LAX Community Noise Roundtable

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

May 11, 2016

What is ACRP?

Airport Cooperative Research Program

The National Academies of SCIENCES · ENGINEERING · MEDICINE

TRB TRANSPORTATION RESEARCH BOARD

- 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:

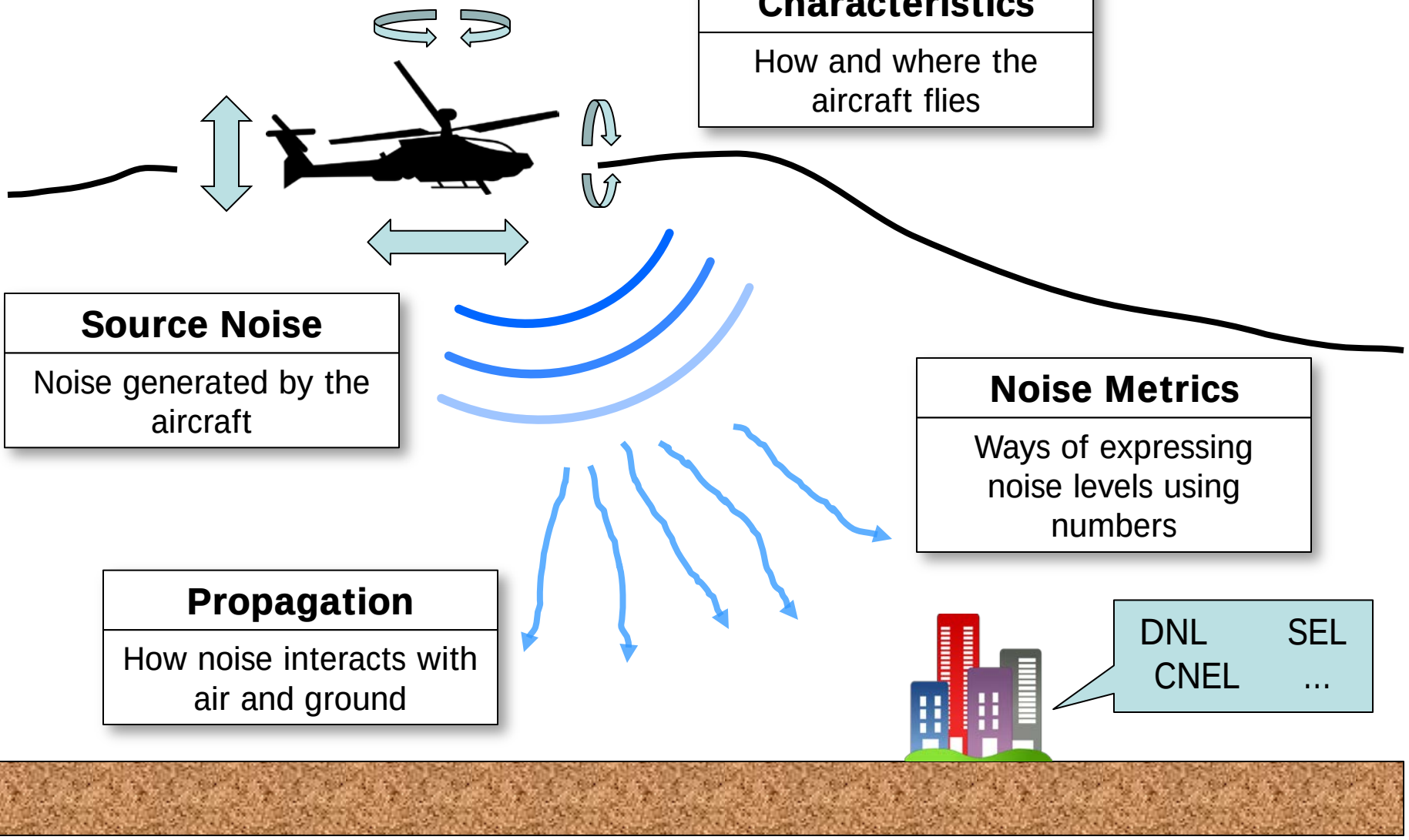
- https://en.wikipedia.org/wiki/MD_Helicopters_MD_500
- https://en.wikipedia.org/wiki/Tiltrotor

