FAA AEE's Aviation Noise Impact Roadmap Annual Meeting

ATMP-AEDT Related Research:
AEDT/INM Enhancements

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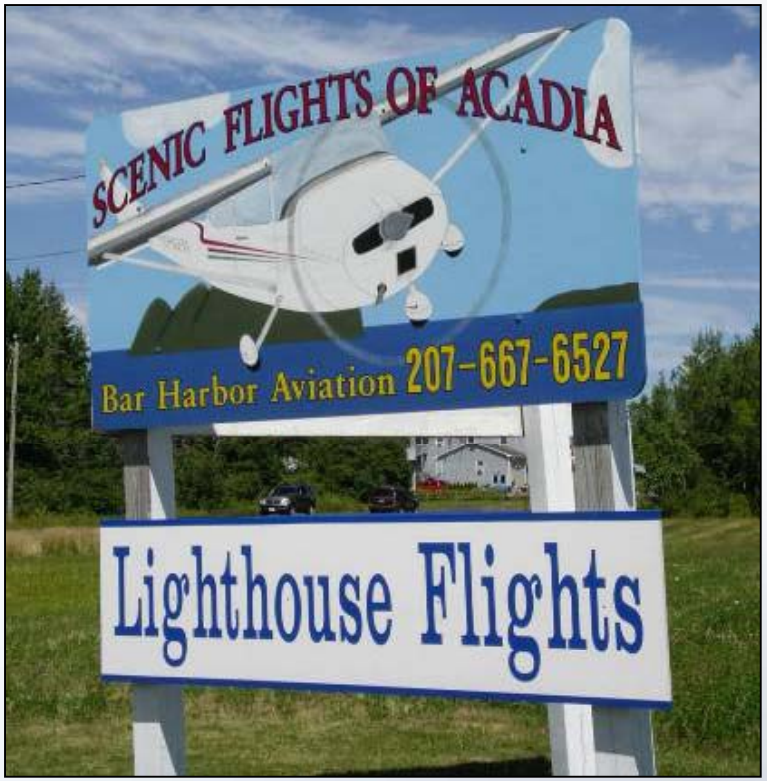
Overview: AEDT/INM Enhancements

Improve noise modeling capabilities in FAA's Aviation Environmental Design Tool (AEDT) and Integrated Noise Model (INM)

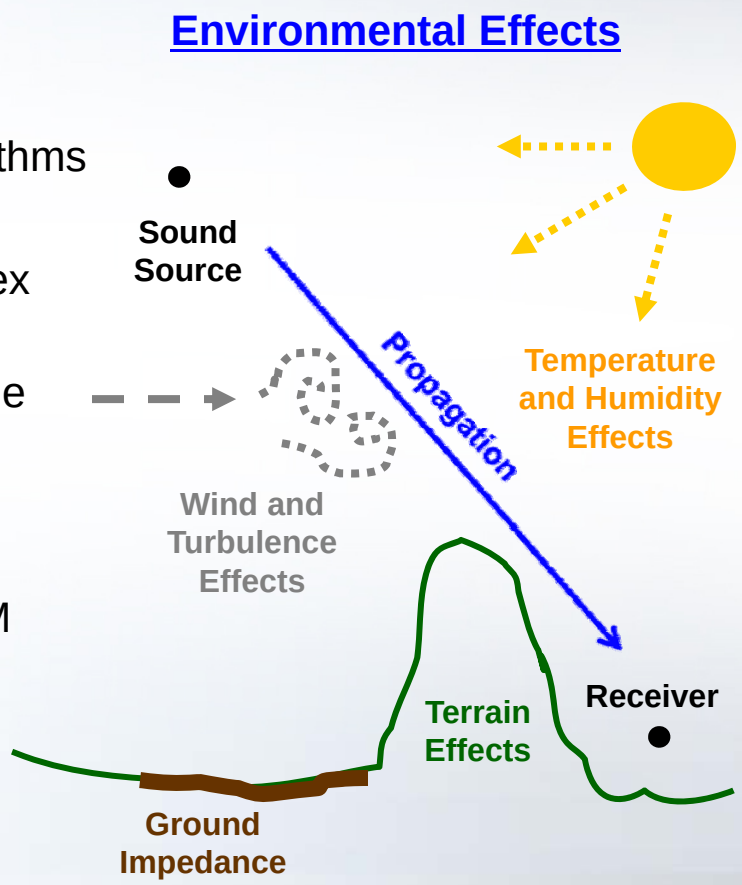
- Advanced aviation noise propagation
- Cumulative noise from simultaneous flights
- Low frequency helicopter noise
- Database updates
- Additional model improvements

