td>
<td>ETL-TR-74-10</td>
<td>1974</td>
</tr>
<tr>
<td>with a Lossy Layer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backscattering of Electromagnetic Waves from a Surface Composed of</td>
<td>ETL-TR-71-4</td>
<td>1971</td>
</tr>
<tr>
<td>Two Types of Surface Roughness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backscattering of Radar Waves by Vegetated Terrain</td>
<td>ETL-0105</td>
<td>1977</td>
</tr>
<tr>
<td>Backscattering of Radar Waves from a Tilted, Slightly Rough Surface</td>
<td>ETL-0124</td>
<td>1977</td>
</tr>
<tr>
<td>Base Plant Correlator</td>
<td>ETL-CR-71-15</td>
<td>1971</td>
</tr>
<tr>
<td>Base Plant Correlator (Final)</td>
<td>ETL-CR-73-3</td>
<td>1973</td>
</tr>
<tr>
<td>Basic Factors Limiting the Accuracy of Mapping and Aerotriangulation</td>
<td>AD 77 390</td>
<td>1955</td>
</tr>
<tr>
<td>by Photogrammetric Procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bayesian Approach to Identification of a Remotely Sensed Environment</td>
<td>AD 860 060</td>
<td>1969</td>
</tr>
<tr>
<td>Bibliographic Literature Search Concerning the Relationship Between</td>
<td>ETL-0171</td>
<td>1978</td>
</tr>
<tr>
<td>Soils and Plants in Arid and Semi-Arid Regions in North America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bibliography and Abstracts of Analytical Photogrammetry</td>
<td>1487-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports</td>
<td>ETL-SR-70-1</td>
<td>1970</td>
</tr>
<tr>
<td>Supplementary 1</td>
<td>ETL-SR-71-3</td>
<td>1971</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 2</td>
<td>ETL-SR-72-3</td>
<td>1972</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 3</td>
<td>ETL-0013</td>
<td>1975</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 4</td>
<td>ETL-0042</td>
<td>1976</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 5</td>
<td>ETL-0104</td>
<td>1977</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 6</td>
<td>ETL-0143</td>
<td>1978</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 7</td>
<td>ETL-0180</td>
<td>1979</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 8</td>
<td>ETL-0216</td>
<td>1980</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 9</td>
<td>ETL-0255</td>
<td>1981</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 10</td>
<td>ETL-0282</td>
<td>1982</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 11</td>
<td>ETL-0320</td>
<td>1983</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 12</td>
<td>ETL-0353</td>
<td>1984</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 13</td>
<td>ETL-0395</td>
<td>1985</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 14</td>
<td>ETL-0434</td>
<td>1986</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 15</td>
<td>ETL-0500</td>
<td>1988</td>
</tr>
<tr>
<td>Bibliography of In-House and Contract Reports, Supplement 16</td>
<td>ETL-0550</td>
<td>1989</td>
</tr>
<tr>
<td>Bibliography on the Chemical Weathering of Granitic Rocks, A</td>
<td>ETL-0505</td>
<td>1988</td>
</tr>
<tr>
<td>Bimodal Display</td>
<td>ETL-0110</td>
<td>197</td>
</tr>
<tr>
<td>Blue Laser</td>
<td>ETL-0412</td>
<td>1985</td>
</tr>
<tr>
<td>Broad-Spectrum Electromagnetic Spectrum Backscatter</td>
<td>AD 878 341L</td>
<td>1970</td>
</tr>
<tr>
<td>Brush Surfaced Lithographic Press Plates</td>
<td>1452-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Building a 3-D World Model for a Mobile Robot from Sensory Data</td>
<td>ETL-0490</td>
<td>1988</td>
</tr>
<tr>
<td>Built-Up Area Feature Extraction: First Year Report</td>
<td>ETL-0561</td>
<td>1990</td>
</tr>
<tr>
<td>Built-Up Area Feature Extraction: Second Year Technical Progress Report</td>
<td>ETL-0562</td>
<td>1990</td>
</tr>
<tr>
<td>Camera Calibration Study</td>
<td>ETL-0081</td>
<td>1976</td>
</tr>
<tr>
<td>Capabilities of Remote Sensors to Determine Environmental Information for Combat</td>
<td>ETL-0081</td>
<td>1976</td>
</tr>
<tr>
<td>Cartographic Application of Conflex I</td>
<td>AD 882 789L</td>
<td>1964</td>
</tr>
<tr>
<td>Cartographic Design Standards — A Preliminary Investigation</td>
<td>1305-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Cartographic Drafting Methods and Equipment (Plastic Scribing Process)</td>
<td></td>
<td>1954</td>
</tr>
<tr>
<td>Cartographic Drafting Methods and Equipment (Plastic Scribing Process)</td>
<td></td>
<td>1954</td>
</tr>
<tr>
<td>Cartographic Drafting Methods and Equipment (Plastic Scribing Process)</td>
<td></td>
<td>1954</td>
</tr>
<tr>
<td>Change Detector Maintenance Instructions</td>
<td>ETL-CR-72-12</td>
<td>1972</td>
</tr>
<tr>
<td>Change Detector Studies</td>
<td>ETL-CR-74-18</td>
<td>1974</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>Characterization of the PROM for Coherent Optical Processing Applications</td>
<td>ETL-0053</td>
<td>1976</td>
</tr>
<tr>
<td>Charging Equipment, Mobile (CEM)</td>
<td>ETL-0089</td>
<td>1976</td>
</tr>
<tr>
<td>Chemical Array Studies</td>
<td>ETL-0130</td>
<td>1977</td>
</tr>
<tr>
<td>Circularly Polarized Measurements of Radar Backscatter from Terrain</td>
<td>ETL-0199</td>
<td>1980</td>
</tr>
<tr>
<td>Circularly Polarized Measurements of Radar Backscatter from Terrain and Snow Covered Terrain</td>
<td>ETL-0234</td>
<td>1980</td>
</tr>
<tr>
<td>Circumpolar Method for Determining Azimuth</td>
<td>ETL-0317</td>
<td>1983</td>
</tr>
<tr>
<td>Classification and World Distribution of Vegetation Relative to V/STOL Aircraft Operations</td>
<td>ETL-SR-74-4</td>
<td>1973</td>
</tr>
<tr>
<td>Classification of Cartographic Features Through Walsh Transforms</td>
<td>ETL-0290</td>
<td>1982</td>
</tr>
<tr>
<td>Classification of Metamorphic Rocks and Their Applications to Air Photo Interpretation Procedures, The</td>
<td>ETL-0341</td>
<td>1983</td>
</tr>
<tr>
<td>Classification of Selected Radar Imagery Patterns Using a Binary Tree Classifier</td>
<td>ETL-0442</td>
<td>1986</td>
</tr>
<tr>
<td>Climatic Information for Application in Designing and Testing U.S. Army Materiel</td>
<td>ETL-0474</td>
<td>1987</td>
</tr>
<tr>
<td>Coated Paper and Developer for Continuous Tone Electrophotography</td>
<td>AD 674 241</td>
<td>1968</td>
</tr>
<tr>
<td>Cold Weather Testing of 10-Second Direction Theodolite, 1-Minute Direction Theodolite (Foreign Model), Astronomical Attachment, and Winterization Kit</td>
<td>1288-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Color Contact Printer Mark III</td>
<td>ETL-ETR-70-9</td>
<td>1970</td>
</tr>
<tr>
<td>Color Ink-Jet Demonstration Program</td>
<td>ETL-0196</td>
<td>1979</td>
</tr>
<tr>
<td>Color Orthophotomaps</td>
<td>ETL-ETR-72-2</td>
<td>1972</td>
</tr>
<tr>
<td>Color Separation System Evaluation</td>
<td>AD 672 078</td>
<td>1968</td>
</tr>
<tr>
<td>Combination Map Reproduction Van Body</td>
<td>1536-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Combined Engineering and Service Tests of the Copy and Supply Van Section of the Motorized Photomapping Train</td>
<td>1444-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Combined Engineering and Service Tests of the Map Revision Van Section of the Motorized Photomapping Train</td>
<td>1447-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Combined Engineering and Service Tests of the Multiplex Van Section of the Motorized Photomapping Train</td>
<td>1520-TR</td>
<td>1958</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Combined Engineering and Service Tests o: the Photomapping Van Section of the Motorized Photomapping Train</td>
<td>1428-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Combined Engineering and Service Tests of the Rectifier Van Section of the Motorized Photomapping Train</td>
<td>1544-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Command Retrieval Information System/Direct Input (CRIS/DI)</td>
<td>42-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Comparative Study of Photography for Soils and Terrain Data</td>
<td>38-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Comparison of Soils from Twentynine Palms, CA and Saudi Arabia, A</td>
<td>ETL-0583</td>
<td>1991</td>
</tr>
<tr>
<td>Comprehensive Summary of Project Trend</td>
<td>ETL-0041</td>
<td>1975</td>
</tr>
<tr>
<td>Computer for Army Artillery Inertial Survey System (GEISHA)</td>
<td>AD 814 052</td>
<td>1963</td>
</tr>
<tr>
<td>Computer Generation of Fractal Terrains</td>
<td>ETL-0504</td>
<td>1988</td>
</tr>
<tr>
<td>Computer Program to Simulate Scenario Functions</td>
<td>ETL-0025</td>
<td>1975</td>
</tr>
<tr>
<td>Concept Development of Automated Image Analysis</td>
<td>ETL-0194</td>
<td>1979</td>
</tr>
<tr>
<td>Concept Development of Automatic Instrumentation for Monitoring Movement of Dams</td>
<td>ETL-0187</td>
<td>1979</td>
</tr>
<tr>
<td>Concept for an Ultraprecise Geodetic Baseline</td>
<td>RN-24</td>
<td>1967</td>
</tr>
<tr>
<td>CONPLOT II — A Contour Generating Program</td>
<td>ETL-CR-71-1</td>
<td>1971</td>
</tr>
<tr>
<td>CONRAD — A Program to Contour Radar Data</td>
<td>ETL-CR-73-20</td>
<td>1973</td>
</tr>
<tr>
<td>Continuous-Tone Electrophotography</td>
<td>AD 673 881</td>
<td>1968</td>
</tr>
<tr>
<td>Contour Digitizing and Tagging Software (CONTAGRID)</td>
<td>ETL-0228</td>
<td>1980</td>
</tr>
<tr>
<td>Contour-to-Grid Interpolation with Nonlinear Finite Elements: A Feasibility Study</td>
<td>ETL-0472</td>
<td>1987</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------</td>
<td>------</td>
</tr>
<tr>
<td>Contribution to the Philosophy of Climatic</td>
<td>ETL-TR-72-5</td>
<td>1972</td>
</tr>
<tr>
<td>Design Limits for Army Materiel: Extreme Hot-Desert Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Unit for Army Artillery Inertial Survey System (GEISHA)</td>
<td>AD 814 068</td>
<td>1968</td>
</tr>
<tr>
<td>Controlled Color for Contact Printing Aerial Imagery</td>
<td>ETL-TR-72-4</td>
<td>1972</td>
</tr>
<tr>
<td>Conversion of the CALAP Program from FORTRAN to DUCK. Final Report</td>
<td>ETL-0419</td>
<td>1986</td>
</tr>
<tr>
<td>the Negative-Reticle Concept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corona Study Relevant to Electrostatic Printing Process</td>
<td>ETL-CR-71-22</td>
<td>1971</td>
</tr>
<tr>
<td>Corps of Engineers Maintenance Package for Inertial Survey Equipment</td>
<td>AD 847 498</td>
<td>1963</td>
</tr>
<tr>
<td>Correlation of Noisy Images</td>
<td>ETL-0230</td>
<td>1980</td>
</tr>
<tr>
<td>Cultural Data Base Implementation Study and Computer-Aided Scene</td>
<td>ETL-0380</td>
<td>1984</td>
</tr>
<tr>
<td>Modeling System Users Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative Probability Tables for Testing</td>
<td>ETL-0418</td>
<td>1986</td>
</tr>
<tr>
<td>Consensus in Ranking Experiments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Base Sizing Methodology Applied to the Army Terrain Information</td>
<td>ETL-0150</td>
<td>1978</td>
</tr>
<tr>
<td>System (ARTINS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Integrity Factors Affecting the Construction of the Mapping,</td>
<td>ETL-0357</td>
<td>1983</td>
</tr>
<tr>
<td>Charting, and Geodesy Data Base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Weighing Analysis</td>
<td>AD 672 101</td>
<td>1968</td>
</tr>
<tr>
<td>Decision Path Approach to Guidance for Climatic Environmental Test</td>
<td>ETL-0183</td>
<td>1979</td>
</tr>
<tr>
<td>Planning (MIL-STD-810C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defense Mapping Agency (DMA) Raster-to-Vector Analysis</td>
<td>ETL-0383</td>
<td>1984</td>
</tr>
<tr>
<td>Defense Mapping Agency (DMA) Raster-to-Vector Analysis — Appendix</td>
<td>ETL-0383A</td>
<td>1984</td>
</tr>
<tr>
<td>Defense Mapping Agency (DMA) Raster-to-Vector Benchmark Testing</td>
<td>ETL-0384</td>
<td>1984</td>
</tr>
<tr>
<td>Delta Pulse Code Modulation Compression Relative to Stereo Image</td>
<td>ETL-0157</td>
<td>1978</td>
</tr>
<tr>
<td>Matching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstration and Evaluation of the Utilization of Side-Looking Air</td>
<td>ETL-0023</td>
<td>1975</td>
</tr>
<tr>
<td>borne Radar for Military Terrain Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>Derivation and Potential of New Filter</td>
<td>ETL-RN-71-3</td>
<td>1971</td>
</tr>
<tr>
<td>Equations for Numerical Weather Prediction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of Instrumentation Data Analysis and Reduction for an Atmospheric Seeing Monitor</td>
<td>AD 701 124</td>
<td>1969</td>
</tr>
<tr>
<td>Design and Analysis of a High-Production Mini-Computer System for Regridding Digital Terrain Elevation Matrices</td>
<td>ETL-0240</td>
<td>1980</td>
</tr>
<tr>
<td>Design and Development of a Position and Azimuth Determining System (PADS)</td>
<td>ETL-CR-71-18</td>
<td>1971</td>
</tr>
<tr>
<td>Design and Development of an Advanced Electron Beam Control System</td>
<td>ETL-0032</td>
<td>1975</td>
</tr>
<tr>
<td>Design and Fabrication of a 70 Millimeter Interference Imaging System</td>
<td>ETL-CR-71-8</td>
<td>1971</td>
</tr>
<tr>
<td>Design and Fabrication of an Experimental Multiband Camera</td>
<td>ETL-CR-71-28</td>
<td>1971</td>
</tr>
<tr>
<td>Design and Feasibility Study of an Off-Line Digital Orthoprinter for Field Use</td>
<td>ETL-0149</td>
<td>1978</td>
</tr>
<tr>
<td>Design and Feasibility Study of HOC as a Van Mounted Stereo Model Digitizer</td>
<td>ETL-0109</td>
<td>1977</td>
</tr>
<tr>
<td>Design, Fabrication, and Test of a Position and Azimuth Determining System (PADS)</td>
<td>ETL-CR-73-6</td>
<td>1973</td>
</tr>
<tr>
<td>Design Issues in Video Disc Map Display</td>
<td>ETL-0362</td>
<td>1984</td>
</tr>
<tr>
<td>Design, Modification, Fabrication, and Test of a Prototype Miniaturized North Reference Unit (MINRU)</td>
<td>ETL-0276</td>
<td>1979</td>
</tr>
<tr>
<td>Design of a Laser Experiment for the Verification of the Inverse Scattering Theory</td>
<td>AD 463 012L</td>
<td>1965</td>
</tr>
<tr>
<td>Design of a Map Update Capability for Engineer Topographic Units</td>
<td>ETL-0107</td>
<td>1977</td>
</tr>
<tr>
<td>Design of an Experimental Program for Evaluation of LBR Systems</td>
<td>ETL-0182</td>
<td>1979</td>
</tr>
<tr>
<td>Design of Engineering Test Model, Topographic Data System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume 1</td>
<td>AD 270 216L</td>
<td>1961</td>
</tr>
<tr>
<td>Volume 2</td>
<td>AD 270 205L</td>
<td>1961</td>
</tr>
<tr>
<td>Volume 3</td>
<td>AD 270 207L</td>
<td>1961</td>
</tr>
<tr>
<td>Volume 4</td>
<td>AD 270 210L</td>
<td>1961</td>
</tr>
<tr>
<td>Volume 5</td>
<td>AD 270 209L</td>
<td>1961</td>
</tr>
</tbody>
</table>

