ASCENT Project 62
Noise Model Validation for AEDT

Georgia Institute of Technology
PIs: Dimitri Mavris, Michelle Kirby
PM: Bill He
Cost Share Partner: Delta Air Lines

Objective:
• Assess the accuracy of AEDT in estimating noise compared to real-world measurements in both the vicinity of airports as well as further afield under various modeling assumptions
• Study incorporation of high-fidelity weather in AEDT noise modeling for real-world flights

Project Benefits:
• One of the main benefits of this project is to suggest possible improvements that could be made in future releases that enhance the predictive capability with respect to real world measurement data

Research Approach:
• Using real-world data (flight data, noise monitoring data, high-fidelity weather) identify the various modeling options available in AEDT
• Develop capabilities to automatically model real-world flights in AEDT and compare outputs against noise measurements from corresponding events
• Identify discrepancies, quantify differences, and document possible improvements for future efforts
• Collaborate with PSU on high-fidelity weather modeling in AEDT

Major Accomplishments (to date):
• Initiated bulk modeling of real-world flight operations using automation scripts developed earlier at any desired settings in AEDT while also automating post-processing
• Published two conference papers at Aviation-2021 [1] and Internoise-2021 [2]

Future Work / Schedule:
• Explore statistical perspectives based on weather/weight/monitor locations etc.
• Interactive analyses using a dashboard

[2] https://doi.org/10.3397/IN-2021-2846

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Objective: Assess the accuracy of AEDT in estimating noise compared to real-world measurements in both the vicinity of airports as well as further afield under various modeling assumptions

Methodology:
- Determine different modeling options to model real-world flights within AEDT
- Develop **capability to automate** AEDT studies with different modeling options for departure and arrival and determine their effect on noise prediction
- Develop scripts to **match available flight data** with corresponding noise monitoring data
- Model each flight and **observe differences** between AEDT results and real-world operations

**Inputs**
- Establish tables:
  - Noise Monitor Locations
  - Weather
  - Aircraft Profiles
  - Aircraft
  - Tracks

**Scripts**
- Profiles
- Tracks
- Profile/Track Combination Matrix
- Organize: Track, Weather, Receptor Grid
- Create Annualizations for Each Case in Study
- Defining all Metric Results

**Modeling/Outputs**
- AEDT Report Extraction Executable
  - Performance:
    - Speed
    - Thrust
    - Fuel Burn
  - Noise
  - Emissions

Flight Data
- Flight operations (arrival and departure) 2018, 2019
Air craft trajectory, tracks, weight, thrust, configuration, and other metadata at 1 Hz frequency

Noise Monitoring Data
- Correlated noise events 2018, 2019
Noise readings (SEL, LAMax) at various monitors near SFO correlated with corresponding flight operation and metadata
### Test Matrix for Departure and Arrival

#### Departure

<table>
<thead>
<tr>
<th>Assumption</th>
<th>AEDT Default</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
<th>Option 5</th>
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<tbody>
<tr>
<td>Thrust</td>
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#### Arrival

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- Possible Combinations vary due to fixed point profile and procedural profile capability within AEDT and compatibilities
- Some combinations / settings currently not implemented (e.g., hard v/s soft surface)
- Test matrices coupled with automation scripts allow for modeling of large number of real-world operations

**Note:**
FOQA = Flight Operations Quality Assurance data, i.e., data obtained from quick access recorder on flights
ASOS = Automated Surface Observing System
(Red) = Outside scope of present work
(Blue) = Not automated using SQL
Example Performance/Noise Results

Flight GT1015 Departure

Flight GT1015 Departure

Flight GT1015 Departure

Flight GT1015

122.5°W 122.4°W 122.3°W 122.2°W

37.8°N
37.7°N
37.6°N
37.5°N
37.4°N

SFO Airport

Actuals
1 | SEL: 95.6 | LMax: 84.5 | NM Height (MSL): 35.9
2 | SEL: 88.4 | LMax: 79.9 | NM Height (MSL): 71.4
3 | SEL: 84.4 | LMax: 74.4 | NM Height (MSL): 44.4
4 | SEL: 86.0 | LMax: 77.5 | NM Height (MSL): 107.1
5 | SEL: 79.9 | LMax: 70.4 | NM Height (MSL): 50.5
6 | SEL: 79.0 | LMax: 70.0 | NM Height (MSL): 592.0
7 | SEL: 79.3 | LMax: 71.2 | NM Height (MSL): 175.9
8 | SEL: 85.3 | LMax: 77.1 | NM Height (MSL): 574.5
9 | SEL: 81.6 | LMax: 74.2 | NM Height (MSL): 583.6

Flight GT1015 Departure

Δ SEL

Noise monitor

1 2 3 4 5 6 14 16 17 18 19

GT1015_D_FOQA_FPP_APTW
STANDARD_APTW
NADP1_1_APTW
NADP2_11_APTW
MODIFIED_AW_RT15_APTW
NADP1_1_RT15_AW_APTW
NADP2_11_RT15_AW_APTW
NADP1_1_APTW
NADP2_11_APTW
NADP1_1_RT15_AW_APTW
NADP2_11_RT15_AW_APTW
Bulk Flight Modeling: Noise Monitor Predictions

- Includes running large number of operations (~50 per study) for different **procedure, thrust, weight, and weather** settings

- **Per-monitor prediction accuracy** – to be expanded for statistical perspectives
**Goal:** Generate standalone and statistical perspectives that feed into an interactive dashboard

- **Pre-AEDT automation:**
  - Run bulk flight studies
  - Per flight results
  - 1. APTW
  - 2. Monitor Alt
  - 3. ASOS
  - 4. HFW

- **Post-AEDT automation:**
  - Per monitor results
  - 1. Departures vs Arrivals
  - 2. Overhead vs Sideline
  - 3. Weather
  - 4. Weight

- **Dashboard:**
  - 1. Interactive analyses

**Completed**

**In-progress**

**Vision**
Next Steps

• Complete bulk modeling of 200+ real world operations within AEDT with different settings
• Continue collaboration with PSU on high fidelity weather data and modeling
• Build statistical analysis capability
  – Operation type/date
  – Weight (stage lengths)
  – Weather variations
  – Per-monitor analysis (overhead/sideline(heights))
  – Outlier analysis (anomalous flight predictions)
• Build dashboard capability
  – Interactive analysis and decision-making tool

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