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NOISEMAP 6.0 - THE USAF MICROCOMPUTER PROGRAM FOR AIRPORT NOISE ANALYSIS

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13. ABSTRACT (Maximum 200 words)

NOISEMAP is a computer program used for generating Noise Exposure Contours in various metrics including DNL, NEF, CNEL, and WECPNL around US military bases. This program uses state-of-the-art modeling techniques developed by the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL) to provide accurate information about noise exposure to local communities for zoning against encroachment. This model is also used by the civilian community to model noise exposure around civil and general aviation airports. Noise and performance datafiles for both US military and civil aircraft are included with the program. AAMRL recently upgraded this mainframe computer model to operate on a desktop microcomputer, resulting in tremendous time and money savings for completing any airbase noise analysis. Two additional programs, BASEOPS and NMPLOT, were created for use with this microcomputer version on NOISEMAP. BASEOPS is a computerized operations input program for creating specific cases. NMPLOT is a versatile microcomputer contouring program that takes the output of NOISEMAP and creates the resulting noise contours to the screen, to the file, or to a plotter.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Harry G. Armstrong Aerospace Medical Research Laboratory, under Project/Task 7231. The author wishes to acknowledge the support of Ms Jackie Brennaman and Ms Bea Heflin for the preparation of this report for publication and to Mr Jerry Speakman for his editorial comments.

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INTRODUCTION

Since 1971 the United States Air Force has been actively
developing and improving NOISEMAP, a fully computerized
procedure for generating cumulative noise exposure contours
around airbases. This mainframe computer program was recently
upgraded to reside on a desktop microcomputer, resulting in
tremendous time and money savings for completing any airbase
noise analysis. Two additional programs, BASEOPS and NMPLOT,
were created for use with this microcomputer version of
NOISEMAP. BASEOPS is a computerized operations input program
for data entry. NMPLOT is a versatile contouring program that
takes the output of NOISEMAP and creates the resulting noise
contours to the screen, to a file or to a plotter. Users
manuals have been published for both the new NOISEMAP and the
BASEOPS programs (ref 1&2).

The underlying methodology of NOISEMAP couples an aircraft
unique noise data base with a comprehensive modeling program
to compute the noise exposure from aircraft flight and ground
runup activity at an airbase on an average busy day. Noise
source characteristics were systematically measured by the
Armstrong Aerospace Medical Research Laboratory (AAMRL) for 52
military aircraft under controlled flight test conditions and
55 military aircraft under controlled ground runup test
conditions . Using this data base (NOISEFILE) an additional
17 aircraft having similar engine power plants have been
estimated. In addition, measured noise data are included for
eleven different demountable suppressors and several
aircraft/engines operating in the USAF Hush House noise
suppressor. Data for 77 civil aircraft used in the US Federal
Aviation Administration Integrated Noise Model are also
included in NOISEFILE for use in modeling joint civil -
military installations with the NOISEMAP program.

To do a noise analysis for a particular airport or airbase the
user need only input the specific flight and ground runup
operations via the BASEOPS program. BASEOPS is a menu driven,
user friendly program that creates operations input files for
the NOISEMAP program. Some of the special features of the
BASEOPS program include graphic display of input ground tracks
and engine power setting profiles, use of background map and
navigational aids for flight track verification, default data
base for civil and military aircraft power/performance/
altitude profiles, custom segmenting of profiles, on line
listings of available aircraft and input flight tracks and
error checking for logical data entry. Five different summary
printouts are available for operations verification. BASEOPS
also provides a global subset menu for creating files for

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"What if" studies. This provides a simplified way to examine
individual impacts from the input operations and examine noise
mitigation efforts.

Once the operations inputs are created they are processed
through NOISEMAP via its Master Control Module (MCM). The MCM
keeps track of file input, data handling, user selected
options and final data archiving. All files used with
NOISEMAP are stored in standard ASCII format and can be viewed
or printed directly from the MCM. Some of the special
modeling features in NOISEMAP are: Excess Sound Attenuation
(ESA) under ground-to-ground propagation conditions that is
aircraft type and power setting dependent; lateral (sideline)
attenuation of flight noise levels at low aircraft-to-observer
elevation angles; takeoff roll noise model that compensates
for directivity and acceleration effects; flight profile
segmentation to account for variations in engine power setting
and airspeed; influence of turns on predicted flight noise
durations; effect of airbase (runway) altitude above sea level
on thrust, airspeed and acoustic impedance; and flexibility to
generate noise contour maps for any specified average
temperature and relative humidity conditions.