- Focus: Aviation noise for flights over National Parks
- Coordinated across FAA (AWP & AEE) and NPS Natural Sounds and Night Skies Division



Advanced Propagation: Hybrid Sound Propagation Model (HPM)

- Cooperative research with PSU to develop HPM for use in FAA tools
- HPM model benefits:
  - Integrated 2 advanced noise propagation algorithms
  - Model low frequency propagation
  - Account for park conditions by modeling complex terrain and meteorology
- Implement HPM within AEDT structure as stand-alone research tool
  - Conversion to AEDT-compatible programming language
  - Stand-alone research tool, accepting AEDT/INM input
- Next steps
  - Code optimization
  - Validation



Advanced Propagation: Nord2000 Analysis

- Nord2000 model benefits:
  - International user base
  - Advanced noise propagation algorithm
  - Account for park conditions by modeling complex terrain and meteorology
- Scope
  - Confirm applicability to aircraft noise modeling - especially in Parks environment
  - Comparison of Nord2000 with AEDT/INM
  - Implement Nord2000 within AEDT structure as research tool
- Next Step:
  - Code implementation
  - Validation

Advanced Propagation: En Route Noise Modeling

Modeling noise from high altitude aircraft requires:

Enroute source noise development

- Cooperative research with GA Tech
- Develop and validate high-altitude aircraft source noise data
- Populate AEDT/INM database

Long-distance noise propagation algorithm

- Cooperative research with PSU
- Review existing enroute noise modeling software, identify gaps and recommend improvements
  - AEDT
  - HPM
  - Nord2000

Cumulative Noise from Simultaneous Flights

Account for simultaneously occurring aircraft events for time-based metrics

- Implement algorithm(s)
- Compare measured and modeled data for several National Parks
  - Grand Canyon
  - Great Smoky
  - Lake Mead
  - Zion

Cumulative Noise from Simultaneous Flights

Preliminary Results

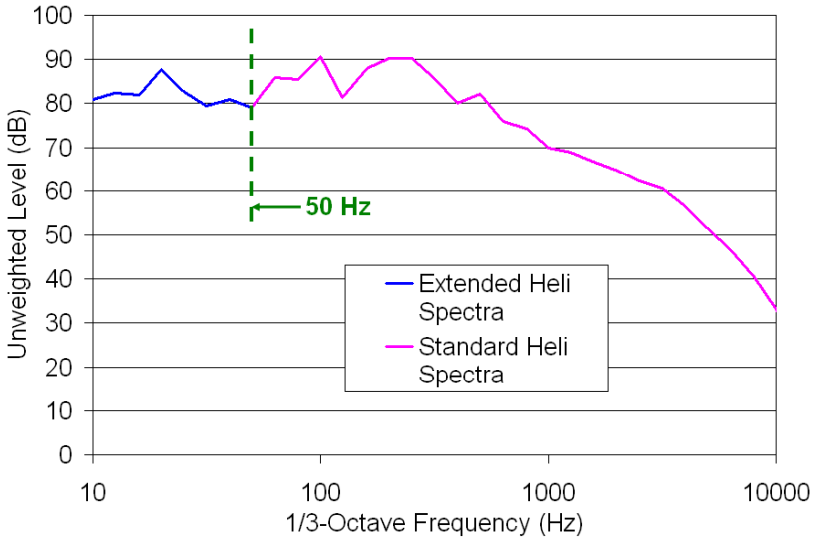
- Statistically-based modeling algorithm outperforms alternatives (no algorithm and empirically-based algorithm)
- Performs better for propeller-driven aircraft than helicopters and high-altitude jets

Next Steps

- Aircraft-specific modeling algorithm(s)?
- Develop calibration procedure (differing site types, etc.)
- Additional validation
- Implement algorithm(s) in AEDT/INM

Low Frequency Helicopter Noise

- Investigate effects of including low frequency noise (<50 Hz) on helicopter noise modeling
  - Develop expanded data for analysis
  - Modify algorithms to allow for extended spectra
- Noticeable effects on C-weighted metrics and line-of-sight blockage adjustment due to terrain
- A-weighted metrics and TAUD minimally affected
- Implement in AEDT/INM



Database Updates

Improve aircraft noise and performance database in AEDT/INM to specifically benefit noise modeling in National Parks

- Expand aircraft databases
  - Small, propeller-driven aircraft
  - Helicopters
  - Floatplanes
- Cooperative research with industry