55
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Studies and Prototype Model Development</td>
<td>ETL-CR-70-4</td>
<td>1970</td>
</tr>
<tr>
<td>of a Small North Orienting Device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Miniaturized Gyrocompass)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Study of a Large Format Printer (LFP)</td>
<td>ETL-0368</td>
<td>1984</td>
</tr>
<tr>
<td>Desk Model Fotosetter Photo-Lettering Machine</td>
<td>1329-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Detecting Line-Road and Road-Intersection Patterns at Various Angles</td>
<td>ETL-0274</td>
<td>1981</td>
</tr>
<tr>
<td>Determination of Height Differences from Gravity and Gravity Gradients</td>
<td>ETL-71-CR-10</td>
<td>1971</td>
</tr>
<tr>
<td>Determination of Level Sensitivity (Field Calibration with the Level on the Instrument)</td>
<td>ETL-RN-74-4</td>
<td>1974</td>
</tr>
<tr>
<td>Determination of the Geometrical Quality of Comparators for Image Coordinate Measurements</td>
<td>RN-3</td>
<td>1962</td>
</tr>
<tr>
<td>Determinations and Statistical Studies of Gravimetric Deflections</td>
<td>ETL-CR-74-8</td>
<td>1973</td>
</tr>
<tr>
<td>Determinations and Statistical Studies of Gravimetric Deflections, Final Report</td>
<td>ETL-0017</td>
<td>1975</td>
</tr>
<tr>
<td>Determinations of Direct and Inverse Azimuths, Zenith Distance, Hour Angle, Declination and Distance Between Two Points on Normal Sections</td>
<td>RN-19</td>
<td>1967</td>
</tr>
<tr>
<td>Determining an Azimuth with a Gyrotheodolite</td>
<td>ETL-0440</td>
<td>1986</td>
</tr>
<tr>
<td>Determining the Translation of a Rigidly Moving Surface, Without Correspondence</td>
<td>ETL-0475</td>
<td>1986</td>
</tr>
<tr>
<td>Developing a Data Base for Predicting Soviet Tactical Behavior</td>
<td>ETL-0015</td>
<td>1975</td>
</tr>
<tr>
<td>Development of a High Precision Capability for Monitoring Structural Movements of Locks and Dams</td>
<td>ETL-0121</td>
<td>1977</td>
</tr>
<tr>
<td>Development of a Prototype Family of Military Geographic Intelligence Products to Support Airmobile Operations</td>
<td>ETL-ETR-70-7</td>
<td>1970</td>
</tr>
<tr>
<td>Development of a Small North Orienting Device AD 869 896L</td>
<td></td>
<td>1970</td>
</tr>
<tr>
<td>Development of a Terrain Profile Recorder Image Point Transfer Instrument</td>
<td>AD 649 830</td>
<td>1967</td>
</tr>
<tr>
<td>Development of Automatic Names Placement Software ETL-0484</td>
<td></td>
<td>1987</td>
</tr>
<tr>
<td>Development of a Variscale Stereo Point Marking Instrument AD 643 722</td>
<td></td>
<td>1966</td>
</tr>
<tr>
<td>Title</td>
<td>Report No.</td>
<td>Year</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>Development of an Evaluation Model-Change Detector</td>
<td>ETL-TR-72-3</td>
<td>1972</td>
</tr>
<tr>
<td>Development of an Experimental Family of Military Geographic Intelligence (MGI) Products to Support Battlefield Sensor Activities</td>
<td>ETL-0565</td>
<td>1990</td>
</tr>
<tr>
<td>Development of Computer Vision Techniques for Automatic Feature Extraction</td>
<td>ETL-0451</td>
<td>1987</td>
</tr>
<tr>
<td>Development of Descriptor Sets for the Unambiguous Characterization of Geographic Features on SAR Imagery</td>
<td>ETL-0369</td>
<td>1984</td>
</tr>
<tr>
<td>Development of Electronic Control of a Superconducting Gravity Gradiometer</td>
<td>ETL-0397</td>
<td>1985</td>
</tr>
<tr>
<td>Development of Electronic Control of a Superconducting Gravity Gradiometer — Phase II</td>
<td>ETL-0447</td>
<td>1986</td>
</tr>
<tr>
<td>Development of Height Finder Oblique, Topographic</td>
<td>1383-TR</td>
<td>1954</td>
</tr>
<tr>
<td>Development of High Speed CRT Print Head Systems for Cartographic Applications</td>
<td>ETL-0213</td>
<td>1980</td>
</tr>
<tr>
<td>Development of Improved Area Correlation Techniques</td>
<td>ETL-CR-73-19</td>
<td>1973</td>
</tr>
<tr>
<td>Development of Lightweight Long-Range Survey System (LRSS)</td>
<td>AD 477 042</td>
<td>1965</td>
</tr>
<tr>
<td>Development of Spherical Map Sections and Transparent Conforming Overlays</td>
<td>1440-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Development, Test, Preparation, Delivery, and Installation of Algorithms for Optimal Adjustment of Inertial Survey Data</td>
<td>ETL-1307</td>
<td>1982</td>
</tr>
<tr>
<td>Developmental Optical Correlator</td>
<td>ETL-0033</td>
<td>1975</td>
</tr>
<tr>
<td>Digest of High Temperature Storage Literature</td>
<td>ETL-0152</td>
<td>1978</td>
</tr>
<tr>
<td>Digital Automatic Map Compilation System</td>
<td>AD 285 258</td>
<td>1962</td>
</tr>
<tr>
<td>Digital Cartographic Study and Benchmark</td>
<td>ETL-0168</td>
<td>1978</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Digital Cartographic Study and Benchmark — First Interim Technical Report</td>
<td>ETL-0090</td>
<td>1975</td>
</tr>
<tr>
<td>Digital Computer Program for the Solution of a Photogrammetric Net (Preparation of Maps from Aerial Photographs)</td>
<td>AD 711 858</td>
<td>1961</td>
</tr>
<tr>
<td>Digital Data Editing System</td>
<td>ETL-0146</td>
<td>1977</td>
</tr>
<tr>
<td>Digital Data to Pressplate Study</td>
<td>ETL-0044</td>
<td>1976</td>
</tr>
<tr>
<td>Digital Laser Platemaker Modifications</td>
<td>ETL-0379</td>
<td>1984</td>
</tr>
<tr>
<td>Digital Mapping Glossary</td>
<td>AD A782 328</td>
<td>1974</td>
</tr>
<tr>
<td>Digital Multicolor Recorders and Scanner</td>
<td>ETL-0551</td>
<td>1989</td>
</tr>
<tr>
<td>The Technology and the Equipment</td>
<td>ETL-ETR-72-1</td>
<td>1972</td>
</tr>
<tr>
<td>Digital Planimetric Compiler</td>
<td>ETL-0339</td>
<td>1983</td>
</tr>
<tr>
<td>Digital Pre-Press System Design Study</td>
<td>AD 448 230L</td>
<td>1964</td>
</tr>
<tr>
<td>Digital Rectification of Side-Looking Radar (DRESLR)</td>
<td>ETL-0019</td>
<td>1975</td>
</tr>
<tr>
<td>Digital Simulation of a Radar Image of Pisgah Crater Test Site, California</td>
<td>ETL-0108</td>
<td>1976</td>
</tr>
<tr>
<td>Digital Terrain Data Compaction Using Array Algebra</td>
<td>ETL-SR-6</td>
<td>1990</td>
</tr>
<tr>
<td>Digital Terrain Elevation Data Resolution and Requirements Study - Interim Report</td>
<td>ETL-0393</td>
<td>1985</td>
</tr>
<tr>
<td>Digital Terrain Elevation Model Analysis</td>
<td>1469-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Dimensionally Stable Opaque Cartographic Bases</td>
<td>ETL-0351</td>
<td>1984</td>
</tr>
<tr>
<td>Direct Digital Color Proofing Technology Overview</td>
<td>ETL-0139</td>
<td>1978</td>
</tr>
<tr>
<td>Direct Electronic Transforms for Feature Extraction</td>
<td>ETL-0215</td>
<td>1980</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>Discrimination of Water from Shadow Regions on Radar Imagery Using Computer Vision Techniques</td>
<td>ETL-0404</td>
<td>1985</td>
</tr>
<tr>
<td></td>
<td>ETL-SR-72-5</td>
<td>1972</td>
</tr>
<tr>
<td></td>
<td>ETL-0364</td>
<td>1984</td>
</tr>
<tr>
<td></td>
<td>ETL-0445</td>
<td>1986</td>
</tr>
<tr>
<td></td>
<td>ETL-0516</td>
<td>1988</td>
</tr>
<tr>
<td></td>
<td>ETL-0549</td>
<td>1989</td>
</tr>
<tr>
<td></td>
<td>RN-30</td>
<td>1968</td>
</tr>
<tr>
<td></td>
<td>ETL-CR-74-12</td>
<td>1974</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------</td>
<td>------</td>
</tr>
<tr>
<td>Electro-Optical Image Processing with an Image Storage Tube</td>
<td>AD A836 685</td>
<td>1968</td>
</tr>
<tr>
<td>Electrophotographic Imaging Materials Evaluation</td>
<td>ETL-0266</td>
<td>1981</td>
</tr>
<tr>
<td>Electrostatic Paper and Toner Development</td>
<td>ETL-0140</td>
<td>1978</td>
</tr>
<tr>
<td>Elevation Data Compaction by Polynomial Modeling</td>
<td>ETL-0328</td>
<td>1983</td>
</tr>
<tr>
<td>Elevation Data Edit Terminal</td>
<td>ETL-0503</td>
<td>1988</td>
</tr>
<tr>
<td>Empirical Surface Temperature Model, An</td>
<td>21-TR</td>
<td>1965</td>
</tr>
<tr>
<td>End of Year Report for Parallel Vision Algorithm</td>
<td>ETL-0467</td>
<td>1987</td>
</tr>
<tr>
<td>Design and Implementation</td>
<td>ETL-0463</td>
<td>1987</td>
</tr>
<tr>
<td>Engineer Design Test and Evaluation of a Planimetric Compiler</td>
<td>35-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Engineer Design Tests and Evaluation of a Multipower Army Stereoscope</td>
<td>12-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Engineer Route Reconnaissance Feasibility Study</td>
<td>AD 486 337L</td>
<td>1966</td>
</tr>
<tr>
<td>Engineer Test and Evaluation of the Command-Retrieval Information System/Direct Input (CRIS/DI)</td>
<td>42-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Engineer Tests of 2.5x Reduction Printer</td>
<td>ETL-ETR-74-7</td>
<td>1975</td>
</tr>
<tr>
<td>Engineering Design Test Report: Inertial Surveying Equipment (ISE)</td>
<td>16-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Engineering Evaluation of Pulsed Xenon Light Sources for Graphic Arts Use</td>
<td>2-TR</td>
<td>1961</td>
</tr>
<tr>
<td>Engineering Test Report: Elevation Meter, Ground</td>
<td>5-TR</td>
<td>1962</td>
</tr>
<tr>
<td>Engineering Test Report: Lightweight Gyro Azimuth Theodolite (Lear North-Seeking Gyro Model No. 11NG530A)</td>
<td>11-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Engineering Test Report Short Range Electronic Positioning Equipment (SREPE)</td>
<td>9-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Engineering Tests and Evaluation of a 9 by 18 inch Electronic Printer</td>
<td>1646-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Engineering Tests and Evaluation of Multiplex Reduction Printer for Metrogon and Distortion-Free Photography</td>
<td>1431-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Engineering Tests and Evaluation of Printers for the Preparation of 9½- by 9½-inch Diapositives for the Precision Stereoplotter</td>
<td>1538-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Engineering Tests and Evaluation of the Photogrammetric Transforming Printer for 20° Convergent Photograph</td>
<td>1497-TR</td>
<td>1957</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Engineering Tests of a Temperature-controlled Processing Unit, Deep-tank, for Photomechanical Film</td>
<td>1599-TR</td>
<td>1959</td>
</tr>
<tr>
<td>Engineering Tests of Diapositive Processing Unit</td>
<td>1628-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Engineering Tests of Interim Target Location Systems for Use in Controlled Areas</td>
<td>1498-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Engineering Tests of Interim Target Location Systems for Use in Uncontrolled Areas</td>
<td>1612-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Engineering Tests of Opaque Cartographic Bases</td>
<td>1290-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Engineering Tests of Scanning Stereoscope</td>
<td>1491-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Engineering Tests of the Cartographic Grid Ruler</td>
<td>1486-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Engineering Tests of the Cartographic Van Section of the Motorized Photomapping Train</td>
<td>1373-TR</td>
<td>1954</td>
</tr>
<tr>
<td>Engineering Tests of the PPI Radar Presentation Restitutor</td>
<td>1629-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Engineering Tests of Translucent Cartographic Bases</td>
<td>1461-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Engineering Tests of Two Printer-Developers, Ammonia Process, 24 Inch</td>
<td>1292-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Enhanced Photomap Evaluation Study</td>
<td>AD 651 396</td>
<td>1967</td>
</tr>
<tr>
<td>Enlarging Printer, 3x</td>
<td>ETL-0049</td>
<td>1976</td>
</tr>
<tr>
<td>Environmental Conditions Experienced by Rockets and Missiles in Storage, Transit, and Operations</td>
<td>ETL-CR-74-3-S</td>
<td>1973</td>
</tr>
<tr>
<td>Environmental Conditions Experienced by Rockets and Missiles in Storage, Transit, and Operations, Supplement</td>
<td>ETL-0129</td>
<td>1974</td>
</tr>
<tr>
<td>Environmental Conditions in a Tropical Forest Region in Thailand</td>
<td>ETL-0055</td>
<td>1976</td>
</tr>
<tr>
<td>Environmental Position Errors of the GPS — Army User Equipment</td>
<td>ETL-0079</td>
<td>1976</td>
</tr>
<tr>
<td>Equilibrium Figures and the Normal-spheroid of the Earth Mass-Functions and Isostasy</td>
<td>ETL-0232</td>
<td>1980</td>
</tr>
<tr>
<td>Equipment and Techniques for the Utilization of Convergent Photography in Mapping</td>
<td>ETL-0079</td>
<td>1976</td>
</tr>
<tr>
<td>Error-Free Compression of Digital Imagery</td>
<td>1583-TR</td>
<td>1959</td>
</tr>
<tr>
<td>Error Propagation into Orbital Positions</td>
<td>ETL-CR-73-13</td>
<td>1973</td>
</tr>
<tr>
<td>Error Propagation in Two-Photo Intersection</td>
<td>ETL-RN-72-1</td>
<td>1972</td>
</tr>
<tr>
<td>Error Statistics for Astrogeodetic Positions for an RGSS Test Course</td>
<td>ETL-0267</td>
<td>1981</td>
</tr>
<tr>
<td>Errors in Automatic Pass Point Mensuration Using Digital Techniques</td>
<td>ETL-0232</td>
<td>1980</td>
</tr>
<tr>
<td>Establishment of an Ideal World Geodetic System</td>
<td>AD 680 225</td>
<td>1968</td>
</tr>
<tr>
<td>ETAK Navigator Modification Final Report</td>
<td>ETL-0569</td>
<td>1990</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>ETL 211-OD Gravitational Model, A Union Solution of Optical and</td>
<td>AD 502 044L</td>
<td>1968</td>
</tr>
<tr>
<td>Doppler Satellite Determinations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating Soil Moisture and Textural Relationships Using Regression</td>
<td>ETL-0226</td>
<td>1980</td>
</tr>
<tr>
<td>Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation and Comparison of Terrain Classification Methods (Type</td>
<td>AD 845 338L</td>
<td>1968</td>
</tr>
<tr>
<td>III)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation and Test of a Five-Color Electrostatic Printing Machine</td>
<td>25-TR</td>
<td>1965</td>
</tr>
<tr>
<td>for the Reproduction of Topographic Maps and Charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation and Test of a Modified Plate Process Section, a Proposed</td>
<td>1560-TR</td>
<td>1959</td>
</tr>
<tr>
<td>New Photomechanical Process and a Redesigned Brush-Surfacing Machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation and Test of a Self-Contained Vehicle Land Navigation</td>
<td>ETL-0167</td>
<td>1979</td>
</tr>
<tr>
<td>System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for the Reproduction of Topographic Maps and Charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of a New Electrostatic Recording Medium</td>
<td>ETL-0102</td>
<td>1977</td>
</tr>
<tr>
<td>Evaluation of a Xerographic Process for Preparing Zinc Oxide-Silico</td>
<td>1545-TR</td>
<td>1958</td>
</tr>
<tr>
<td>ne, Binder-Type Lithographic Plates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Automatic Mapping APQ as a Radar Mapping System</td>
<td>31-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Evaluation of Coherent Radar Photography</td>
<td>18-TR</td>
<td>1963</td>
</tr>
<tr>
<td>from Multicolor Maps and Charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Color Test Photography for Military Geographic</td>
<td>ETL-TR-70-6</td>
<td>1970</td>
</tr>
<tr>
<td>Analysis: A Literature Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Components for Some Elevation-Determining Systems</td>
<td>AD 407 297L</td>
<td>1963</td>
</tr>
<tr>
<td>Evaluation of Conventional Correlation Methods When Matching</td>
<td>ETL-0195</td>
<td>1979</td>
</tr>
<tr>
<td>Infrared Imagery to Panchromatic Imagery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Experimental Xerographic Process for Lithographic</td>
<td>1417-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Platemaking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of High Precision SHORAN-Controlled Photography</td>
<td>1484-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Evaluation of Land Use Techniques for Processing MGI</td>
<td>AD 817 124L</td>
<td>1967</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Evaluation of Multiband and Color Aerial Photography for Selected Military Geographic Intelligence in a Subtropical Desert Environment</td>
<td>54-TR</td>
<td>1970</td>
</tr>
<tr>
<td>Evaluation of Offset Collotype Printing for the Field Reproduction of Aerial Photographs</td>
<td>1465-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Evaluation of Pointing to a Sharp Edge</td>
<td>AD 668 260</td>
<td>1968</td>
</tr>
<tr>
<td>Evaluation of Published Criteria for Identifying Metamorphic Rocks on Air Photos: Two Case Studies in the Northeastern United States</td>
<td>ETL-0326</td>
<td>1983</td>
</tr>
<tr>
<td>Evaluation of Registering Image Gradients When Matching Infrared Imagery to Panchromatic Imagery</td>
<td>ETL-0250</td>
<td>1981</td>
</tr>
<tr>
<td>Evaluation of Single and Multicolor Map and Chart Reproduction Equipment</td>
<td>ETL-0080</td>
<td>1976</td>
</tr>
<tr>
<td>Evaluation of the Method of Determining Parallax from Measured Phase Difference</td>
<td>ETL-0145</td>
<td>1977</td>
</tr>
<tr>
<td>Evaluation of the Prototype, Natural-Image Computer</td>
<td>48-TR</td>
<td>1969</td>
</tr>
<tr>
<td>Evaluation of the Stellar-Moon Camera System</td>
<td>AD 673 270</td>
<td>1968</td>
</tr>
<tr>
<td>Evaluation Tests of Royal Zenith, 29 Press</td>
<td>1490-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Evidential Reasoning in Expert Systems for Image Analysis</td>
<td>ETL-0381</td>
<td>1985</td>
</tr>
<tr>
<td>Experimental Assessment of Improved Spatial Resolution LANDSAT Data</td>
<td>ETL-0268</td>
<td>1981</td>
</tr>
<tr>
<td>Experimental Correlator Studies</td>
<td>AD 374 450L</td>
<td>1966</td>
</tr>
<tr>
<td>Experimental Determinations of Fringe Counting</td>
<td>RN-26</td>
<td>1967</td>
</tr>
<tr>
<td>Errors Associated with Rotation of a Corner Cube Forming an Arm of a Laser Interferometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Heterodyne Optical Correlator</td>
<td>ETL-0071</td>
<td>1976</td>
</tr>
<tr>
<td>Experimental Production of Military Geographic Intelligence Products from Side-Looking Airborne Radar Imagery</td>
<td>AD 376 554</td>
<td>1966</td>
</tr>
<tr>
<td>Expert System for Minefield Site Prediction, Phase I, First Year Report</td>
<td>ETL-0492</td>
<td>1988</td>
</tr>
<tr>
<td>Expert Vision System for Autonomous Land Vehicle Road Following, An</td>
<td>ETL-0489</td>
<td>1988</td>
</tr>
<tr>
<td>Extended Area Exit Pupil Viewer</td>
<td>ETL-0399</td>
<td>1985</td>
</tr>
<tr>
<td>Title</td>
<td>Report No.</td>
<td>Year</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Extension of Kendall's Concordance Test Where Ties are Allowed, An</td>
<td>ETL-0316</td>
<td>1983</td>
</tr>
<tr>
<td>Extraction of Mapping Detail from Radar Photography</td>
<td>AD 328 256</td>
<td>1961</td>
</tr>
<tr>
<td>Extraction of Mapping Detail from Radar Photography</td>
<td>AD 328 257</td>
<td>1961</td>
</tr>
<tr>
<td>Feasibility of a Reduced Power-Consumption Magnetometer for Use in a Digicomps Lensatic Compass</td>
<td>ETL-0547</td>
<td>1989</td>
</tr>
<tr>
<td>Feasibility of Using Optical Power Spectrum Analysis Techniques for Automatic Feature Classification from High Resolution Thermal, Radar, and Panchromatic Imagery</td>
<td>ETL-0186</td>
<td>1979</td>
</tr>
<tr>
<td>Feasibility Study for an All-Weather Surveying Signal Light</td>
<td>37-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Feasibility Study for Field Generation of Input for Radar Scene Generation from DLMS Terrain and Elevation Data</td>
<td>ETL-0203</td>
<td>1978</td>
</tr>
<tr>
<td>Feasibility Study of a Quick Response Multicolor Printer (QRMP)</td>
<td>ETL-0242</td>
<td>1980</td>
</tr>
<tr>
<td>Feasibility Test of a Proposed 3-D Radar System</td>
<td>AD 349 882L</td>
<td>1964</td>
</tr>
<tr>
<td>Feature Analysis and Reduction of Laws Texture Measure</td>
<td>ETL-0343</td>
<td>1983</td>
</tr>
<tr>
<td>Feature Component Reduction Through Divergence Analysis</td>
<td>ETL-0305</td>
<td>1982</td>
</tr>
<tr>
<td>Feature Extraction Assessment Study, Final Report</td>
<td>ETL-0377</td>
<td>1984</td>
</tr>
<tr>
<td>Feature Extraction of the Illiac IV</td>
<td>ETL-0191</td>
<td>1979</td>
</tr>
<tr>
<td>Feature Tagging</td>
<td>ETL-0227</td>
<td>1980</td>
</tr>
<tr>
<td>FEED Evaluation</td>
<td>ETL-0322</td>
<td>1983</td>
</tr>
<tr>
<td>FEED Software Documentation</td>
<td>ETL-0335</td>
<td>1983</td>
</tr>
<tr>
<td>Fictitious Data Generator for Analytical Aerotriangulation</td>
<td>AD 640 799</td>
<td>1965</td>
</tr>
<tr>
<td>Field Artillery Plotting Equipment</td>
<td>1421-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Final Report, Development of Mirror Stereoscope</td>
<td>1382-TR</td>
<td>1954</td>
</tr>
<tr>
<td>Final Report on Stable Cartographic Bases</td>
<td>1542-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Finite Element Models of the Earth's Gravity Field Phase IV</td>
<td>ETL-0198</td>
<td>1979</td>
</tr>
<tr>
<td>Five-Color Separation Investigation</td>
<td>AD 662 725</td>
<td>1967</td>
</tr>
</tbody>
</table>
Fixed and Multiple Frequency Angle Measurements with 35-GHz Microwaves