In the NOISEMAP program two lateral attenuation models are
used. For civil aircraft the lateral attenuation model
developed by the Society of Automotive Engineers, Inc. A-21
Committee on Aircraft Noise (ref 3) is used. Since it was
derived mainly from measured data on civil aircraft, the
predicted results generally show good agreement when compared
with actual measurements around airports. However the
frequency spectra of most military aircraft is often quite
different from that associated with civil transports,
therefore AAMRL conducted a series of field experiments to
collect a data base to insure the accurate prediction of the
lateral attenuation associated with military aircraft flight
operations. These data were analyzed and a specific algorithm
was developed for military aircraft. Figure 1 shows a
comparison between the military and civil aircraft lateral
attenuation models.

The NOISEMAP program calculates noise exposure for a fixed
grid with equal spacing of 10,000 points, calculates the area
within equal noise exposure values and provides a detailed,
rank ordered summary of operations and their contribution to
the total noise exposure at up to twenty specific locations.
This specific locations printout is useful in determining the
cause of problems at a specific noise sensitive area. The MCM
allows the user to input any spacing and location for the grid
computations as well as determining the contour levels for the
area computation calculations.

NOISEMAP can be used to generate either single event footprints or cumulative noise exposure contour maps. The noise characteristics are stored in NOISEFILE in a variety of metrics including maximum A-weighted level, perceived noise level and the time integrated A-weighted level (Sound Exposure Level) all with and without a pure tone correction. The noise data are also stored in terms of the Effective Perceived Noise Level. NOISEMAP can therefore be used to generate exposure contours in terms of the Day-Night Sound Level (DNL), Community Noise Equivalent Level (CNEL), Noise Exposure Forecast (NEF) and Weighted Equivalent Continuous Perceived Noise Level (WECPNL).

Once the noise exposure values are computed for the 10,000 grid point array, the NMPLOT program will calculate and display the user selected contours. Special features of the NMPLOT program are complete on-line context sensitive help, complete plot manipulation and annotation control (size, scaling, rotation, labeling, color, etc.), plot to screen, contour overlay, flight track display and zoom features. The program will drive any Hewlett Packard compatible plotter to produce plots to whatever size the plotter can handle. The program has the capability of plotting directly on background maps input to the plotter. Two points are identified on the map (usually a single runway end points) and fed back to the program via the plotter. With this information the program will scale and rotate the output to match the background map and plot the selected contours. Figure 2 shows the output contours from the NMPLOT program.

While rehosting the NOISEMAP program to a desktop micro-computer, AAMRL revised the code to reduce inefficiencies in the noise exposure calculations and contour generation. A typical large USAF airbase (22 different aircraft, 73 flyover profiles, 25 runup profiles) was used to determine program run times on various computers. The run times started from input of the operations files (BASEOPS output) to the grid calculation including creating the weather specific noise profiles for each aircraft type. For a 80286 based microcomputer running at 8 MHz the run time was 108 minutes. For a 80386 based microcomputer running at 20 MHz the run time was 26 minutes. To get a final contour displayed the user need only load this grid into NMPLOT, select the options (defaults are provided) for display and hit the display function key. NMPLOT takes about 2 to 3 seconds to display the contour to the screen and is limited by the plot device for paper output (typically 3 to 4 minutes).