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**

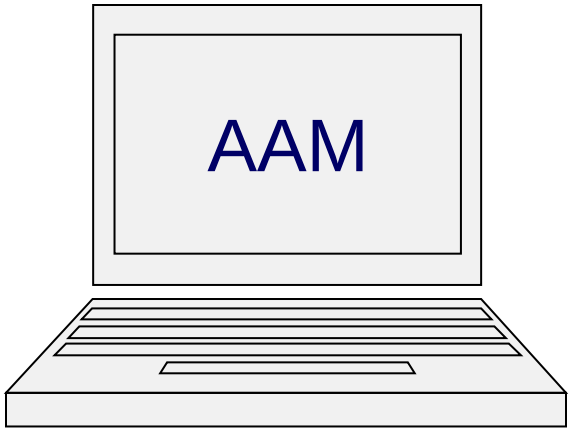
The project does not recommend what noise metric to use for modeling helicopter noise

Aircraft Noise Modeling Data



The Project Compared 3 Models

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



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

- 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

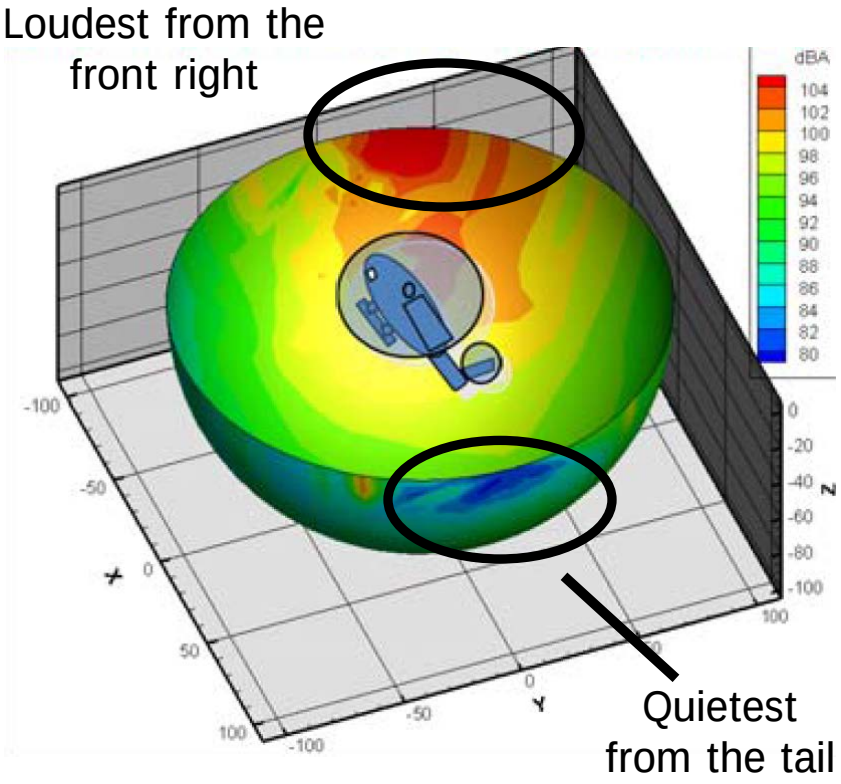
ACRP 02-44 made recommendations to improve AEDT in several key areas:

- **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

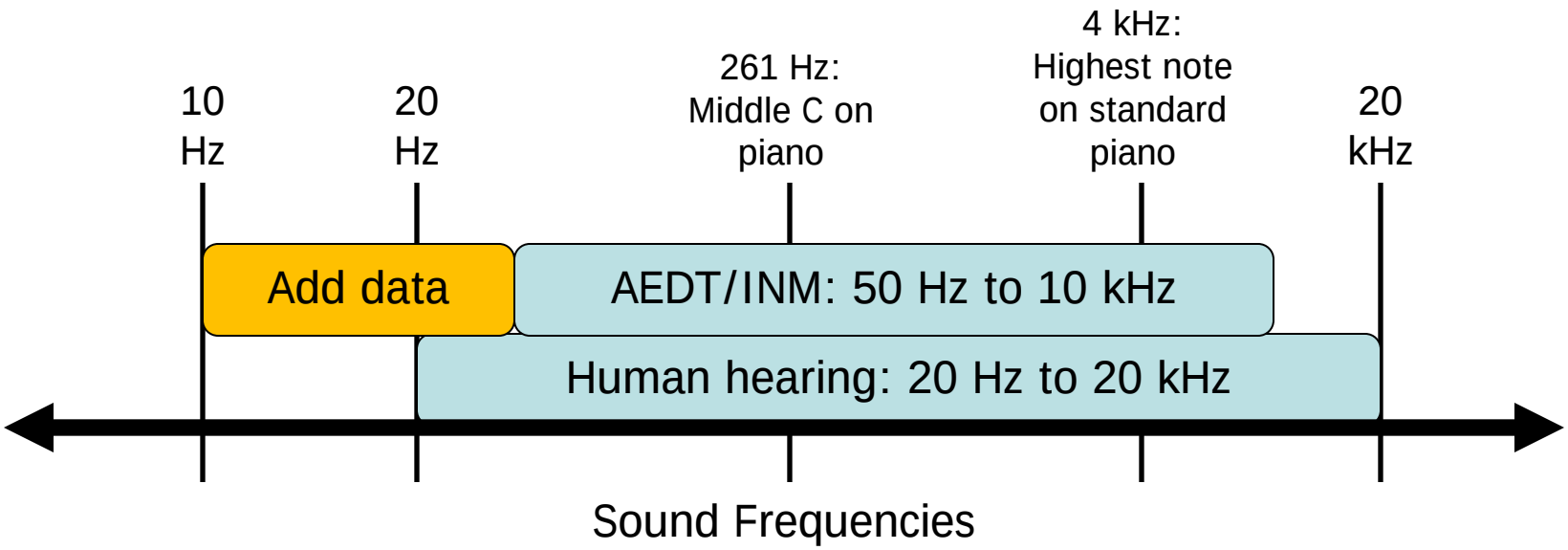


- Directionality of noise depends on how the helicopter is operated
- For forward flight, AEDT/INM only includes noise data for:
  - Directly underneath
  - 45 degrees from the left side
  - 45 degrees from the right side
- For hover and idle, AEDT/INM only includes noise data for helicopter front and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