Floodplain Tree Species: A Bibliographic Literature Search with Abstracts

Flux Valve Heading Reference System

Forced Dynamics of Asymmetric Spacecraft

Forecast for the 1970's in Mapping, Charting, and Geodesy Research and Development

Formulas for Computing Atmospheric Refraction for Objects Inside or Outside the Atmosphere

Formulation of a Space Oblique Mercator Map Projection


Fourier Transform Autocorrelation

Fractures in Rock: An Annotated Bibliography

Frequency Dependence of Backscatter from Rough Surfaces (An Experiment with Broad-Spectrum Acoustic Waves)

Full View Holograms

Further Investigation of an Electronic Angle-Measuring Device

Further Study of Digital Matching of Dissimilar Images

Gamma-Ray Spectrometer Study

GEISHA Computer Theory of Operation

General Climatological Guide to Daily Freezing Conditions: Frost Days, Ice Days, and Freeze-Thaw Days, A

General Noniterative Solution of the Inverse and Direct Geodetic Problems

General Programming on a Parallel Processor

Geocentric Position and/or Orbital Parameters with Star Satellite Photography from a Single Camera Station

Geodetic Control by Means of Astronomic and Torsion Balance Observations and the Gravimetric Reduction of Levelling

Geodetic Control without Triangulation, Trilateration, or Gravity Data and Gravimetric Reduction of Levelling

1st Interim Report

2nd Interim Report

3rd Interim Report

Geodetic SECOR
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geodetic SECOR Ground Equipment</td>
<td>AD 721 649</td>
<td>1964</td>
</tr>
<tr>
<td>Geodetic SECOR Satellite</td>
<td>ETL-TR-74-6</td>
<td>1974</td>
</tr>
<tr>
<td>Geodetic SECOR Wide-BandRF Subsystem</td>
<td>AD 721 641</td>
<td>1967</td>
</tr>
<tr>
<td>Geodetic SECOR Wide-Band RF Subsystem for SECOR Ground Equipment Sets</td>
<td>AD 824 780L</td>
<td>1967</td>
</tr>
<tr>
<td>Geodetic SECOR Wide-Band System</td>
<td>AD 721 640</td>
<td>1966</td>
</tr>
<tr>
<td>Geodetic Spacecraft, Final Report</td>
<td>AD 721 650</td>
<td>1961</td>
</tr>
<tr>
<td>Geodetic Spacecraft, Addendum</td>
<td>AD 721 651</td>
<td>1961</td>
</tr>
<tr>
<td>Geodimeter, Models I and II</td>
<td>1495-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Geographic Modelling of Insurgency Resources</td>
<td>AD 848 723L</td>
<td>1969</td>
</tr>
<tr>
<td>Geographic Modelling of Insurgency Resources, Appendix</td>
<td>AD 851 896L</td>
<td>1969</td>
</tr>
<tr>
<td>Geoid Representation from Satellite-Determined Coefficients</td>
<td>AD 634 541</td>
<td>1966</td>
</tr>
<tr>
<td>Geologic Evaluation of Radar Imagery from Darien Province, Panama</td>
<td>AD 853 884</td>
<td>1969</td>
</tr>
<tr>
<td>Geometric Simultaneous Multistation Determination, with Constraints,</td>
<td>RN-22</td>
<td>1967</td>
</tr>
<tr>
<td>Using Data from Geodetic Satellites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometrical Quality of Lunar Mapping by Photogrammetric Methods</td>
<td>RN-9</td>
<td>1962</td>
</tr>
<tr>
<td>Geomorphic Evaluation of Radar Imagery of Southeastern Panama and</td>
<td>ETL-CR-71-2</td>
<td>1971</td>
</tr>
<tr>
<td>Northwestern Columbia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geopotential Determination from Satellite to Satellite Tracking and Satellite Altimetry</td>
<td>ETL-CR-74-21</td>
<td>1975</td>
</tr>
<tr>
<td>Geopotential Determination from Satellite to Satellite Tracking and Satellite Altimetry, Supplement I</td>
<td>ETL-CR-74-21-S</td>
<td>1975</td>
</tr>
<tr>
<td>GEOPS</td>
<td>RN-25</td>
<td>1967</td>
</tr>
<tr>
<td>Geo-Spin Precision Inertial Survey</td>
<td>ETL-0135</td>
<td>1978</td>
</tr>
<tr>
<td>Gigas-Zeiss Digital Control Unit</td>
<td>ETL-ETR-73-1</td>
<td>1973</td>
</tr>
<tr>
<td>Gradiometer-Aided Rapid Gravity Survey System</td>
<td>ETL-0112</td>
<td>1977</td>
</tr>
<tr>
<td>Graphic Arts Symbol Generating Hardware for a Gerber Plotting System</td>
<td>ETL-CR-74-14</td>
<td>1974</td>
</tr>
<tr>
<td>Graphic Data Handling Techniques</td>
<td>AD 659 807</td>
<td>1967</td>
</tr>
<tr>
<td>Gravimetric Geodesy Free of Density Estimates through Analysis of</td>
<td>RN-12</td>
<td>1963</td>
</tr>
<tr>
<td>Discrete Gravity Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravity Anomalies as Indicators of Groundwater Reserves in Glacial</td>
<td>ETL-CR-73-16</td>
<td>1973</td>
</tr>
<tr>
<td>Deposits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravity Correlation Studies for Determination of the Gravity Field of</td>
<td>AD 866 798L</td>
<td>1970</td>
</tr>
<tr>
<td>the Earth</td>
<td>ETL-0262</td>
<td>1981</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Gravity Study Program, Interim Report</td>
<td>ETL-0253</td>
<td>1981</td>
</tr>
<tr>
<td>Ground Target Location Errors Derived From</td>
<td>ETL-0538</td>
<td>1989</td>
</tr>
<tr>
<td>Hail and Its Distribution</td>
<td>ETL-SR-73-3</td>
<td>1973</td>
</tr>
<tr>
<td>Hexagonal Data Base Study</td>
<td>ETL-0338</td>
<td>1983</td>
</tr>
<tr>
<td>Hexagonal Data Base Study, Phase II</td>
<td>ETL-0360</td>
<td>1984</td>
</tr>
<tr>
<td>High Resolution Optical Power Spectrum Analyzer</td>
<td>ETL-0127</td>
<td>1978</td>
</tr>
<tr>
<td>High Resolution Orthophoto Output Table (HIROOT)</td>
<td>AD 856 731L</td>
<td>1969</td>
</tr>
<tr>
<td>High Resolution Orthophoto Output Table</td>
<td>ETL-ETR-72-3</td>
<td>1972</td>
</tr>
<tr>
<td>High Speed Disc Memory and a Color Image Display for a Small Computer</td>
<td>AD 878 975L</td>
<td>1970</td>
</tr>
<tr>
<td>High-Speed, Large-Format Film Writer Methodologies and Design Study</td>
<td>ETL-0389</td>
<td>1985</td>
</tr>
<tr>
<td>High Speed Parallel Sensing Scheme</td>
<td>ETL-0119</td>
<td>1977</td>
</tr>
<tr>
<td>History of U.S. Army Engineer Topographic Laboratories (1920 to 1970)</td>
<td>ETL-SR-74-1</td>
<td>1973</td>
</tr>
<tr>
<td>Holographic Compensation of Wavefront Aberrations</td>
<td>ETL-RN-74-11</td>
<td>1975</td>
</tr>
<tr>
<td>Holographic Optical Elements With Low Q-Factors</td>
<td>ETL-0123</td>
<td>1977</td>
</tr>
<tr>
<td>Holographic Ray Tracing and Spot Diagrams</td>
<td>ETL-0052</td>
<td>1975</td>
</tr>
<tr>
<td>Holographic Stereogram Display Techniques for the Viewing and Mensuration of Stereo Photogrammetric Imagery</td>
<td>ETL-CR-74-2</td>
<td>1973</td>
</tr>
<tr>
<td>Holographic Terrain Displays</td>
<td>ETL-0083</td>
<td>1976</td>
</tr>
<tr>
<td>Holography and Stereoscopy</td>
<td>ETL-CR-72-2</td>
<td>1972</td>
</tr>
<tr>
<td>Horizontal Gradients of Gravity in Geodesy</td>
<td>AD 672 492</td>
<td>1964</td>
</tr>
<tr>
<td>Horizontal Gradients of Gravity in S.W. Ohio</td>
<td>AD 672 489</td>
<td>1967</td>
</tr>
<tr>
<td>Hot Weather Testing of 10-Second Direction</td>
<td>1289-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Theodolite with Universal Tribrach and Universal Tripod, Astronomical Attachment, Universal Sun Compass, Lensatic Compass, and Wrist Compass Air Photo Patterns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hough Transform on the Butterfly and the NCUBE, The</td>
<td>ETL-0438</td>
<td>1986</td>
</tr>
<tr>
<td>Hourly and Daily Precipitation Frequencies for the United States</td>
<td>ETL-0498</td>
<td>1988</td>
</tr>
<tr>
<td>Hybrid Methodology for Detecting Cartographically Significant Features Using Landsat TM Imagery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperspectral Signatures (400 to 2500 nm) of Vegetation, Minerals, Soils, Rocks, and Cultural Features: I. Laboratory and Field Measurements</td>
<td>ETL-0573</td>
<td>1990</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>IBIS Query — Software to Support the Image Based Information System (IBIS) Expansion for Mapping, Charting, and Geodesy</td>
<td>ETL-0422</td>
<td>1986</td>
</tr>
<tr>
<td>Image Alignment and Correlation System</td>
<td>ETL-0237</td>
<td>1980</td>
</tr>
<tr>
<td>Image-Based Approach to Mapping, Charting, and Geodesy</td>
<td>ETL-0366</td>
<td>1982</td>
</tr>
<tr>
<td>Image Correlation on a Parallel Processor</td>
<td>ETL-0061</td>
<td>1976</td>
</tr>
<tr>
<td>Image Enhancement by Chemical Intensification</td>
<td>ETL-0014</td>
<td>1975</td>
</tr>
<tr>
<td>Image-Processing Precision and Affecting Relative Orientation</td>
<td>ETL-RN-71-6</td>
<td>1971</td>
</tr>
<tr>
<td>Image Scanner Technology Study</td>
<td>ETL-0137</td>
<td>1978</td>
</tr>
<tr>
<td>Image Tube Validation Study</td>
<td>ETL-CR-70-5</td>
<td>1970</td>
</tr>
<tr>
<td>Implications of Symbol Usage on U.S. Army Maps for an Automated Cartographic System</td>
<td>AD 667 979</td>
<td>1968</td>
</tr>
<tr>
<td>Implications of Symbol Usage on U.S. Army Maps for an Automated Cartographic System, Appendix</td>
<td>AD 667 986</td>
<td>1968</td>
</tr>
<tr>
<td>Improvement Program Automatic Map Compilation System</td>
<td>AD 442 522</td>
<td>1964</td>
</tr>
<tr>
<td>Improving Classification Accuracy of Radar Images Using a Multiple-Stage Classifier</td>
<td>ETL-0502</td>
<td>1988</td>
</tr>
<tr>
<td>Inertial Platform Subsystem for Army Artillery Inertial Survey System (GEISHA)</td>
<td>AD 681 931</td>
<td>1962</td>
</tr>
<tr>
<td>Inertial Positioning System Test Data Summary Report</td>
<td>ETL-0028</td>
<td>1975</td>
</tr>
<tr>
<td>Inertial Survey Applications to Civil Works</td>
<td>ETL-0309</td>
<td>1983</td>
</tr>
<tr>
<td>Inertial Survey Equipment (GEISHA)</td>
<td>AD 814 051</td>
<td>1963</td>
</tr>
<tr>
<td>Inferential Techniques for Soil Depth Determinations, Part I: Coleogyne ramossissima Torr. (Black-Brush)</td>
<td>ETL-0036</td>
<td>1975</td>
</tr>
<tr>
<td>Inferential Techniques for Soil Depth Determinations, Part II: Artemisia filifolia Torr. (Sand Sagebrush)</td>
<td>ETL-0176</td>
<td>1979</td>
</tr>
<tr>
<td>Influence of Atmospheric Refraction on Directions Measured to and from a Satellite Instrument for Measuring Absolute Acceleration of Gravity</td>
<td>RN-10</td>
<td>1963</td>
</tr>
<tr>
<td>Instrument to Measure the Tilt of Large Structures, An Instrumentation for Color Aerial Photography</td>
<td>ETL-0313</td>
<td>1983</td>
</tr>
<tr>
<td></td>
<td>ETL-RN-70-1</td>
<td>1970</td>
</tr>
</tbody>
</table>
Integration of Artificial Intelligence Concepts into the Methods for Extracting Line Objects from Monochromatic Aerial Imagery

