

INM Version 6

General Information

The Federal Aviation Administration (FAA) has just released Version 6.0 of the Integrated Noise Model (INM). You should be notified by FAA shortly. Information should also be posted on the Office of Environment and Energy's Web Site: <http://aee.faa.gov>.

Harris Miller Miller & Hanson Inc. (HMMH) has been extensively involved in the beta-testing of Version 6.0. We have developed this newsletter to inform you of the *major changes* you should expect to see in the model, with some discussion of how they might affect model output (i.e., contours). The following information is based on HMMH's beta-testing efforts.

Version 6 will include a number of new features and model capabilities. For the sake of our discussion, we have divided them into several categories: changes that may affect output for *existing* cases (**Computational Changes**), new features and functions (**New Features**), **Data Base Changes**, and changes that affect how the program operates, but not the computations (**User Interface Changes**). Each of these areas is discussed below.

Computational Changes

Version 6 will have several modifications to the computational algorithms in the INM. These include:

- Introduction of "spectral classes"
- Division of NPD data into distinct curves for departure and approach
- Changes to the base grid for contour computations
- Changes to the significance-testing algorithm
- Changes to the terrain computational algorithm

We expect that detailed descriptions of these changes will be provided with the release notes for Version 6.0

Computational Changes: Spectral Classes

Version 6 includes several modifications and new features that are relevant to the aircraft's frequency spectrum. Because that data is detailed, the FAA has divided the entire database of 222 aircraft into some 72 different "spectral classes" -- that is, a collection of aircraft whose frequency spectrum is similar. The spectral class information is described under **Aircraft/Noise Identifiers**. However, even if you are not computing C-weighted metrics (which will directly use the spectral classes), your computations for existing cases may change due to the manner in which propagation is computed using the new spectral class information.

**Computational Changes:
Spectral Classes (continued)**

Spectral classes will allow the future inclusion of lateral attenuation based on specific ground type. This feature is currently being reviewed by the Society of Automotive Engineers' Committee on Aircraft Acoustics, A-21. It will be added to INM upon approval by A-21. We caution that this lateral attenuation change may have significant changes in the resulting contours, especially in areas currently affected by ground and/or sideline noise (i.e., takeoff roll, reverse thrust).

**Computational Changes: NPD
Curves**

INM 5 did not identify the mode of operation associated with a given Noise-Power-Distance (NPD) curve (i.e., takeoff or approach). This occasionally resulted in some difficult interpolation and/or extrapolation errors. Version 6 deals with this issue by assigning a departure or approach code to every NPD curve in the data base. This may result in some changes to the output for existing cases (in particular, those with aircraft that had this problem in the past). NPD curves also are now limited to a maximum extrapolation of 5 dB beyond the highest power NPD curve and - 5 dB below the lowest NPD curve. This also may change results for existing cases.

**Computational Changes:
Contour Base Grid**

INM Version 5 initiated its computations (refinement level 4) as a 17 by 17 grid, based on the initial computation window defined by the user (default is 16 nm by 16 nm, resulting in a default initial grid spacing of approximately one nautical mile). Version 6 starts computations with a variable-size grid, again based on the initial computation window, but starting at a one nautical mile grid spacing, *regardless of the size of the computation window*. This may affect cases for which you have defined non-standard grid windows.

**Computational Changes:
Significance-Testing**

In Version 5, the computations for a given grid point were limited to the top 97% of flights (operations assigned to flight tracks) at that point. In Version 6, the algorithm has been revised to include the top 97% of flight *segments* affecting a given grid point. This change was made to dramatically decrease the run time of contour computations.

**Computational Changes:
Terrain Computation**

In Version 5, the beta angle has been removed from the computation of terrain effects. The beta angle is the angle between the ground and the aircraft. For example, if the listener is on terrain with a 30 degree slope and an aircraft flies directly overhead, the beta angle is 60 degrees. The beta angle is used in the computation calculation of lateral attenuation. The ground slope was removed from the model because it was causing unrealistic results, particularly in areas with undulating terrain.

New Features

New features include:

- C-weighted metrics
- Atmospheric Propagation due to weather
- Variable ambient noise
- New metrics: % Time Above, Number of Events Above
- 100% of Flights in detailed grid analysis
- View/Calculate function for EPR/N1 computation

These are described briefly below.

New Features: C-Weighted Metrics

Version 6 allows the user to conduct analyses using C-weighting. This feature was added primarily to address low frequency noise issues. For example, you can now prepare contours which will depict the maximum C-weighted noise level.

New Features: Weather Effects

Version 6 now considers the annual average relative humidity as well as the temperature at the study airport in its computation of aircraft noise propagation, if invoked by the user under **Setup/Cases**. This enhancement is possible due to the addition of spectral classes, since attenuation is a function of frequency. Previous versions of the INM used temperature only to calculate the effect on aircraft performance; now temperature and relative humidity are both used to compute the attenuation (atmospheric absorption) due to weather. This may affect your results, depending on the spectral classes of the aircraft in the study, and how different the weather conditions at your airport are as compared with the standard.

New Metrics: Percent Time Above and Number of Events Above

These new metrics allow the user to compute:

- **Percent Time Above** [Threshold]: the *percent of time* (in a 24-hour period) above a given threshold (or, in the case described in the section above, time above ambient).
- **Number of Events Above** [Threshold]: the *number of* aircraft events (in a 24-hour period) which have noise levels exceeding a given threshold (or ambient level).

We caution that these metrics, while perhaps more intuitive than the logarithmic metrics have the same fundamental problems as Time Above (TA): there is no scientific evidence associating any given “dose” with a community “response” (as has been demonstrated for DNL and other exposure-based metrics).

New Features: Variable ambient noise

Version 6 will allow the user to include a file containing the ambient noise levels for a given grid. These levels can be used instead of a fixed threshold for computing Time Above; that is, you can now compute Time Above Ambient.

New Features: 100% of Flights in Detailed Grid Analysis

In previous versions, the **Output/Noise at Detailed Grid** report included the top 97% of flights contributing toward the total noise level at a Detailed Grid Location (this was related to the significance testing algorithm). Version 6 will provide 100% of the flight information.

New Features: Thrust Calculator

This new feature will calculate engine thrust levels based on EPR/N1 data provided by the user. This feature, found under **View/Thrust Calculator** is useful for developing User-defined procedures, such as Noise Abatement Departure Procedures.

Data Base Changes

The following aircraft types have been added to the INM data base with Version 6.0:

- Embraer 145 (added in 5.2a)
- P3C (Military)
- JPATS (Military)
- F18EF (Military)

The following aircraft types are expected to be included in Version 6.1 (imminent):

- Airbus 340
- 737x00
- Boeing 727 revision

In addition, several substitutions have been added or modified; see the **Aircraft/Substitution** database for details.

User Interface Changes

Several features have been added to streamline data entry. Several are described below:

- Aircraft copy: Version 6.0 will support full copy of aircraft data base information. This is useful for defining aircraft.
- NMPLOT: Version 6.0 uses the new Windows-based NMPLOT, which has several effects on graphical display of contours, and also enables the user to use long filenames for the first time.
- Track and profile names: the labels can now be eight characters long.