Database Updates: Expand Aircraft Database

Measure and develop noise and performance data for:

- Propeller: Cessna 182 / 208, Dornier 228 / 328, Piper 42
- Helicopters: Bell 407, Robinson R44, Schweizer 300C
- Floatplanes: Cessna 182S and DeHavilland DHC-2

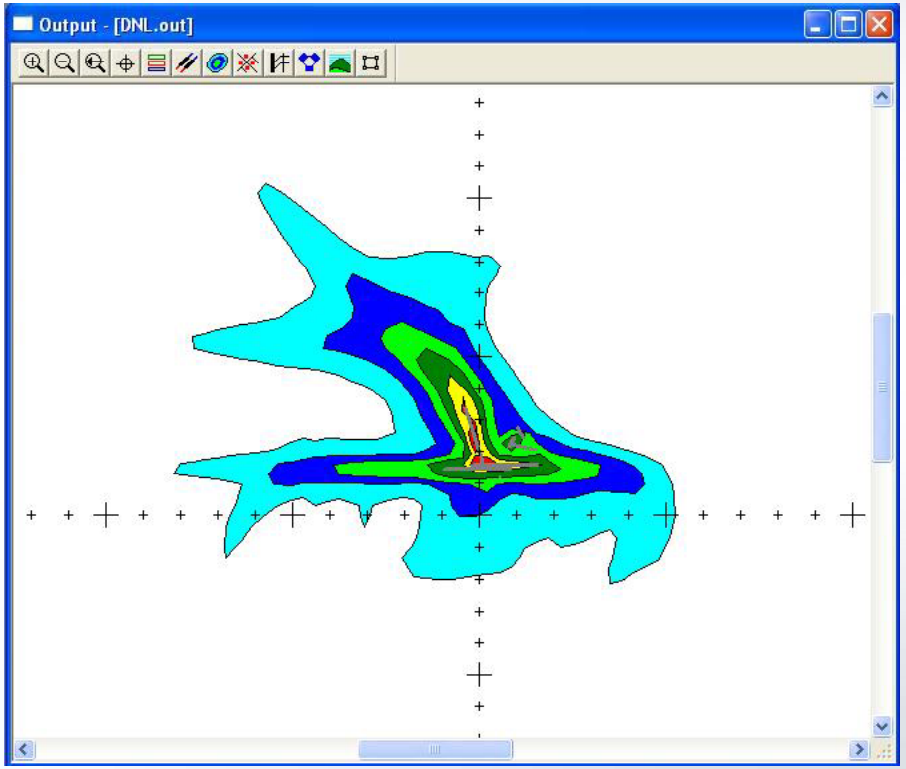
Database Updates: Industry Collaboration

- Data development collaboration with Bell-Textron
- Guidance on Noise-Power-Distance (NPD) development
- Helicopters: B206B-3, B407, B427, B429 and B430

Additional Model Improvements

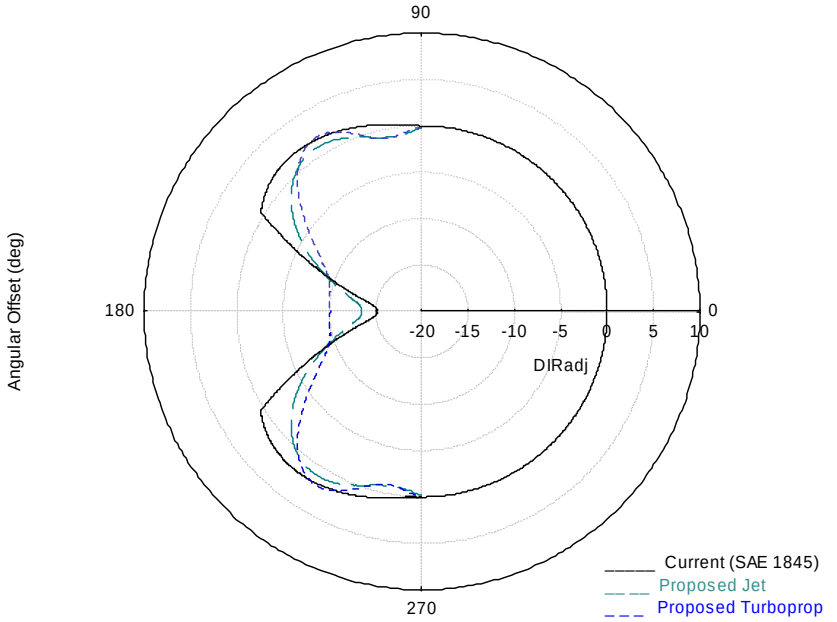
Improve noise modeling capabilities in AEDT/INM