Intelligent Advisors for Cross-Country Route Planning

Interactive Digital Correlation Techniques for Automatic Compilation of Elevation Data

Interactive Digital Image Processing for Terrain Data Extraction

Interactive Digital Image Processing for Terrain Data Extraction, Phase 2

Interactive Digital Image Processing for Terrain Data Extraction, Phase 3

Interactive Digital Image Processing for Terrain Data Extraction, Phase 4

Interactive Digital Image Processing for Terrain Data Extraction, Phase 5

Interactive Digital Image Processing Investigation

Interactive Digital Image Processing Investigation, Phase II

Interactive Image Analysis System Design

Interactive Knowledge-Based Cartographic Feature Extraction

Interagency Energy and Environmental Survey

Interferometer Data Reduction Study

Interim Solution Rectifier Van


Interpolation of Deflections from Horizontal Gravity Gradients

Interpolation of Gravity Anomalies and Deflection of the Vertical Components from Rapid Gravity Survey System Data

Interpretation of Radar Imagery for Terrain Analysis in Tropical Environments

Introduction to the Terrain Effects on the Intelligence Preparation of the Battlefield (IPB)

Inverse Perspective of a Road from a Single Image

Inverse Scattering Applications in Determining Terrain Feature Parameters

Investigation and Evaluation of Planigon Lens Distortion Characteristics
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation of Bjerhammar’s New Gravity Reduction Method</td>
<td>AD 460 404</td>
<td>1964</td>
</tr>
<tr>
<td>Investigation of Cartographic Pressplate Recording from Digital Data</td>
<td>ETL-0043</td>
<td>1976</td>
</tr>
<tr>
<td>Investigation of Continuous Photoconductive Layer Arrays</td>
<td>ETL-0011</td>
<td>1975</td>
</tr>
<tr>
<td>Investigation of Discrete Function Technology for Topographic Sciences</td>
<td>ETL-0162</td>
<td>1978</td>
</tr>
<tr>
<td>Investigation of Electro-Acoustic Technology for Topographic Application</td>
<td>ETL-0160</td>
<td>1978</td>
</tr>
<tr>
<td>Investigation of Extrema in Digital Images for Texture Analysis</td>
<td>ETL-0210</td>
<td>1979</td>
</tr>
<tr>
<td>Investigation of Fusion and Fixation Disparity Limits for Photogrammetry</td>
<td>AD 625 217</td>
<td>1965</td>
</tr>
<tr>
<td>Investigation of Linear Transformations for Automatic Cartographic Analysis</td>
<td>ETL-0181</td>
<td>1979</td>
</tr>
<tr>
<td>Investigation of Multiband Photographic Techniques, Vol. I</td>
<td>AD 479 300L</td>
<td>1965</td>
</tr>
<tr>
<td>Investigation of Photographic Mapping Detail and Data Encoding</td>
<td>AD 286 715</td>
<td>1962</td>
</tr>
<tr>
<td>Investigation of Techniques to Generate Contours from Stereo Pairs</td>
<td>ETL-0029</td>
<td>1975</td>
</tr>
<tr>
<td>Investigation of the Application of &quot;Array Algebra&quot; to Terrain Modeling</td>
<td>ETL-0141</td>
<td>1978</td>
</tr>
<tr>
<td>Investigation of the Electronic Distance Measuring Equipment Electrotape</td>
<td>AD 460 401L</td>
<td>1964</td>
</tr>
<tr>
<td>Investigation of the Geometrical Quality of the Relative and Absolute Orientation Procedures and the Final Results of the Photogrammetric Procedure</td>
<td>RN-6</td>
<td>1962</td>
</tr>
<tr>
<td>Investigations into the Problems of Relative Orientation in Stereo Aerial Photogrammetry</td>
<td>AD 452 686L</td>
<td>1964</td>
</tr>
<tr>
<td>Investigations of Basic Geometric Quality of Aerial Photographs and Some Related Problems</td>
<td>RN-4</td>
<td>1962</td>
</tr>
<tr>
<td>Investigations of the Use of Conventional Films in the ETL Cartographic EBR</td>
<td>ETL-0177</td>
<td>1979</td>
</tr>
<tr>
<td>InvestigationsRelated to the Establishment of a World Geodetic System</td>
<td>AD 697 163</td>
<td>1969</td>
</tr>
<tr>
<td>IRS: A Simulator for Autonomous Land Vehicle Navigation</td>
<td>ETL-0455</td>
<td>1987</td>
</tr>
<tr>
<td>Joint Analyses in Glen Canyon National Recreational Area</td>
<td>ETL-0073</td>
<td>1976</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Kalman Filtering and Smoothing in Fotonap for Orbit Determination</td>
<td>ETL-0161</td>
<td>1978</td>
</tr>
<tr>
<td>using GPS Measurements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Analysis of Scene Dynamics for Target Motion</td>
<td>ETL-CR-71-3</td>
<td>1971</td>
</tr>
<tr>
<td>Detection, Recognition, and Tracking</td>
<td>ETL-0486</td>
<td>1987</td>
</tr>
<tr>
<td>Knowledge-Based Analysis of Scene Dynamics</td>
<td>ETL-0525</td>
<td>1989</td>
</tr>
<tr>
<td>for Target Motion Detection, Recognition and Tracking, Second Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Images Analysis</td>
<td>ETL-0258</td>
<td>1981</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques (March 1985 - March 1986)</td>
<td>ETL-0431</td>
<td>1986</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques: Obstacle Detection and</td>
<td>ETL-0536</td>
<td>1989</td>
</tr>
<tr>
<td>Avoidance, Fourth Annual Report</td>
<td>ETL-0521</td>
<td>1988</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques, Third Annual Report</td>
<td>ETL-0439</td>
<td>1986</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques for the Autonomous Land</td>
<td>ETL-0507</td>
<td>1988</td>
</tr>
<tr>
<td>Vehicle Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques for the Autonomous Land Vehicle</td>
<td>ETL-0512</td>
<td>1988</td>
</tr>
<tr>
<td>(ALV) Program, Second Annual Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques for the Autonomous Land Vehicle</td>
<td>ETL-0582</td>
<td>1990</td>
</tr>
<tr>
<td>(ALV) Program, Third Annual Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques - Task B: Terrain and</td>
<td>ETL-0557</td>
<td>1990</td>
</tr>
<tr>
<td>Object Modeling Recognition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Executive Summary</td>
<td>ETL-0428</td>
<td>1986</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques — Task B: Terrain and</td>
<td>ETL-0485</td>
<td>1987</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques — Task B: Terrain and</td>
<td>ETL-0535</td>
<td>1989</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B:</td>
<td>ETL-0558</td>
<td>1990</td>
</tr>
<tr>
<td>Terrain and Object Modeling Recognition,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third Annual Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terrain and Object Modeling Recognition - Volume I: Autonomous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems for Navigation and Terrain Recognition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B:</td>
<td>ETL-0559</td>
<td>1990</td>
</tr>
<tr>
<td>Terrain and Object Modeling Recognition - Volume II: Tech Base Vision Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Based Vision Techniques Task B:</td>
<td>ETL-0560</td>
<td>1990</td>
</tr>
<tr>
<td>Terrain and Object Modeling Recognition - Volume III: Image Understanding Software Environments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KT2 Gyro-Theodolite (Otto Fennel GMBH &amp; Co)</td>
<td>57-TR</td>
<td>1970</td>
</tr>
<tr>
<td>Land Cover Classification from LANDSAT Data: Phase III of a Joint OCE/NASA Demonstration</td>
<td>ETL-0175</td>
<td>1979</td>
</tr>
<tr>
<td>Landforms of Granitic Rocks: An Annotated Bibliography, The LANDSAT and DMA Elevation Study</td>
<td>ETL-0386</td>
<td>1984</td>
</tr>
<tr>
<td>LANDSAT D: Corps of Engineers Interface with Advanced NASA Ground Systems Study</td>
<td>ETL-0151</td>
<td>1978</td>
</tr>
<tr>
<td>LASS-II Rapid Geodetic Survey System (RGSS)</td>
<td>ETL-0518</td>
<td>1986</td>
</tr>
<tr>
<td>Light, Target for Ranging Pole</td>
<td>1402-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Lightweight North-Seeking Gyro Azimuth Surveying Instrument, Model 11NG531A</td>
<td>AD 486 317</td>
<td>1965</td>
</tr>
<tr>
<td>Lightweight North-Seeking Gyro Azimuth Surveying Instrument, Model 11NG531B</td>
<td>AD 844 011L</td>
<td>1968</td>
</tr>
<tr>
<td>Linear Feature Extraction from Radar Imagery</td>
<td>ETL-0405</td>
<td>1985</td>
</tr>
<tr>
<td>Linear Feature Extraction from Radar Imagery, SBIR Phase II Base Contract</td>
<td>ETL-0469</td>
<td>1987</td>
</tr>
<tr>
<td>Linear Feature Extraction From Radar Imagery:</td>
<td>ETL-0497</td>
<td>1988</td>
</tr>
<tr>
<td>SBIR Phase II, Option I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Feature Extraction From Radar Imagery:</td>
<td>ETL-0530</td>
<td>1988</td>
</tr>
<tr>
<td>SBIR Phase II, Option II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.N.K. Software Systems for Transferring, Merging, and Displaying DFAD/DTED Data on AMS/CAPIR</td>
<td>ETL-0318</td>
<td>1983</td>
</tr>
<tr>
<td>Local Gravity Field Modeling</td>
<td>ETL-0448</td>
<td>1986</td>
</tr>
<tr>
<td>Long Range Survey System</td>
<td>AD 356 441L</td>
<td>1964</td>
</tr>
<tr>
<td>Long Range Surveying System</td>
<td>AD 328 203</td>
<td>1960</td>
</tr>
<tr>
<td>Low Cost Gyrocompass</td>
<td>ETL-0355</td>
<td>1984</td>
</tr>
<tr>
<td>Low Light Level Photography</td>
<td>32-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Manual and Automated Line Generalization and Feature Displacement</td>
<td>ETL-0359</td>
<td>1984</td>
</tr>
<tr>
<td>Manual for Maintenance and Operation of the MB-1 Multiband Aerial Camera</td>
<td>ETL-0040</td>
<td>1976</td>
</tr>
<tr>
<td>Map Coating Concept Studies</td>
<td>AD 679 215</td>
<td>1968</td>
</tr>
<tr>
<td>Map Illuminator Test, Phase I</td>
<td>ETL-0034</td>
<td>1975</td>
</tr>
<tr>
<td>MAPCON Design Study</td>
<td>AD 854 619L</td>
<td>1967</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>------------------</td>
<td>------</td>
</tr>
<tr>
<td>Mapping Camera Image Errors Due to Star</td>
<td>ETL-RN-73-1</td>
<td>1973</td>
</tr>
<tr>
<td>Camera Identification and Measuring Errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping from Airborne Radar Scope Presentations</td>
<td>1397-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Mapping from Radar Presentations, Second Interim Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping from Side-Looking Radar</td>
<td>AD 392 041L</td>
<td>1968</td>
</tr>
<tr>
<td>Mapping with Minimum Ground Control</td>
<td>1483-TR</td>
<td>1957</td>
</tr>
<tr>
<td>MAT Transponder Model No. 10002</td>
<td>AD 721 638</td>
<td>1967</td>
</tr>
<tr>
<td>Materials Research for Holographic Recording (Report No. 1)</td>
<td>ETL-0088</td>
<td>1976</td>
</tr>
<tr>
<td>Multiple Image Storage of Continuous Tone Data in Volume Holograms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Research for Holographic Recording (Report No. 2)</td>
<td>ETL-0156</td>
<td>1978</td>
</tr>
<tr>
<td>Bleaching Methods for Photographically Recorded Holograms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Research for Holographic Recording (Report No. 3)</td>
<td>ETL-0197</td>
<td>1979</td>
</tr>
<tr>
<td>Hardened Gelatin Holographic Recording Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical Analysis of a Technique for the Calibration of a Synthetic Aperture Radar</td>
<td>43-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Mathematical Techniques for Automated Cartography</td>
<td>ETL-CR-73-4</td>
<td>1973</td>
</tr>
<tr>
<td>Mathematics of Geodetic SECOR Data Processing</td>
<td>AD 721 837</td>
<td>1964</td>
</tr>
<tr>
<td>MATS Performance with the SECOR System</td>
<td>AD 721 635</td>
<td>no date</td>
</tr>
<tr>
<td>MATS Transponder</td>
<td>AD 721 634</td>
<td>1966</td>
</tr>
<tr>
<td>Measurement of the Change in the Deflection of the Vertical with a Schuler-Tuned North-Slaved Inertial System</td>
<td>ETL-0138</td>
<td>1977</td>
</tr>
<tr>
<td>Measurement Techniques of Electrical Parameters of Surface Materials in the X-Band Region</td>
<td>ETL-0304</td>
<td>1982</td>
</tr>
<tr>
<td>Mensuration and Reduction Accuracy and Precision Standard Applicable to an Integrated Worldwide Topographic System</td>
<td>58-TR</td>
<td>1970</td>
</tr>
<tr>
<td>Methodological Preliminaries to the Development of an Expert System for Aerial Photo Interpretation</td>
<td>ETL-0342</td>
<td>1984</td>
</tr>
<tr>
<td>Methodology for Military Geographic Analysis</td>
<td>36-TR</td>
<td>1967</td>
</tr>
<tr>
<td>Methods and Results of Remote Barometric Altimetry and Views on the Estimation of Meteorological Field Variables</td>
<td>ETL-RN-73-3</td>
<td>1973</td>
</tr>
<tr>
<td>Title</td>
<td>Report No.</td>
<td>Year</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>Methods for Calculating Atmospheric Refraction and Its Perturbation</td>
<td>ETL-0299</td>
<td>1982</td>
</tr>
<tr>
<td>Micromap Camera for Display Systems</td>
<td>ETL-ETR-71-5</td>
<td>1971</td>
</tr>
<tr>
<td>Micreduction and Enlargement of Graphic Information Study (MEGIS)</td>
<td>ETL-0063</td>
<td>1977</td>
</tr>
<tr>
<td>Microwave Pointing Variations and Angle Measurements</td>
<td>26-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Military Applications of Multiband Aerial Photography (Report No. 5 in</td>
<td>ETL-0030</td>
<td>1975</td>
</tr>
<tr>
<td>the ETL Series on Remote Sensing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Military Geographic Intelligence Products</td>
<td>ETL-ETR-70-10</td>
<td>1970</td>
</tr>
<tr>
<td>Associated with the SLAR Topo Map Test in Panama</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Military Potential Test of Selected Items of Hydrologic Survey</td>
<td>AD 890 746</td>
<td>1971</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Military Significance of the USAETL Research</td>
<td>RN-34</td>
<td>1970</td>
</tr>
<tr>
<td>Note &quot;A New Solution for the Anomalous Gravity Potential Resulting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from a Modification of Molodensky's Linear Approximation, Its Practical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance, and Numerous Ramifications&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miniaturized Gyrocompass</td>
<td>ETL-0289</td>
<td>1982</td>
</tr>
<tr>
<td>Miniaturized Gyrocompass (Small North-Orienting Device)</td>
<td>ETL-ETR-70-11</td>
<td>1970</td>
</tr>
<tr>
<td>Minipim-MK II Precision Indicator of the Meridian (British Aircraft</td>
<td>45-TR</td>
<td>1969</td>
</tr>
<tr>
<td>Corp.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini Raster-to-Vector Conversion</td>
<td>ETL-0269</td>
<td>1981</td>
</tr>
<tr>
<td>Mod II Power Supply for Army Artillery Inertial Survey System</td>
<td>AD 814 067</td>
<td>1963</td>
</tr>
<tr>
<td>(GEISHA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modeling and Contouring Irregular Surfaces Subject to Constraints</td>
<td>ETL-CR-74-19</td>
<td>1975</td>
</tr>
<tr>
<td>Modes of Satellite Triangulation Adjustment, Vol. I</td>
<td>AD 633 863</td>
<td>1966</td>
</tr>
<tr>
<td>Modes of Satellite Triangulation Adjustment, Vol. II</td>
<td>AD 633 864</td>
<td>1966</td>
</tr>
<tr>
<td>Modification of a Cartographic Mapping Camera from Type T-11 to Type</td>
<td>ETL-TR-71-1</td>
<td>1971</td>
</tr>
<tr>
<td>KC-4B (with Automatic Exposure Control)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modification of the MUSAT Aerotriangulation Programs to Accommodate</td>
<td>ETL-0306</td>
<td>1983</td>
</tr>
<tr>
<td>Bathymetric Image Points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modifications to FOTONAP</td>
<td>ETL-0116</td>
<td>1977</td>
</tr>
<tr>
<td>Mono Versus Stereo Analytical Photogrammetry, Part 1</td>
<td>AD 664 184</td>
<td>1967</td>
</tr>
<tr>
<td>Mono Versus Stereo Analytical Photogrammetry, Part 2</td>
<td>AD 828 750</td>
<td>1968</td>
</tr>
</tbody>
</table>
Morphometry of Landforms: Quantification of Slope Gradients in Glaciated Terrain