Image from ACRP 02-44 Final Report

Low-Frequency Noise

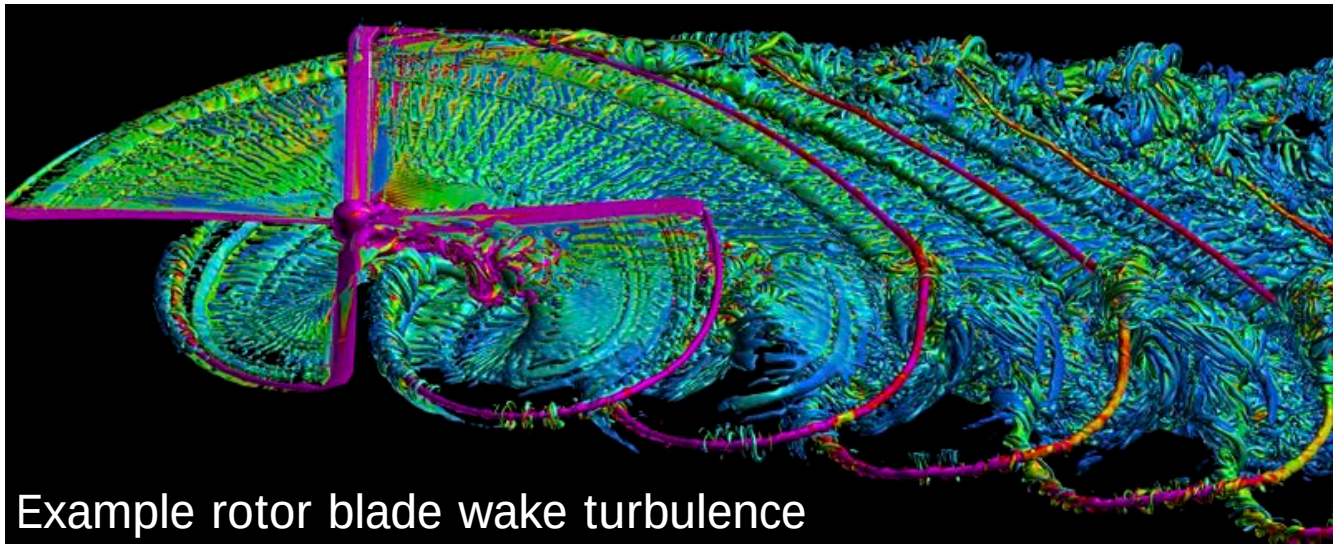
Add data to AEDT to extend sound frequency range down to 10 Hertz (Hz)



- **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



Example rotor blade wake turbulence

- **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

Buildings affect noise levels at example airport in research study

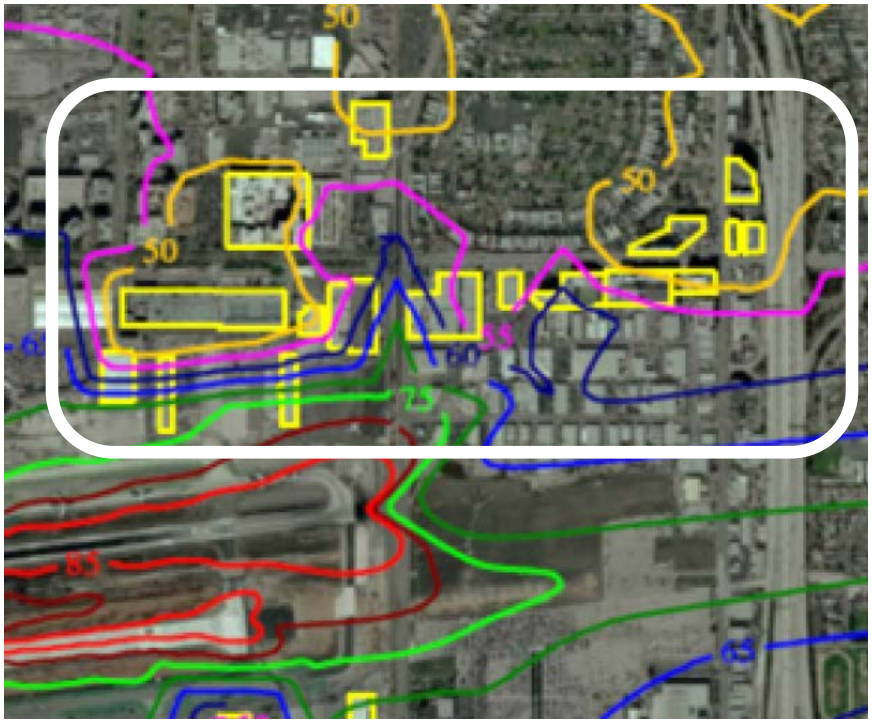


Image from ACRP 02-44 Final Report

- 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

Tiltrotors

Incorporate techniques for modeling tiltrotor "transition" mode

Helicopter mode

Transition mode

Airplane 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

ACRP 02-44

Questions?