- Noise and performance modeling from a variety of aircraft operations in the vicinity of airports
- Include recent noise modeling methodology updates
  - CAEP Modeling and Database Group
  - ECAC Airport Noise Modeling Group
  - SAE Aircraft Noise Measurement and Aircraft Noise/Aviation Emission Modeling Committee (A-21)



Behind Start-of-Takeoff-Roll Noise Directivity

- Original directivity empirically-derived from measurements at Logan International Airport in 1980
  - Included 48 jet aircraft (80% narrow-body – primarily Boeing 727s)
- Revised directivity empirically-derived from measurements at Washington Dulles International Airport in 2004 (390 jets and 4 turboprops)
    - Dominant jet aircraft: B737 and A320
    - 27 measurement positions at various azimuth angles behind departing aircraft
- Two sets of fleet-weighted directivity:
  - Jets
  - Turboprop aircraft



Atmospheric Absorption Update

- Existing procedure: SAE-ARP-866A "Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity"
- Updated procedure:
  - Changes in atmospheric pressure
  - Temperature
  - Relative Humidity
  - Extends usable range of the method:
    - 25 Hz to 20 kHz
    - Process reciprocal up to 150 dB
- Next step: Publish SAE-ARP-5534 "Application of Pure-Tone Atmospheric Absorption to One-Third Octave-Band Data"

Expand Aircraft Performance Data

- Proprietary tool: Performance Interactive Analysis and Optimization (PIANO)
- Performance data (including fuel consumption) for the majority of jets and turboprops in the current fleet
  - Performance and fuel consumption data derived for:
    - Unsupported Airbus aircraft
    - CRJ-200
    - Embraer E-170 and E-190 families
- Data added to databases
- PIANO does *not* contain noise data

Next steps

- Develop corresponding noise data for PIANO-generated aircraft – exploring certification-based substitution

Aircraft Taxiway Noise

- ACRP project to enhance modeling of aircraft taxiway noise
  - Identify modeling needs
    - Inputs & outputs
      - New Database: Taxi-specific NPDs, spectral classes and directivity
    - Model methodology
    - Test cases
  - Perform sensitivity analysis
  - Design and document capabilities for integration into AEDT

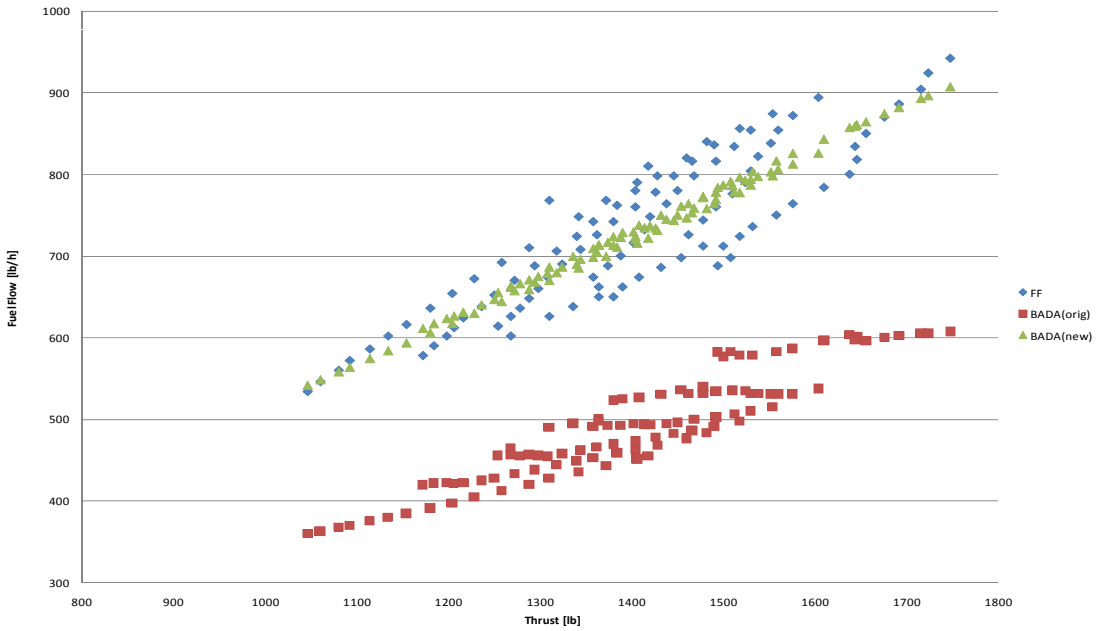
Next steps

- Implement in AEDT

Expand Aircraft Performance Data (cont.)