Multi-Altitude Transponder — Volume I, Schematic Diagrams

Multi-Altitude Transponder — Volume II, Part 1, Test Procedures and Results of Test MATS Transponder

Multi-Altitude Transponder — Volume II, Part 2

Multi-Altitude Transponder — Volume II, Part 3

Multi-Altitude Transponder — Volume II, Part 4

Multi-Altitude Transponder — Volume II, Part 5

Multi-Altitude Transponder — Volume III, Final Reliability Report

Multi-Altitude Transponder — Volume IV, Design Considerations and Component Selection Criteria

Multi-Image Correlation Systems Study for MGI

Multi-Image Correlation Systems Study, Quantitative Evaluation of Electronic Multi-Image Processor

Multi-Image Pattern Recognition: Ideas and Results

Multi-Parametric Figures of Equilibrium: Curvature of the Plumb Line

Multi-Parametric Theory of Spheroidal Equilibrium Figures and the Normal-Spheroids of Earth and Moon

Multispectral Image Maps from Landsat Thematic Mapper Data

Multiple Camera Analytical Triangulation Program

Multiple Station Analytical Triangulation Program

Multipower Army Stereoscope

Multisensor Approaches for Determining Deflections of the Vertical

Multisensor Study of Plant Communities at Horsefly Mountain, Oregon

Multisource Image Analysis

Multispectral Capability of H&W Film (Photographic Technology Series)

Multispectral Target Signatures

MUSAT IV

Natural Image Computers, Vol. I

Natural Image Computers, Vol. II

Near-Real-Time Application of Digital Terrain Data in a Minicomputer Environment

Near-Surface Bathymetry System (Report No. 11 in the ETL Series on Remote Sensing)
### TITLE

<table>
<thead>
<tr>
<th>Title</th>
<th>Report No.</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neural Networks for Object Detection Using All-Source Imagery</td>
<td>ETL-0585</td>
<td>1991</td>
</tr>
<tr>
<td>New Analyses and Methods Leading to Improved Acquisition Requirements Involving Systems, Geodetic and Reentry Errors, and Increased Weapons Effectiveness for Conventional Weapons (Part I)</td>
<td>RN-35</td>
<td>1970</td>
</tr>
<tr>
<td>New Analyses and Methods Leading to Improved Acquisition Requirements Involving Systems, Geodetic and Reentry Errors, and Increased Weapons Effectiveness for Conventional Weapons (Part II)</td>
<td>ETL-RN-70-3</td>
<td>1970</td>
</tr>
<tr>
<td>New Formulas Useful When Changing Ellipsoidal Parameters or Orientation</td>
<td>RN-2</td>
<td>1962</td>
</tr>
<tr>
<td>New Insights and Results Regarding L.F. Richardson’s Turbulence Criterion</td>
<td>ETL-RN-72-2</td>
<td>1972</td>
</tr>
<tr>
<td>New Large-Scale, High-Resolution, Multicolor Software Display Concept, A</td>
<td>ETL-0388</td>
<td>1985</td>
</tr>
<tr>
<td>New Method for Determining Azimuth and Latitude Independent of Time and Zenith Distance</td>
<td>RN-17</td>
<td>1966</td>
</tr>
<tr>
<td>New Methods of Change Detection Using Multispectral Data</td>
<td>ETL-0586</td>
<td>1991</td>
</tr>
<tr>
<td>New Solution for the Anomalous Gravity Potential Resulting from a Modification of Molodensky’s Linear Approximation, Its Practical Significance and Numerous Ramifications, A</td>
<td>RN-33</td>
<td>1970</td>
</tr>
<tr>
<td>1986 Year End Report for Road Following at Carnegie-Mellon</td>
<td>ETL-0464</td>
<td>1987</td>
</tr>
<tr>
<td>Noise Removal on Radar Imagery Using Local Gradient and Statistics</td>
<td>ETL-0402</td>
<td>1985</td>
</tr>
<tr>
<td>Noncontact Array Velocimeter</td>
<td>ETL-0077</td>
<td>1976</td>
</tr>
<tr>
<td>Observations on Multi-Peg Towers of Hanoi</td>
<td>ETL-0476</td>
<td>1986</td>
</tr>
<tr>
<td>Occurrence of Ice in the Form of Glaze, Rime, and Hoar-Frost with Respect to the Operation and Storage of V/STOL Aircraft</td>
<td>ETL-SR-73-1</td>
<td>1973</td>
</tr>
<tr>
<td>On Computing Histograms of Images in Log $\eta$ Time Using Fat Pyramids</td>
<td>ETL-0454</td>
<td>1987</td>
</tr>
<tr>
<td>On the Energy Integral for Satellites</td>
<td>RN-29</td>
<td>1968</td>
</tr>
</tbody>
</table>
TITLE

On the Thermal Nature and Sensing of Snow-Covered Arctic Terrain

Optical-Electronic Precision Pointing System

Optical Power Spectral Analysis for Machine-Readable Factor Maps

Optical Power Spectrum Analysis (OPSA) (Report No. 1 Recording Optical Spectrum Analyzer System Hardware)

Optical Theodolite Readout

Optimized Digital Automatic Map Compilation System

1st Interim Report
2nd Interim Report
3rd Interim Report
4th Interim Report

Optimized Method for the Derivation of the Deflection of the Vertical from RGSS Data

Optimized Post-Mission Determination of the Deflection of the Vertical Using RGSS Data

Orthographic Radar Restitutor Engineer Design Test

Orthophoto Viewer and Transfer Device

Overview of Vision-Based Navigation for Autonomous Land Vehicles 1986, An

Parallel Algorithms for Computer Vision

Parallel Algorithms for Computer Vision, Second Year Report

Parallel Algorithms for Computer Vision, Third Year Report

Parallel Algorithms for Computer Vision, Final Report

Parallel Optical Processing to Convert Elevation Data to Slope Maps. Phase I: Theoretical Analysis

Parallel Optical Processing to Convert Elevation Data to Slope Maps. Phase II: Practical Considerations