Because NOISEMAP is a key factor in the Air Force defense against noise related lawsuits and the high cost involved in the management decisions made based on its use, several

validation studies have been conducted. Predicted single event flight noise levels were validated by hundreds of measurements and several cumulative exposure validation studies were completed showing great agreement with the NOISEMAP predicted levels (ref 4).
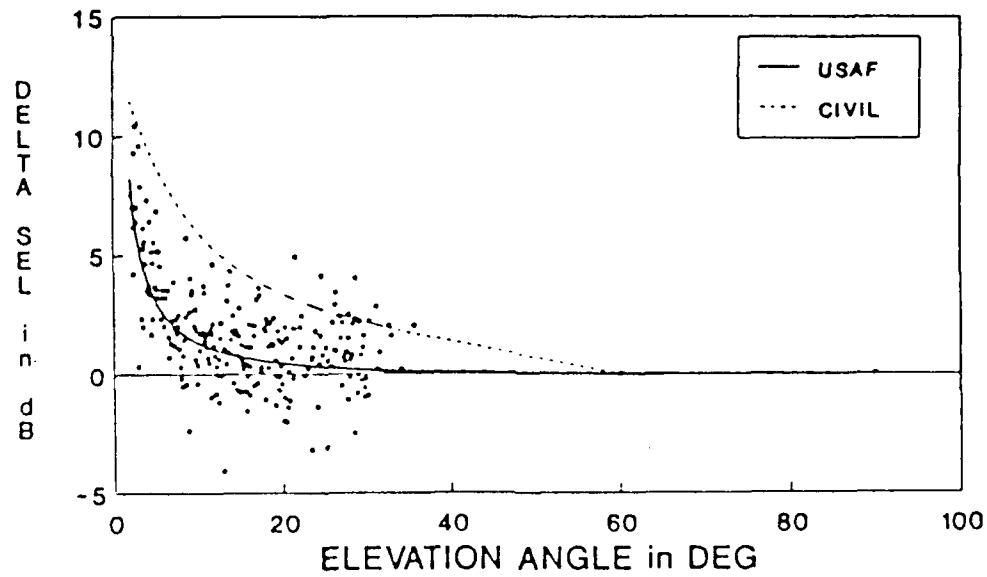
MODEL COMPARISON
LATERAL ATTENUATION

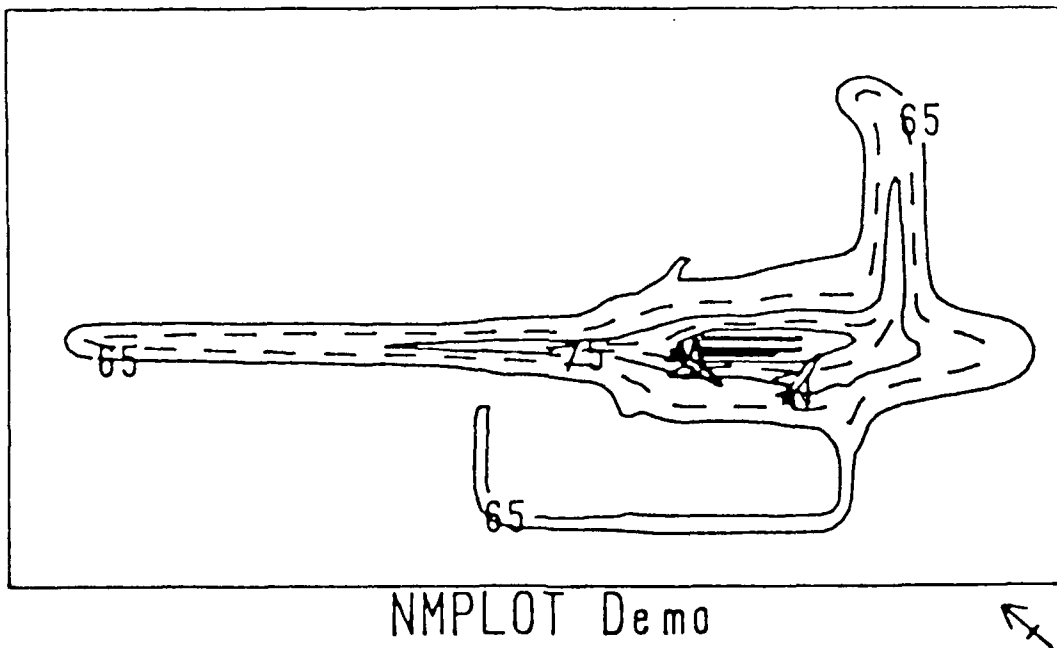Figure 1. Lateral Attenuation Model Comparison

Figure 2. NOISEMAP 6.0 Plot Output

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