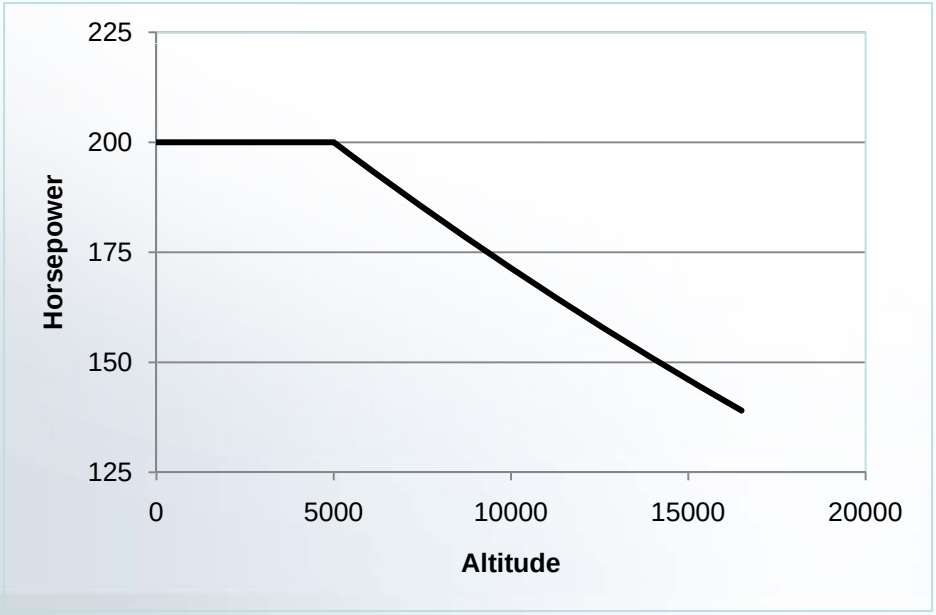
- Improve performance modeling through better fuel consumption models
  - Examination of Turboprop aircraft fuel consumption models based on:
    - Data from manufacturers' documentation
    - Known or assumed state parameters (e.g. speed, altitude, weight)
    - Derived parameters (e.g. thrust)

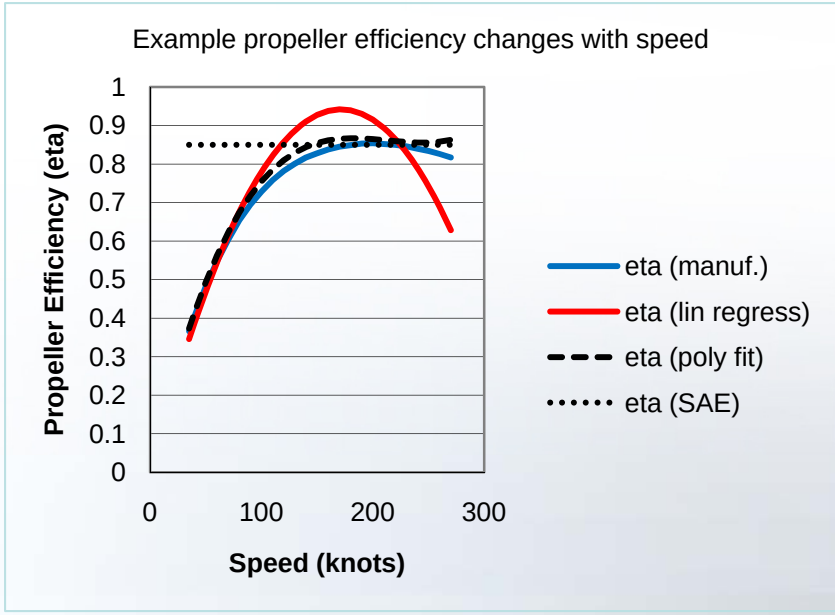
- Improved fuel consumption models give better weight prediction
  -> Results in better slant range and airspeed predictions for noise



Expand Aircraft Performance Data (cont.)

- Improve performance and noise modeling through better propeller thrust models
  - Improved propeller thrust based on:
    - More realistic piston engine performance
    - Propeller efficiency models from manufacturers





Questions / Discussion

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