Parallel Profile Plots for Visual Terrain Display

Parallel Vision Algorithm Design and Implementation, 1987 End of Year Report

Parallel Vision Algorithm Design and Implementation, 1988 End of Year Report


REPORT NO. YEAR

ETL-RN-73-4 1973
AD 883 021 1965
ETL-0212 1980
ETL-TR-74-11 1975
AD 821 660L 1967
AD 412 798 1963
AD 422 227 1963
AD 432 243 1963
AD 600 117 1964
ETL-0122 1977
ETL-0164 1978
ETL-ETR-74-6 1974
AD 722 788 1965
ETL-0479 1987
ETL-0456 1987
ETL-0495 1988
ETL-0528 1989
ETL-0564 1990
ETL-RN-74-9 1974
ETL-RN-74-12 1975
ETL-0115 1977
ETL-0513 1988
ETL-0541 1989
ETL-0488 1987
ETL-0529 1989
Particulate Matter Considerations in the Design of V/STOL Aircraft
Pattern Classification Techniques Applied to High Resolution, Synthetic Aperture Radar Imagery
PDEF: A Standard File Format for Data Interchange
Perception for Outdoor Navigation - First Year Report
Performance Evaluation of the Position and Azimuth Determining System (PADS) with an Improved Vertical Accelerometer
Phoenix Laser and Terrain Profile Test
Photo Analysis of a Desert Area
Photo-Geomorphology of Coastal Landforms, Cat Island, Bahamas (Vol. II)
Photogrammetric and Tracking Network Analysis Program
Photogrammetric and Tracking Network Analysis Program for the UNIVAC 1108 Computer
Photogrammetric Applications to Field Artillery
Photogrammetric Aspects of the Heterodyne Optical Correlator
Photogrammetric Flash Triangulation for Corps of Engineers Field Use
  1st Interim Report
  2nd Interim Report
  3rd Interim Report
  Final Report
Photogrammetric Reduction for ATL
Photographic Visibility of Light Images on Aerial Film
Photomap Reproduction System
Pilot Program of Lunar Photography for Precise Selenodesy
Plastic-Scribing Color Separation for Military Cartography
Platform Orientation System Test Program
Point Light Source Contact Printer
Photographic Technology Series
Position and Azimuth Determining System (PADS)
Helicopter Study
Position and Surveying System (PASS)
Possibility of Adapting a Land Navigation System to Perform Artillery Survey
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Mission Smoothing and Analysis of the</td>
<td>ETL-0065</td>
<td>1976</td>
</tr>
<tr>
<td>Measurements of the Change in the Deflection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of the Vertical Obtained by the Rapid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geodetic Survey System (RGSS) at the White Sands Test Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential of Thermal IR Imagery for Supplemental</td>
<td>ETL-0059</td>
<td>1976</td>
</tr>
<tr>
<td>Map Information in Snow-Covered Areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Sand and Dust Source Areas</td>
<td>ETL-SR-72-1</td>
<td>1972</td>
</tr>
<tr>
<td>Practical Field Accuracy Limits for a Wild T-2 Theodolite</td>
<td>30-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Practical Second-Order Theory for the Disturbance</td>
<td>ETL-RN-71-1</td>
<td>1971</td>
</tr>
<tr>
<td>Potential and Deflections of the Vertical, Including an Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of the Limitations of the Molodensky/Brovar Series and Downward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuation of Gravity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical Tests of the Theoretical Accuracy of Aerial Triangulation</td>
<td>RN-1</td>
<td>1962</td>
</tr>
<tr>
<td>Precise Photogrammetric Orientation and Data Determination of</td>
<td>AD 238 857</td>
<td>1960</td>
</tr>
<tr>
<td>HIRAN Mapping System AN/APQ 73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precision Enlarging Printer (4X)</td>
<td>27-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Precision 2.0X Enlarging Printer</td>
<td>55-TR</td>
<td>1970</td>
</tr>
<tr>
<td>Precision 3.3X Enlarging Printer</td>
<td>ETL-ETR-71-3</td>
<td>1971</td>
</tr>
<tr>
<td>Precision STARAN Correlator</td>
<td>ETL-0133</td>
<td>1977</td>
</tr>
<tr>
<td>Predesign Data for the Radar Stereo Equipment Program</td>
<td>AD 701 169</td>
<td>1969</td>
</tr>
<tr>
<td>Preliminary Image Data Extraction Experiments with the Phase I,</td>
<td>ETL-RN-74-7</td>
<td>1974</td>
</tr>
<tr>
<td>Automated Image Data Extraction System-I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preliminary Radar Feature Extraction and Recognition Using</td>
<td>ETL-0315</td>
<td>1983</td>
</tr>
<tr>
<td>Texture Measurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preliminary Reliability Prediction — MATS</td>
<td>AD 721 639</td>
<td>1965</td>
</tr>
<tr>
<td>Preliminary Study into the Principles of Continuous Tone</td>
<td>AD 401 863</td>
<td>1962</td>
</tr>
<tr>
<td>Electrophotography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preproduction Model Cartographic EBR System</td>
<td>ETL-0246</td>
<td>1980</td>
</tr>
<tr>
<td>Proceedings of the International Symposium</td>
<td>AD 825 792</td>
<td>1967</td>
</tr>
<tr>
<td>Figure of the Earth and Refraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production of Dense Range Images with the CVL Light-Stripe Range</td>
<td>ETL-0491</td>
<td>1988</td>
</tr>
<tr>
<td>Scanner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program and Test Procedures to Determine the Geocentric</td>
<td>AD 617 698</td>
<td>1968</td>
</tr>
<tr>
<td>Coordinates and Orbital Parameters of an Unidentified Satellite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>Program Maintenance Manual for the Reference Scene Software (RSS)</td>
<td>ETL-0067</td>
<td>1976</td>
</tr>
<tr>
<td>Programmer for Army Artillery Inertial Survey System (GEISHA)</td>
<td>AD 814 065</td>
<td>1963</td>
</tr>
<tr>
<td>Project SAND — Availability of Construction Materials in the Mekong Delta</td>
<td>Tech Memo 156-1</td>
<td>1968</td>
</tr>
<tr>
<td>Project SAND (Phase III) — Analysis of Remote Sensor Imagery of Selected Areas in the Mississippi Delta</td>
<td>ETL-TR-71-3</td>
<td>1971</td>
</tr>
<tr>
<td>Project THEMIS: A Center for Remote Sensing Study Plan</td>
<td>AD 690 361</td>
<td>1968</td>
</tr>
<tr>
<td>Progress Report</td>
<td>AD 847 276</td>
<td>1968</td>
</tr>
<tr>
<td>Interim Report</td>
<td>AD 683 584</td>
<td>1968</td>
</tr>
<tr>
<td>Progress Report</td>
<td>AD 853 884</td>
<td>1969</td>
</tr>
<tr>
<td>Progress Report</td>
<td>AD 864 859</td>
<td>1969</td>
</tr>
<tr>
<td>5th Semi-annual Report</td>
<td>AD 869 511</td>
<td>1970</td>
</tr>
<tr>
<td>6th Semi-annual Report</td>
<td>AD 879 981L</td>
<td>1970</td>
</tr>
<tr>
<td>7th Semi-annual Report (ETL-CR-71-7)</td>
<td>AD 726 966</td>
<td>1971</td>
</tr>
<tr>
<td>8th Semi-annual Report (ETL-CR-71-21)</td>
<td>AD 735 752</td>
<td>1971</td>
</tr>
<tr>
<td>Final Report (ETL-CR-74-10)</td>
<td>AD A003 266</td>
<td>1974</td>
</tr>
<tr>
<td>Proposed Stereophotogrammetric System for Topographic Mapping from Photography Taken at Altitudes up to 100,000 Feet</td>
<td>1518-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Prototype Automatic Mosaicking System</td>
<td>17-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Prototype Electrostatic Image Reproducer</td>
<td>ETL-0035</td>
<td>1973</td>
</tr>
<tr>
<td>Prototype Image Spectrum Analyzer (PISA) for Cartographic Feature Extraction</td>
<td>ETL-0204</td>
<td>1979</td>
</tr>
<tr>
<td>Prototype Lithographic Enlarging Projection Platemaker</td>
<td>ETL-ETR-72-4</td>
<td>1972</td>
</tr>
<tr>
<td>Prototype Stereomat System</td>
<td>4-TR</td>
<td>1962</td>
</tr>
<tr>
<td>Quantitative Geography: Achievements and Prospects</td>
<td>ETL-CR-71-12</td>
<td>1971</td>
</tr>
<tr>
<td>RACOMS Cartographic Module</td>
<td>ETL-ETR-70-3</td>
<td>1970</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td>RACOMS Compilation Module I</td>
<td>ETL-ETR-70-1</td>
<td>1970</td>
</tr>
<tr>
<td>RACOMS Data Processing Module</td>
<td>ETL-ETR-70-4</td>
<td>1970</td>
</tr>
<tr>
<td>RACOMS Image Processing Module I</td>
<td>47-TR</td>
<td>1969</td>
</tr>
<tr>
<td>RACOMS Image Processing Module II</td>
<td>ETL-ETR-70-2</td>
<td>1970</td>
</tr>
<tr>
<td>RACOMS Map Revision Module</td>
<td>ETL-ETR-70-5</td>
<td>1970</td>
</tr>
<tr>
<td>RACOMS Operations Module</td>
<td>44-TR</td>
<td>1969</td>
</tr>
<tr>
<td>RACOMS Pass Point Marking and Measuring Instrument</td>
<td>53-TR</td>
<td>1970</td>
</tr>
<tr>
<td>RACOMS Reproduction Module</td>
<td>ETL-ETR-71-1</td>
<td>1971</td>
</tr>
<tr>
<td>Radar Backscatter from a Vegetated Terrain: A Discrete Scattering Approach</td>
<td>ETL-0159</td>
<td>1979</td>
</tr>
<tr>
<td>Radar Bridge Patterns Extraction and Recognition</td>
<td>ETL-0323</td>
<td>1983</td>
</tr>
<tr>
<td>Radar Image Simulation of Seasonally Dependent Reference Scenes</td>
<td>ETL-0188</td>
<td>1979</td>
</tr>
<tr>
<td>Radar Image Simulation Project</td>
<td>ETL-0098</td>
<td>1976</td>
</tr>
<tr>
<td>Radar Image Simulation Project: Development of a General Simulation Model and an Interactive Simulation Model, and Sample Results</td>
<td>ETL-0047</td>
<td>1976</td>
</tr>
<tr>
<td>Radar Image Simulation: Validation of the Point Scattering Model, Volume I</td>
<td>ETL-0117</td>
<td>1977</td>
</tr>
<tr>
<td>Radar Image Simulation: Validation of the Point Scattering Model, Volume II</td>
<td>ETL-0118</td>
<td>1977</td>
</tr>
<tr>
<td>Radar Image Simulation: Validation of the Point Scattering Method Addendum</td>
<td>ETL-0155</td>
<td>1978</td>
</tr>
<tr>
<td>Radar Mapping Test Ranges</td>
<td>AD 231 433</td>
<td>1959</td>
</tr>
<tr>
<td>Radar Network Adjustment</td>
<td></td>
<td>1962</td>
</tr>
<tr>
<td>Radar Presentation Restitutor</td>
<td></td>
<td>1956</td>
</tr>
<tr>
<td>Radar Sketching Device</td>
<td>20-TR</td>
<td>1965</td>
</tr>
<tr>
<td>Radar Stereo Equipment Program</td>
<td>AD 732 875</td>
<td>1971</td>
</tr>
<tr>
<td>Radar, Thermal Infrared, and Panchromatic Image Collection and Analysis</td>
<td>ETL-0249</td>
<td>1980</td>
</tr>
<tr>
<td>Radiative Transfer in One-Dimensional Discretely Stratified Media</td>
<td>ETL-0236</td>
<td>1980</td>
</tr>
<tr>
<td>RADOT Code for the Tracking of Radar Incident on Trees</td>
<td>ETL-0147</td>
<td>1978</td>
</tr>
<tr>
<td>RADOT Code System to Calculate the Radar Return from a Forested Area</td>
<td>ETL-0206</td>
<td>1979</td>
</tr>
<tr>
<td>Rainfall Intensities in the Conterminous United States and Hawaii (Supplement 1 to ETL-SR-72-5: Distribution of Mean Monthly Precipitation and Rainfall Intensities)</td>
<td>ETL-SR-74-3</td>
<td>1973</td>
</tr>
<tr>
<td>Range Imagery Algorithms for the Detection of Obstacles by Autonomous Vehicles</td>
<td>ETL-0461</td>
<td>1987</td>
</tr>
<tr>
<td>Rapid Cartographic Processing System Study</td>
<td>AD 454 086L</td>
<td>1964</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Rapid Geodetic Survey System</td>
<td>ETL-0074</td>
<td>1976</td>
</tr>
<tr>
<td>Rapid Geodetic Survey System (RGSS) Deflection of the Vertical and</td>
<td>ETL-0308</td>
<td>1982</td>
</tr>
<tr>
<td>Gravity Anomaly Tests at White Sands Missile Range, 1980</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rapid Gravity Survey System Aided with Supplemental Gravimetric Data</td>
<td>ETL-0113</td>
<td>1977</td>
</tr>
<tr>
<td>RC-135A/USQ-28 Category II Test (The Photographic Resolution</td>
<td>TM-69-1</td>
<td>1969</td>
</tr>
<tr>
<td>Capabilities of the KS-78A Camera Subsystem)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D Plan for Army Applications of AI/ROBOTICS</td>
<td>ETL-0296</td>
<td>1982</td>
</tr>
<tr>
<td>Recording and Scanning Advances in Cartographic EBR Systems</td>
<td>ETL-0265</td>
<td>1981</td>
</tr>
<tr>
<td>Reduction and Classification of the Data Base List</td>
<td>AD 817 518</td>
<td>1967</td>
</tr>
<tr>
<td>Reduction Procedures for Absolute Direction and Geodetic Azimuths</td>
<td>RN-14</td>
<td>1965</td>
</tr>
<tr>
<td>from Optical Observations of Satellites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflection and Identification Studies Applied to Terrain Imaging</td>
<td>ETL-0331</td>
<td>1983</td>
</tr>
<tr>
<td>Radar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refraction in Selected Model Atmospheres</td>
<td>AD 404 465</td>
<td>1964</td>
</tr>
<tr>
<td>Registration of a LANDSAT Image to a DTM — An Error Analysis</td>
<td>ETL-0350</td>
<td>1984</td>
</tr>
<tr>
<td>Relation Between the Spectrum of Surface Slopes and the Spectrum</td>
<td>ETL-RN-70-2</td>
<td>1970</td>
</tr>
<tr>
<td>of Surface Elevations and its Usefulness in the Theory of Electromagnetic Wave Scattering from Rough Surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relational Data Base Management Study</td>
<td>ETL-0136</td>
<td>1978</td>
</tr>
<tr>
<td>Relative Mapping Triangulation Program, Vol. II</td>
<td>AD 721 602</td>
<td>1969</td>
</tr>
<tr>
<td>Relative Mapping Triangulation Program, Vol. III</td>
<td>AD 721 603</td>
<td>1969</td>
</tr>
<tr>
<td>Relative Mapping Triangulation Program, Vol. IV</td>
<td>AD 721 604</td>
<td>1969</td>
</tr>
<tr>
<td>Remote Sensor Image Capabilities for Acquisition of Terrain</td>
<td>ETL-0054</td>
<td>1976</td>
</tr>
<tr>
<td>Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote Sensor Imagery Analysis for Location of Construction Materials in the Mekong Delta-Project SAND (Phase II)</td>
<td>52-TR</td>
<td>1970</td>
</tr>
<tr>
<td>Replacement of Photographic Imagery Equipment (RPIE)</td>
<td>ETL-0038</td>
<td>1976</td>
</tr>
<tr>
<td>Report on Atmospheric Obstructions to Visibility: Volume I — Study</td>
<td>ETL-0169</td>
<td>1979</td>
</tr>
<tr>
<td>Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report on Atmospheric Obstructions to Visibility: Volume II — Results of Literature Search</td>
<td>ETL-0170</td>
<td>1979</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Research and Design of a PROM Coherent Optical Processor</td>
<td>ETL-0219</td>
<td>1980</td>
</tr>
<tr>
<td>Research and Development Acceptance Test Report</td>
<td>23-TR</td>
<td>1965</td>
</tr>
<tr>
<td>Surveying Instrument: Azimuth, Gyro, Lightweight (Lear Siegler, Inc. Models)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research and Development of a Prototype Laser Point Marking Instrument</td>
<td>AD 673 291</td>
<td>1967</td>
</tr>
<tr>
<td>Research in Expert Interactive Cartographic Systems</td>
<td>ETL-0417</td>
<td>1986</td>
</tr>
<tr>
<td>Research in Knowledge-Based Vision Techniques for the Autonomous Land Vehicle Program (June 1, 1985 - May 31, 1986)</td>
<td>ETL-0444</td>
<td>1986</td>
</tr>
<tr>
<td>Research in Knowledge-Based Vision Techniques for the Autonomous Land Vehicle Program (June 1, 1986 - May 31, 1987)</td>
<td>ETL-0482</td>
<td>1987</td>
</tr>
<tr>
<td>Research in Knowledge-Based Vision Techniques for the Autonomous Land Vehicle Program Third Annual Report</td>
<td>ETL-0522</td>
<td>1988</td>
</tr>
<tr>
<td>Research in Knowledge-Based Vision Techniques for the Autonomous Land Vehicle Program Final Annual Report</td>
<td>ETL-0545</td>
<td>1989</td>
</tr>
<tr>
<td>Research in Space Photogrammetry</td>
<td>AD 722 789</td>
<td>1961</td>
</tr>
<tr>
<td>Research in Surveying, Mapping and Geodesy</td>
<td>AD 230 066</td>
<td>1959</td>
</tr>
<tr>
<td>Research Institute Lectures on Geography</td>
<td>ETL-SR-71-1</td>
<td>1971</td>
</tr>
<tr>
<td>Research on Refinement and Interpretation of Gravity Anomaly Computations</td>
<td>AD 831 840</td>
<td>1968</td>
</tr>
<tr>
<td>Research Studies Related to Mapping, Geodesy, and Position Determination</td>
<td>AD 286 300</td>
<td>1961</td>
</tr>
<tr>
<td>Interim Report No. 10</td>
<td>AD 286 298</td>
<td>1961</td>
</tr>
<tr>
<td>Interim Report No. 11</td>
<td>AD 286 299</td>
<td>1962</td>
</tr>
<tr>
<td>Interim Report No. 13</td>
<td>AD 284 969</td>
<td>1962</td>
</tr>
<tr>
<td>Interim Report No. 14</td>
<td>AD 298 584</td>
<td>1962</td>
</tr>
<tr>
<td>Results of Space Triangulation Adjustments from Satellite Data</td>
<td>RN-13</td>
<td>1965</td>
</tr>
<tr>
<td>Review and Analysis of U.S. Army Geodetic SECOR System and Development</td>
<td>AD 818 483</td>
<td>1962</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------</td>
<td>------</td>
</tr>
<tr>
<td>Review of Photosensitive Materials for Holographic Recordings</td>
<td>ETL-0128</td>
<td>1978</td>
</tr>
<tr>
<td>Road Boundary Detection for Autonomous Vehicle Navigation</td>
<td>ETL-0407</td>
<td>1985</td>
</tr>
<tr>
<td>Road Detection on Radar Imagery</td>
<td>ETL-0403</td>
<td>1985</td>
</tr>
<tr>
<td>Robust Image Understanding - Techniques and Applications - First Annual Report</td>
<td>ETL-0580</td>
<td>1990</td>
</tr>
<tr>
<td>RPIE Symbol Placement Accuracy</td>
<td>ETL-0076</td>
<td>1976</td>
</tr>
<tr>
<td>Ruggedized Geodetic SECOR</td>
<td>AD 722 642</td>
<td>1967</td>
</tr>
<tr>
<td>Ruggedized Geodetic SECOR System</td>
<td>ETL-0367</td>
<td>1984</td>
</tr>
<tr>
<td>Sand and Dust Considerations in the Design of Military Equipment</td>
<td>ETL-TR-72-7</td>
<td>1972</td>
</tr>
<tr>
<td>Satellite Angulateration</td>
<td>RN-16</td>
<td>1965</td>
</tr>
<tr>
<td>Satellite Geodesy Based on Stellar Orientation of Lines Between Unknown Stations</td>
<td>RN-32</td>
<td>1969</td>
</tr>
<tr>
<td>Satellite Observations of Widespread Fog</td>
<td>ETL-0361</td>
<td>1984</td>
</tr>
<tr>
<td>Satellite-to-Satellite Tracking for Orbit Improvement and Determination of a $1^\circ \times 1^\circ$ Gravity Field</td>
<td>ETL-0064</td>
<td>1976</td>
</tr>
<tr>
<td>Satellite, U.S. Army Type II, Geodetic, Final Report</td>
<td>AD 871 283</td>
<td>1963</td>
</tr>
<tr>
<td>Volume 1</td>
<td>AD 871 284</td>
<td>1964</td>
</tr>
<tr>
<td>Volume 2, Appendix, Antenna Patterns</td>
<td>AD 871 285</td>
<td>1964</td>
</tr>
<tr>
<td>Scale Problems in Geographic Research</td>
<td>ETL-CR-71-16</td>
<td>1971</td>
</tr>
<tr>
<td>Scattering from a Vegetation Layer with an Irregular Vegetation Soil Boundary</td>
<td>ETL-0270</td>
<td>1981</td>
</tr>
<tr>
<td>Scene Classification Results Using the Max-Min Texture Measure</td>
<td>ETL-0300</td>
<td>1982</td>
</tr>
<tr>
<td>Selected Bibliography of Corps of Engineers Remote Sensing Reports</td>
<td>ETL-0126</td>
<td>1977</td>
</tr>
<tr>
<td>Semi-automatic Coordinate Reader</td>
<td>ETL-ETR-71-4</td>
<td>1971</td>
</tr>
<tr>
<td>Semi-Automatic Pass Point Determination Using Digital Techniques</td>
<td>ETL-0051</td>
<td>1975</td>
</tr>
<tr>
<td>Sensing Array System with Image Statistics Processing, A</td>
<td>ETL-0297</td>
<td>1983</td>
</tr>
<tr>
<td>Sentinel Satellite Positional Precision Derived from the NAVSTAR Global Positioning System</td>
<td>ETL-0544</td>
<td>1989</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------</td>
<td>-------</td>
</tr>
<tr>
<td>Sequential Independent Model Block Analytical Triangulation (SIMBAT)</td>
<td>AD 805 606L</td>
<td>1966</td>
</tr>
<tr>
<td>Service Tests and Subsequent Modifications and Test of Compass Sun, Universal, 0 to 90 Degrees North and South Latitudes, with Case Shaded Relief Images for Cartographic Applications</td>
<td>1422-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Side-Looking Radar Data Requirements for Automated Mapping on the UNAMACE</td>
<td>ETL-0259</td>
<td>1981</td>
</tr>
<tr>
<td>Side-Looking Radar Presentation Viewing and Measuring Instrument</td>
<td>ETL-0453</td>
<td>1987</td>
</tr>
<tr>
<td>Signal Signatures of Topographic Features Using Analog Technology</td>
<td>ETL-0441</td>
<td>1986</td>
</tr>
<tr>
<td>Simple Analytical Methods for Estimating Short-Term Rainfall</td>
<td>ETL-0494</td>
<td>1988</td>
</tr>
<tr>
<td>Simple Computer Database System for UNIX, A</td>
<td>ETL-0421</td>
<td>1986</td>
</tr>
<tr>
<td>Simplified Electrostatic Color Printing</td>
<td>ETL-0007</td>
<td>1975</td>
</tr>
<tr>
<td>Simulation of a Radar Image for Garden City Test Site</td>
<td>ETL-ETR-74-4</td>
<td>1974</td>
</tr>
<tr>
<td>Single-Lens, Four-Channel Multiband Camera (Report No. 3 in the ETL Series on Remote Sensing)</td>
<td>ETL-RN-74-10</td>
<td>1974</td>
</tr>
<tr>
<td>Single Photo Analysis of Sampled Aerial Imagery</td>
<td>ETL-0458</td>
<td>1987</td>
</tr>
<tr>
<td>Smart Mapping, Charting and Geodesy Control Generator, Phase I, A</td>
<td>ETL-0523</td>
<td>1988</td>
</tr>
<tr>
<td>Smart Mapping, Charting and Geodesy Control Generator, Phase II, A</td>
<td>ETL-0394</td>
<td>1985</td>
</tr>
<tr>
<td>Software Conversion of Standard Linear Format (SLF) to Standard Interchange Format (SIF)</td>
<td>ETL-0449</td>
<td>1987</td>
</tr>
<tr>
<td>Software System Description for Minefield Site Prediction Expert System</td>
<td>AD 202 318</td>
<td>1958</td>
</tr>
<tr>
<td>Solution of the General Analytical Aerotriangulation Problem</td>
<td>RN-7</td>
<td>1962</td>
</tr>
<tr>
<td>Some Relations Between the Geometrical Quality of Topographic Mapping and Aerial Photogrammetry</td>
<td>ETL-0424</td>
<td>1986</td>
</tr>
<tr>
<td>Sparse Area Stereo Matching Experiment</td>
<td>ETL-0520</td>
<td>1988</td>
</tr>
<tr>
<td>Spatial Data Structures for Robotic Vehicle Route Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Light Modulators: Test and Evaluation</td>
<td>ETL-0192</td>
<td>1979</td>
</tr>
<tr>
<td>Spatial Sampling: A Technique for Acquisition of Geographic Data from Aerial Photographs and Maps</td>
<td>ETL-CR-71-11</td>
<td>1971</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Spatial Target Location Errors Derived From Measurements Collected From Sixteen Satellite Constellations</td>
<td>ETL-0532</td>
<td>1989</td>
</tr>
<tr>
