Results of ACRP Project 02-44, “Guidance for Helicopter Community Noise Prediction”

May 11, 2016
What is ACRP?

Airport Cooperative Research Program

• Focuses on research to serve airport needs
• Managed by the Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine
• Sponsored by the FAA, but the FAA does not endorse and is not bound by any research results
Why Was ACRP 02-44 Started?

There is no peer-reviewed document describing modeling techniques for helicopter and tiltrotor noise.

Photos from:
- https://en.wikipedia.org/wiki/MD_Helicopters_MD_500
Key ACRP 02-44 Tasks

• Document current helicopter modeling methods

• Recommend peer-reviewable improvements to FAA regulatory noise model for greater accuracy

• Recommend implementation steps for model improvements

The project does not recommend what noise metric to use for modeling helicopter noise
Aircraft Noise Modeling Data

### Source Noise
Noise generated by the aircraft

### Operational Characteristics
How and where the aircraft flies

### Propagation
How noise interacts with air and ground

### Noise Metrics
Ways of expressing noise levels using numbers

- DNL
- SEL
- CNEL
The Project Compared 3 Models

- **AEDT / INM**
  - FAA Aviation Environmental Design Tool / Integrated Noise Model
  - AEDT replaced INM in 2015 for most aviation projects

- **AAM**
  - US Department of Defense Advanced Acoustic Model
  - Higher fidelity than AEDT/INM

- **HELEN A**
  - HELicopter Environmental Noise Analysis model
  - Developed and maintained in Europe
  - Higher fidelity than AEDT/INM

The project primarily compared AAM and INM
ACRP 02-44 Recommendations

ACRP 02-44 made recommendations to improve AEDT in several key areas:

• Directional noise
• Low-frequency noise
• Operational characteristics
• Sound propagation
• Tiltrotors
Directional Noise

Increase AEDT fidelity to better capture how noise changes with angle between helicopter and listener

AAM Example: Noise Level vs. Angle

- Loudest from the front right
- Quietest from the tail

- Directionality of noise depends on how the helicopter is operated
- For forward flight, AEDT/INM only includes noise data for:
  - Directly underneath
  - 45 degrees from the left side
  - 45 degrees from the right side
- For hover and idle, AEDT/INM only includes noise data for helicopter front and back

Image from ACRP 02-44 Final Report
Low-Frequency Noise

Add data to AEDT to extend sound frequency range down to 10 Hertz (Hz)

- Helicopters produce a high degree of sound energy below 50 Hz
- Low frequencies travel further than high frequencies
- Frequencies below 20 Hz can be perceived as “rumble”
Operational Characteristics

Include methods to model how maneuvers and climb / descent angle affect helicopter noise

• Certain maneuvers and climb / descent angles cause “blade slap” (rotor blades colliding with their own wake turbulence), which can increase noise by over 10 decibels
• An increase of 6 – 10 decibels is perceived as a doubling of loudness

Image from https://www.nas.nasa.gov/SC12/demos/demo1.html
Sound Propagation

Model changes in sound propagation due to varying weather, terrain, and buildings

- Weather affects how sound travels, and AEDT/INM only use airport average weather data
- AEDT/INM can only model all hard ground (e.g., water) or all soft ground (e.g., grass), but not both simultaneously
- AEDT/INM cannot model the effects of buildings on sound propagation

Buildings affect noise levels at example airport in research study

Image from ACRP 02-44 Final Report
Tiltrotors

Incorporate techniques for modeling tiltrotor “transition” mode

- Noise from tiltrotors during transition is different from noise during “helicopter” and “airplane” modes
- AEDT/INM has no transition mode data

Images from:
- https://commons.wikimedia.org/wiki/V-22_Osprey
- https://en.wikipedia.org/wiki/Bell_Boeing_V-22_Osprey
Implementation Steps

• Develop and validate a method of expanding the AEDT helicopter database

• Exercise the method for a variety of helicopters

• Update AEDT modeling using the recommendations in this project

The FAA does not endorse and is not bound by ACRP results
The FAA decides whether AEDT will be updated
Questions?