<td>Spectral Reflectivity Data: A Practical Acquisition Procedure</td>
<td>AD 880 049L</td>
<td>1970</td>
</tr>
<tr>
<td>Stable Platform Assembly for Army Artillery Inertial Survey System</td>
<td>AD 681 932</td>
<td>1962</td>
</tr>
<tr>
<td>Stable Platform Electronics for Army Artillery Inertial Survey System (GEISHA)</td>
<td>AD 681 933</td>
<td>1962</td>
</tr>
<tr>
<td>Star Pattern Recognition and Spacecraft Attitude Determination</td>
<td>ETL-0173</td>
<td>1978</td>
</tr>
<tr>
<td>Star Pattern Recognition and Spacecraft Attitude Determination, Phase II</td>
<td>ETL-0211</td>
<td>1979</td>
</tr>
<tr>
<td>Star Pattern Recognition and Spacecraft Attitude Determination, Final Report</td>
<td>ETL-0260</td>
<td>1981</td>
</tr>
<tr>
<td>STARAN Image Processing Stars’ Position Determined by Combining Micrometric Observations with an Observed Known Star in a Vertical Plane Close to the Meridian</td>
<td>ETL-0243</td>
<td>1980</td>
</tr>
<tr>
<td>State-of-the-Art Assessment of Automatic Name Placement, A</td>
<td>ETL-0427</td>
<td>1986</td>
</tr>
<tr>
<td>State-of-the-Art of Slope Mapping</td>
<td>ETL-0060</td>
<td>1976</td>
</tr>
<tr>
<td>Status of Aerial Color Photography in Government Agencies</td>
<td>TB-1</td>
<td>1968</td>
</tr>
<tr>
<td>Stereo Analysis of a Specific Digital Model Sampled from Aerial Imagery</td>
<td>ETL-0072</td>
<td>1976</td>
</tr>
<tr>
<td>Stereo Radar Analysis</td>
<td>AD 903 321L</td>
<td>1970</td>
</tr>
<tr>
<td>Stereoplotter, Topographic, Projection-Type High Precision</td>
<td>1627-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Stereoscopic Terrain Display for Measurement Applications</td>
<td>ETL-0002</td>
<td>1974</td>
</tr>
<tr>
<td>Stress Analysis, Study of the M4 Van Expansible and Adapter, Detachable Running Gear</td>
<td>AD 636 445</td>
<td>1966</td>
</tr>
<tr>
<td>Structural Analysis from Radar Imagery, Eastern Panamanian Isthmus</td>
<td>AD 715 322</td>
<td>1970</td>
</tr>
<tr>
<td>Studies in Zinc Oxide Photoconductivity</td>
<td>AD 673 836</td>
<td>1968</td>
</tr>
<tr>
<td>Studies of Gravity in Space According to Bjerhammer</td>
<td>AD 485 687L</td>
<td>1966</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>Study and Analysis of the Position and Azimuth Determining System (PADS) Field Maintenance Concept</td>
<td>ETL-CR-74-22</td>
<td>1974</td>
</tr>
<tr>
<td>Study and Analysis of the Position and Azimuth Determining System (PADS) for Mapping, Charting, and Geodesy Applications</td>
<td>ETL-CR-73-12</td>
<td>1973</td>
</tr>
<tr>
<td>Study and Prototype Model Design of a Miniaturized Gyrocompass, Interim</td>
<td>AD 462 322</td>
<td>1964</td>
</tr>
<tr>
<td>Study and Prototype Model Design of a Miniaturized Gyrocompass, Final</td>
<td>AD 465 330</td>
<td>1965</td>
</tr>
<tr>
<td>Study of a Digital Interface Design for the Quick Response Multicolor Printer (QRMP)</td>
<td>ETL-0327</td>
<td>1983</td>
</tr>
<tr>
<td>Study of Classification and Nomenclature of Vegetation</td>
<td>ETL-0058</td>
<td>1976</td>
</tr>
<tr>
<td>Study of Digital Matching of Dissimilar Images</td>
<td>ETL-0248</td>
<td>1980</td>
</tr>
<tr>
<td>Study of Environmental Monitoring and Information Systems</td>
<td>ETL-CR-72-1</td>
<td>1972</td>
</tr>
<tr>
<td>Study of Knowledge-Based Systems for Photo Interpretation</td>
<td>ETL-0235</td>
<td>1980</td>
</tr>
<tr>
<td>Study of Lithographic Fountain Solutions</td>
<td>AD 830 674L</td>
<td>1967</td>
</tr>
<tr>
<td>Study of Panoramic-Metric Image Matching for Photogrammetric Instrumentation</td>
<td>AD 474 839L</td>
<td>1965</td>
</tr>
<tr>
<td>Study of Raster Metafile Formats</td>
<td>ETL-0363</td>
<td>1984</td>
</tr>
<tr>
<td>Study of Solution of a Large System of Linearized Normal Equations and the Inversion of the Associated Coefficient Matrix</td>
<td>AD 676 849</td>
<td>1968</td>
</tr>
<tr>
<td>Study of Visual Stereoscopic Acuity</td>
<td></td>
<td>1956-1957</td>
</tr>
<tr>
<td>Study of the Application of Piezoelectric Techniques to a Small North-Orienting Device</td>
<td>AD 486 467L</td>
<td>1966</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>Study of the Effect of Corona Conditions on Electrostatic Processes</td>
<td>ETL-CR-72-17</td>
<td>1972</td>
</tr>
<tr>
<td>Study of the Effects of Nonhomogeneous Target Backgrounds on</td>
<td>AD 722 790</td>
<td>1969</td>
</tr>
<tr>
<td>Photogrammetric Coordinate Measurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant to the IFAX Printing Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study of the Long Range Position Determination System</td>
<td>AD 505 912</td>
<td>1969</td>
</tr>
<tr>
<td>Study to Establish a Method of Selecting Input Photographic Material</td>
<td>ETL-CR-71-24</td>
<td>1971</td>
</tr>
<tr>
<td>for Automated Compilation Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study to Optimize Performance of the Rapid Geodetic Survey System</td>
<td>ETL-0252</td>
<td>1981</td>
</tr>
<tr>
<td>— Interim Technical Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study to Optimize Performance of the Rapid Geodetic Survey System</td>
<td>ETL-0264</td>
<td>1981</td>
</tr>
<tr>
<td>— Second Interim Technical Report, A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study to Optimize Performance of the Rapid Geodetic Survey System</td>
<td>ETL-0321</td>
<td>1983</td>
</tr>
<tr>
<td>— Addendum Report, A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Climate of the Arctic Basin</td>
<td>ETL-TR-71-5</td>
<td>1971</td>
</tr>
<tr>
<td>Surface Gravity Effects of Subterranean Tunnels</td>
<td>ETL-0069</td>
<td>1976</td>
</tr>
<tr>
<td>Surface Materials and Terrain Features of Yuma Proving Ground, Part</td>
<td>ETL-0021</td>
<td>1975</td>
</tr>
<tr>
<td>I Summary Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Soft Copy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey of Display Devices (Hard Copy)</td>
<td>ETL-0086</td>
<td>1976</td>
</tr>
<tr>
<td>Survey of Mass Storage Systems</td>
<td>ETL-0082</td>
<td>1975</td>
</tr>
<tr>
<td>Surveying Instrument: Azimuth, Gyro, Lightweight (SIAGL) (Lear</td>
<td>ETL-TR-72-2</td>
<td>1972</td>
</tr>
<tr>
<td>Siegler, Inc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETL Series on Guides for Army Terrain Analysts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synthesis Guide for Helicopter Landing Zone and Drop Zone Sites</td>
<td>ETL-0401</td>
<td>1985</td>
</tr>
<tr>
<td>(Report No. 7 in the ETL Series on Guides for Army Terrain Analysts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Synthesis Guide for Obstacle Siting (Report No. 9 in the ETL Series</td>
<td>ETL-0283</td>
<td>1982</td>
</tr>
<tr>
<td>for Army Terrain Analysts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for Army Terrain Analysts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Analysis of the Entire Topographic Support System</td>
<td>ETL-0390</td>
<td>1985</td>
</tr>
<tr>
<td>System Analysis of the Entire Topographic Support System (TSS), Final</td>
<td>ETL-0158-2</td>
<td>1978</td>
</tr>
<tr>
<td>Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Analysis of the Entire Topographic Support System (TSS), Inter</td>
<td>ETL-0158-1</td>
<td>1978</td>
</tr>
<tr>
<td>im Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System and Design Study for an Advanced Drum Plotter</td>
<td>ETL-CR-70-3</td>
<td>1970</td>
</tr>
<tr>
<td>System for Automatic Secure Transmission and Reception of Topographic</td>
<td>ETL-CR-71-2</td>
<td>1971</td>
</tr>
<tr>
<td>Information — Maps, Photographs, or Alphanumeric Facsimile — at TV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System for Topographic Inquiry — No. 1, Micrographic Subsystem</td>
<td>ETL-ETR-74-2</td>
<td>1974</td>
</tr>
<tr>
<td>System for Topographic Inquiry — No. 2, Alphanumeric Subsystem</td>
<td>ETL-0003</td>
<td>1975</td>
</tr>
<tr>
<td>System for Topographic Inquiry — No. 3, Alphanumeric Subsystem Data</td>
<td>ETL-0004</td>
<td>1975</td>
</tr>
<tr>
<td>Base Listing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System for Topographic Inquiry — No. 4, Program Conversion Procedures</td>
<td>ETL-0005</td>
<td>1975</td>
</tr>
<tr>
<td>System for Topographic Inquiry — No. 5, Alphanumeric Subsystem Users</td>
<td>ETL-0031</td>
<td>1975</td>
</tr>
<tr>
<td>Guide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systematic Correction and Weighing of Analogue Aerial Triangulation</td>
<td>AD 476 273L</td>
<td>1965</td>
</tr>
<tr>
<td>Observations and Their Use in Strip and Block Adjustments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systematic Investigations of Geodetic Networks in Space, Interim</td>
<td>AD 482 852L</td>
<td>1966</td>
</tr>
<tr>
<td>Systematic Investigations of Geodetic Networks in Space, Final</td>
<td>AD 815 717</td>
<td>1967</td>
</tr>
<tr>
<td>Tactical/Strategic Point Positioning Study</td>
<td>ETL-0319</td>
<td>1981</td>
</tr>
<tr>
<td>Target Location Errors Derived From a Hypothetical Target Tracking</td>
<td>ETL-0531</td>
<td>1989</td>
</tr>
<tr>
<td>System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Data on KC-Film, Toners, and Processes</td>
<td>ETL-0224</td>
<td>1980</td>
</tr>
<tr>
<td>Techniques to Improve Astronomic Positioning in the Field</td>
<td>ETL-0400</td>
<td>1985</td>
</tr>
<tr>
<td>Television Display of Topographic Information</td>
<td>ETL-CR-70-7</td>
<td>1970</td>
</tr>
<tr>
<td>Title</td>
<td>Report No.</td>
<td>Year</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>Television Display of Topographic Information, Phase II</td>
<td>ETL-CR-71-23</td>
<td>1971</td>
</tr>
<tr>
<td>Terrain Analysis Procedural Guide for Climate (Report No. 5 in the ETL Series on Guides for Army Terrain Analysts)</td>
<td>ETL-0247</td>
<td>1980</td>
</tr>
<tr>
<td>Terrain Analysis Procedural Guide for Geology (Report No. 3 in the ETL Series on Guides for Army Terrain Analysts)</td>
<td>ETL-0207</td>
<td>1979</td>
</tr>
<tr>
<td>Terrain Analysis Procedural Guide for Roads and Related Structures (Report No. 2 in the ETL Series on Guides for Army Terrain Analysts)</td>
<td>ETL-0205</td>
<td>1979</td>
</tr>
<tr>
<td>Terrain Analysis Procedural Guide for Vegetation (Report No. 1 in the ETL Series on Guides for Army Terrain Analysts)</td>
<td>ETL-0178</td>
<td>1979</td>
</tr>
<tr>
<td>Terrain Analyst Synthesizer Station</td>
<td>ETL-0231</td>
<td>1980</td>
</tr>
<tr>
<td>Terrain Analyst Work Station (TAWS): 1AD After Action Report</td>
<td>ETL-0470</td>
<td>1987</td>
</tr>
<tr>
<td>Terrain Data of Mount Hayes D-4 Quadrangle, Fort Greely, Alaska (Report No. 4 in the ETL Series on Remote Sensing)</td>
<td>ETL-TR-74-7</td>
<td>1974</td>
</tr>
<tr>
<td>Terrain Effects Analysis Routine for an MGI System</td>
<td>ETL-0010</td>
<td>1975</td>
</tr>
<tr>
<td>Terrain Eigenvector Dyad Analysis</td>
<td>AD 649 347</td>
<td>1967</td>
</tr>
<tr>
<td>Terrain Factor Analysis and Automatic Color Coded Mapping Utilizing the IDECS</td>
<td>ETL-CR-72-13</td>
<td>1972</td>
</tr>
<tr>
<td>Test and Evaluation of 9 by 18 Rectifier for 12- and 24-inch Focal Length Photography</td>
<td>1460-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Test and Evaluation of Target Map Coordinate Locator Equipment</td>
<td>14-TR</td>
<td>1963</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Test and Evaluation of the Analytical Photogrammetric Positioning System, Advanced (APPS-II)</td>
<td>ETL-0293</td>
<td>1982</td>
</tr>
<tr>
<td>Test and Evaluation of the Direct Viewing Stereoplotter, Wernstedt-Mahan Type</td>
<td>1471-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Test and Evaluation of the Headliner, Model 400</td>
<td>1568-TR</td>
<td>1959</td>
</tr>
<tr>
<td>Test and Evaluation of the Interim Halccon Mapping System</td>
<td>3-TR</td>
<td>1961</td>
</tr>
<tr>
<td>Test and Evaluation of the Interim Stereoplotter, Topographic, Projection Type, High Precision</td>
<td>1493-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Test and Evaluation of the Kelsh Plotter, Model 5000, Manufactured by the Instruments Corp.</td>
<td>1311-TR</td>
<td>1953</td>
</tr>
<tr>
<td>Test and Evaluation of the Near Real Time Exploitation System</td>
<td>ETL-0281</td>
<td>1982</td>
</tr>
<tr>
<td>Test and Evaluation of the Prototype Side-Looking Radar Restitutor</td>
<td>29-TR</td>
<td>1966</td>
</tr>
<tr>
<td>Test and Evaluation of the Santoni Cartographic Stereomicrometer</td>
<td>1644-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Test and Evaluation of the 720 Plotter</td>
<td>1348-TR</td>
<td>1954</td>
</tr>
<tr>
<td>Test and Evaluation of the Stereopontometer and Adapted Multiplex</td>
<td>1381-TR</td>
<td>1954</td>
</tr>
<tr>
<td>Test and Evaluation of the Stereopontometer with Kelsh Type Stereoplotters</td>
<td>1425-TR</td>
<td>1955</td>
</tr>
<tr>
<td>Test and Evaluation of Ultrasonic Scribing Equipment</td>
<td>1641-TR</td>
<td>1960</td>
</tr>
<tr>
<td>Test and Investigation of the Photonymograph (PN-4)</td>
<td>1537-TR</td>
<td>1958</td>
</tr>
<tr>
<td>Test of Map-Read Magnetic Declination Accuracy</td>
<td>ETL-148</td>
<td>1978</td>
</tr>
<tr>
<td>Test of Reconnaissance Photographic Transposer MAN/GSH-1</td>
<td>1566-TR</td>
<td>1959</td>
</tr>
<tr>
<td>Test Results of a Singer, Kearfott Division Modified Land Navigation System</td>
<td>ETL-0238</td>
<td>1980</td>
</tr>
<tr>
<td>Test Results of the Lear Siegler, Singer and Sperry Gyro Heading Reference Systems</td>
<td>ETL-0288</td>
<td>1982</td>
</tr>
<tr>
<td>Test Results of the Litton Low-Cost Semi-Strapped-Down Inertial Land Navigation System</td>
<td>ETL-0202</td>
<td>1979</td>
</tr>
<tr>
<td>Test Strategy for High Resolution Image Scanners, A</td>
<td>ETL-0345</td>
<td>1983</td>
</tr>
<tr>
<td>Testing and Evaluation of the Shiran System by Advanced Data Reduction Methods</td>
<td>AD 707 418</td>
<td>1969</td>
</tr>
<tr>
<td>Testing of an Experimental Viscous-Friction Coupled Small North Orienting Device</td>
<td>AD 822 011</td>
<td>1967</td>
</tr>
<tr>
<td>Tests and Evaluation of an Automatic Point Reading, Plotting, and Grid Ruling Machine</td>
<td>8-TR</td>
<td>1962</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Tests and Evaluation of an Earth Curvature Correction Device</td>
<td>10-TR</td>
<td>1963</td>
</tr>
<tr>
<td>Tests and Evaluation of the AS-11A Stereoplotter</td>
<td>50-TR</td>
<td>1969</td>
</tr>
<tr>
<td>Tests and Evaluation of the Zeiss Stereotype Stereoplotting Instrument</td>
<td>1567-TR</td>
<td>1959</td>
</tr>
<tr>
<td>Tests and Evaluation of Ultrawide-Angle Mapping Photography</td>
<td>6-TR</td>
<td>1961</td>
</tr>
<tr>
<td>Tests and Evaluations of Precision Coordinatographs</td>
<td>1-TR</td>
<td>1961</td>
</tr>
<tr>
<td>Tests of Basic Geometrical Qualities of Photogrammetric Plotting Instrument</td>
<td>RN-5</td>
<td>1962</td>
</tr>
<tr>
<td>Tests on the Change Detector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texture Analysis and Cartographic Feature Extraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texture Tone Study — Category Maps, Gradient and Homogeneity Images</td>
<td>ETL-CR-73-10</td>
<td>1973</td>
</tr>
<tr>
<td>Texture Tone Study — Classification Experiments</td>
<td>ETL-CR-72-16</td>
<td>1972</td>
</tr>
<tr>
<td>Texture Tone Study (Quantizing on the IDECS/PDP)</td>
<td>ETL-CR-72-3</td>
<td>1972</td>
</tr>
<tr>
<td>Texture Tone Study: Summary and Evaluation</td>
<td>ETL-0005</td>
<td>1975</td>
</tr>
<tr>
<td>Texture Tone Study with Application to Digitized Imagery</td>
<td>TR-182-1</td>
<td>1976</td>
</tr>
<tr>
<td>Texture Tone Study with Application to Digitized Imagery (Interim Report)</td>
<td>ETL-CR-71-14</td>
<td>1971</td>
</tr>
<tr>
<td>Texture Tone Study with Application to Digitized Imagery (Final Report)</td>
<td>ETL-CR-74-17</td>
<td>1974</td>
</tr>
<tr>
<td>Theodolite with Shaft Angle Encoder and Display</td>
<td>AD 662 080</td>
<td>1967</td>
</tr>
<tr>
<td>Theoretical and Experimental Study of Wave Scattering from Composite Rough Surfaces</td>
<td>ETL-CR-74-4</td>
<td>1974</td>
</tr>
<tr>
<td>Thermal Infrared Spectra of Natural and Man-Made Materials: Implications for Remote Sensing</td>
<td>ETL-0587</td>
<td></td>
</tr>
<tr>
<td>Third-Order Co-Occurrence Texture Analysis Applied to Samples of High Resolution Synthetic Aperture Radar Imagery</td>
<td>ETL-0396</td>
<td>1985</td>
</tr>
<tr>
<td>3-D Road Structure from Motion Stereo</td>
<td>ETL-0471</td>
<td>1987</td>
</tr>
<tr>
<td>Tight Upper Bound for the Speed-Up of Parallel Best-First Branch-and-Bound Algorithms, A Topographic Data Output Study</td>
<td>ETL-0462</td>
<td>1987</td>
</tr>
<tr>
<td>Topographic Eigenvector Analysis</td>
<td>AD 262 161L</td>
<td>1961</td>
</tr>
<tr>
<td>Topographic Radar Mapping Systems Design Study</td>
<td>AD 484 747L</td>
<td>1966</td>
</tr>
<tr>
<td>Topographic Relaxation Study</td>
<td>ETL-0209</td>
<td>1979</td>
</tr>
<tr>
<td>Total Optical Color System (Report No. 2 in the ETL series on Remote Sensing)</td>
<td>ETL-ETR-74-3</td>
<td>1974</td>
</tr>
<tr>
<td>Toward Automatic Extraction of Cartographic Features</td>
<td>ETL-0153</td>
<td>1978</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>T PLOT: A Simple Program for Plotting Percent Composition Data on Ternary Diagrams</td>
<td>ETL-RN-74-2</td>
<td>1973</td>
</tr>
<tr>
<td>Training Course on Data Reduction of Radar Topographic Imagery</td>
<td>AD 721 653</td>
<td>1969</td>
</tr>
<tr>
<td>Transformation of Coordinates of Cartographic Digital Data</td>
<td>ETL-TR-74-8</td>
<td>1974</td>
</tr>
<tr>
<td>Transforming Printers: Acceptance and Engineering Tests</td>
<td>40-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Transitional Design Study of the Position and Azimuth Determining System (PADS)</td>
<td>ETL-0001</td>
<td>1975</td>
</tr>
<tr>
<td>Tribrach, Universal</td>
<td>1453-TR</td>
<td>1956</td>
</tr>
<tr>
<td>Two Approaches to a Portable Color-Measuring System</td>
<td>RN-15</td>
<td>1966</td>
</tr>
<tr>
<td>Two Dimensional Path Planning with Obstacles and Shadows</td>
<td>ETL-0452</td>
<td>1987</td>
</tr>
<tr>
<td>Two-Way Linear Interpolation</td>
<td>ETL-RN-71-5</td>
<td>1971</td>
</tr>
<tr>
<td>Type I Geodetic Satellite</td>
<td>AD 721 652</td>
<td>1964</td>
</tr>
<tr>
<td>TyPro Composer Photolettering Machine</td>
<td>1504-TR</td>
<td>1957</td>
</tr>
<tr>
<td>Unified Approach to Mapping, Charting, and Geodesy (MC&amp;G) Data Base Structure Design</td>
<td>ETL-0144</td>
<td>1978</td>
</tr>
<tr>
<td>Unified Geodetic Parameter Program (GEOPS), Vol. 1 of 2 — Mathematical Analysis</td>
<td>AD 640 321</td>
<td>1966</td>
</tr>
<tr>
<td>Unified Geodetic Parameter Program (GEOPS), Vol. 2 — Program Description</td>
<td>AD 640 322</td>
<td>1966</td>
</tr>
<tr>
<td>Universal Analog Rectification System for Map Revision</td>
<td>24-TR</td>
<td>1965</td>
</tr>
<tr>
<td>Universal Automatic Map Compilation Equipment</td>
<td>51-TR</td>
<td>1969</td>
</tr>
<tr>
<td>Universal Radar Signal Processor (Correlator), Interim</td>
<td>AD 487 144L</td>
<td>1966</td>
</tr>
<tr>
<td>Universal Radar Signal Processor (Correlator), Final</td>
<td>AD 841 545L</td>
<td>1968</td>
</tr>
<tr>
<td>U.S. Army Type II Geodetic Satellites, Vol. 1</td>
<td>AD 721 645</td>
<td>1965</td>
</tr>
<tr>
<td>U.S. Army Type II Geodetic Satellites, Vol. 2</td>
<td>AD 721 646</td>
<td>1965</td>
</tr>
<tr>
<td>U.S. Army Type II Geodetic Satellites, Vol. 3</td>
<td>AD 721 647</td>
<td>1965</td>
</tr>
<tr>
<td>Use and Calibration of Distance Measuring Equipment for Precise Mensuration of Dams (Revised)</td>
<td>ETL-0048</td>
<td>1976</td>
</tr>
<tr>
<td>Use and Calibration of Distance Measuring Equipment for Precise Mensuration of Dams</td>
<td>ETL-0190</td>
<td>1979</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------</td>
<td>------</td>
</tr>
<tr>
<td>Use of a Vidicon to Digitize Certain Types of Target Image in a Photographic Background</td>
<td>AD 457 818L</td>
<td>1964</td>
</tr>
<tr>
<td>Use of Array Algebra in Terrain Modeling Procedures</td>
<td>ETL-0094</td>
<td>1976</td>
</tr>
<tr>
<td>Use of Edges of Photographic Images as Specifiers of Image Quality</td>
<td>ETL-CR-72-15</td>
<td>1972</td>
</tr>
<tr>
<td>Use of Radar Images in Terrain Analysis: An Annotated Bibliography</td>
<td>ETL-0024</td>
<td>1975</td>
</tr>
<tr>
<td>Using Terrain Analysis to Predict Likely Minefield Sites</td>
<td>ETL-0325</td>
<td>1983</td>
</tr>
<tr>
<td>Utility of Radar Imagery in the Production of Tactical Terrain Data. Military Capabilities Report</td>
<td>ETL-0045</td>
<td>1975</td>
</tr>
<tr>
<td>Utilization of a Photogrammetric Facility (PF) in Human Engineering Laboratories Battalion Artillery Test Number Two (HELBAT II)</td>
<td>ETL-SR-71-2</td>
<td>1971</td>
</tr>
<tr>
<td>Variscale Stereo Point Marking Instrument</td>
<td>39-TR</td>
<td>1968</td>
</tr>
<tr>
<td>Vegetation and Terrain Effects on Digital Classification of LANDSAT Imagery</td>
<td>ETL-0292</td>
<td>1982</td>
</tr>
<tr>
<td>Vegetation and Terrain Relationships in South-Central New Mexico and Western Texas</td>
<td>ETL-0245</td>
<td>1980</td>
</tr>
<tr>
<td>Vegetation Data Extraction Software Documentation/User’s Manual</td>
<td>ETL-0340</td>
<td>1983</td>
</tr>
<tr>
<td>Vegetative Cover Effects on Soil Spectral Reflectance</td>
<td>ETL-0284</td>
<td>1982</td>
</tr>
<tr>
<td>Visual Factors Affecting the Precision of Coordinate Measurement in Aerotriangulation</td>
<td>RN-21</td>
<td>1967</td>
</tr>
</tbody>
</table>

94
<table>
<thead>
<tr>
<th>TITLE</th>
<th>REPORT NO.</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Interactive Systems Technology (VIST) Research</td>
<td>ETL-0349</td>
<td>1984</td>
</tr>
<tr>
<td>Voice Interactive Systems Technology (VIST) Research</td>
<td>ETL-0349</td>
<td>1984</td>
</tr>
<tr>
<td>Weighted Line-Finding Algorithm</td>
<td>ETL-0200</td>
<td>1979</td>
</tr>
<tr>
<td>What is a Hill? An Analysis of the Meaning of Generic Topographic Terms</td>
<td>ETL-0576</td>
<td>1991</td>
</tr>
<tr>
<td>Wind Design Criteria for Field Shelters — A Study</td>
<td>ETL-0037</td>
<td>1975</td>
</tr>
<tr>
<td>Wire List GEISHA Computer</td>
<td>AD 847 667</td>
<td>1969</td>
</tr>
<tr>
<td>World Areas More Humid Than the Canal Zone during the Wet Season (Note 3 of “Studies to Aid TECOM in Analyses of Environmental Risks to Materiel”)</td>
<td>ETL-RN-74-8</td>
<td>1974</td>
</tr>
<tr>
<td>World Areas with Higher Precipitation Intensities and Frequencies than the Tropic Test Center, Canal Zone</td>
<td>ETL-0022</td>
<td>1975</td>
</tr>
<tr>
<td>World Areas with Higher Temperatures than the Yuma Proving Ground During Summer (Note 2 of “Studies to Aid TECOM in Analyses of Environmental Risks to Materiel”)</td>
<td>ETL-RN-74-6</td>
<td>1974</td>
</tr>
<tr>
<td>World Areas with Lower Temperatures than the Arctic Test Center During Winter (Note 1 of “Studies to Aid TECOM in Analyses of Environmental Risks to Materiel”)</td>
<td>ETL-RN-74-5</td>
<td>1974</td>
</tr>
<tr>
<td>World Weather Extremes</td>
<td>ETL-0416</td>
<td>1985</td>
</tr>
<tr>
<td>Worldwide Distributions of Ambient Temperatures and Temperatures of Materiel Exposed to Direct Solar Radiation</td>
<td>ETL-SR-73-2</td>
<td>1972</td>
</tr>
<tr>
<td>Worldwide Distribution of Mean Dewpoint: Surface and Lower Atmosphere</td>
<td>ETL-SR-72-4</td>
<td>1972</td>
</tr>
<tr>
<td>Worldwide Distribution of Mean Monthly Dewpoint (Supplement to ETL-SR-72-4 “Worldwide Distributions of Mean Dewpoint: Surface and Lower Atmosphere”)</td>
<td>ETL-SR-72-2</td>
<td>1973</td>
</tr>
<tr>
<td>Xerox 6500 Color Copier</td>
<td>ETL-0106</td>
<td>1977</td>
</tr>
<tr>
<td>TITLE</td>
<td>REPORT NO.</td>
<td>YEAR</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Zoom Transfer Scope</td>
<td>ETL-ETR-72-5</td>
<td>1972</td>
</tr>
</tbody>
</table>