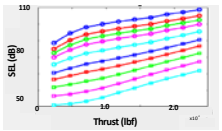
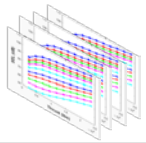
Project 43
Noise Power Distance Re-evaluation

Motivation and Objectives

- Current NPDs only consider thrust and distance, not configuration
- Increase dimension of NPDs to include speed, flap-slat, gear settings





Project Overview

Practical Outcomes

Short Term
- Sensitivity analysis of environmental metrics (noise, and emissions) to ambient weather conditions
- Quantified improvements to noise predictions due to use of NPD+C

Long Term
- Development and implementation of NPD+C into AEDT
- Development and implementation of multi-configuration spectral data into AEDT

Task Plan

- Task 1 – Investigate the Impact of Frequency Content on Standard NPD
- Task 2 – Investigate the Impact of Frequency Content on NPD+C Data
- Task 3 – Validation with Noise Data in AEDT

Summary and Next Steps

So far, the impact of spectral data on the standard NPD model has been analyzed. Multi-configuration NPD and spectral datasets have been generated using ANOPP for a range of aircraft types. Multiple NPDs have also been implemented and tested within AEDT using mode-based noise computation.

Future work involves the implementation of multi-configuration NPD and spectral data within AEDT, and the recombination of segment level noise associated with the appropriate configuration. This combined noise will then be used for validation with real world data.

Task 1

Investigate the Impact of Frequency Content on Standard NPD

AEDT currently uses a single spectral dataset, assumed to be consistent with an observer located directly underneath the flight path. Spectral data is used to correct for atmospheric noise attenuation on non-standard days. Inaccuracies in this data can lead to substantial over- or underestimations of noise results.

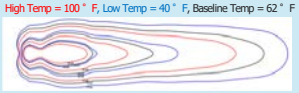
Task 1 key questions
- How is spectral data utilized in AEDT?
- Which parameters should be varied and what should the variation range be?
- What are the major drivers behind the impact?

Weather parameters variation

Using the weather parameter Design of Experiments (DoE), a one-factor-at-a-time (OFAT) analysis is performed at a major US airport

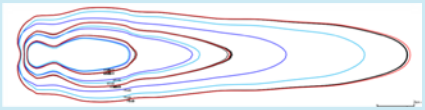
Test Scenario	Temperature (deg F)	Sea-level Pressure (mb)	Station Pressure (mb)	Dew Point (deg F)	Relative Humidity (%)	Wind Speed (knots)
Baseline	62	1018.02	980.61	50.86	67.65	7.03
Temperature	40	1018.02	980.61	30.00	67.65	7.03
Wind Speed	62	1018.02	980.61	50.86	67.65	0.00 30.00
Humidity	62	1018.02	980.61	-40.03 20.44 37.40 47.96 55.76 62.00	1 20 40 60 80 100	7.03

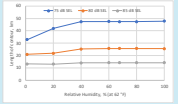
High Temp = 100 ° F, Low Temp = 40 ° F, Baseline Temp = 62 ° F

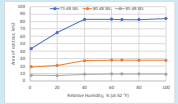


High Wind = 30 kts, Low Wind = 0 kts; Baseline = 7.03 kts

Humidity range = 1%, 20%, 40%, 60%, 80%, 100%; Baseline = 67.65 % (all at baseline Temp 62 F)







Contour (dB)	Baseline Length (km)	Baseline Area (sq km)	Low Temperature Length (km)	Low Temperature Area (sq km)		High Temperature Length (km)	High Temperature Area (sq km)	
75	47.37	82.63	53.04	11.98%	112.50 36.15%	41.53	-12.32%	63.25 -23.45%
80	25.72	28.03	30.39	18.14%	36.12 28.87%	20.91	-18.69%	19.02 -32.13%
85	14.19	9.25	14.95	5.32%	10.26 10.91%	12.74	-10.21%	6.59 -28.71%

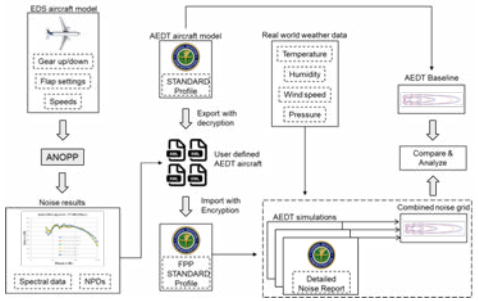
Noise observations

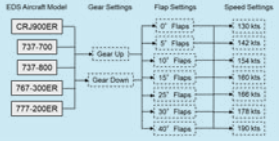
- Inverse correlation with temperature
- No effect of wind on noise propagation
- Non-linear behavior observed with humidity variation, initial increase, plateaus around 40 % relative humidity at 62 °F

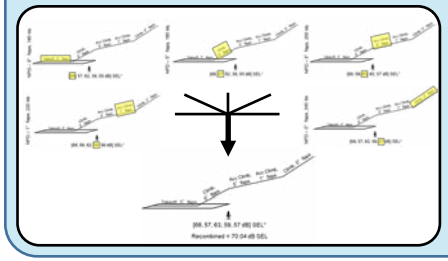
Task 2

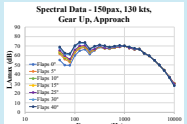
Investigate the Impact of Frequency Content on NPD+C Data

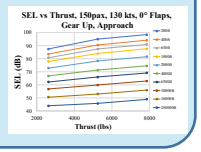
Task objectives –
1. Generate NPD+C and multi-configuration spectral data using ANOPP
2. Devise a procedure to utilize generated data in AEDT and obtain noise results
3. Re-combine different noise grids to calculate resultant grid with the noise calculations from each flight performance segment referring to the correct spectral and NPD dataset









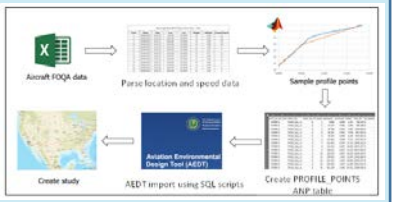


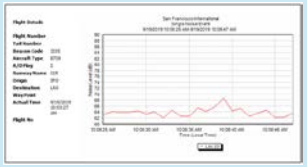
Task 3

Validation with Noise Data in AEDT

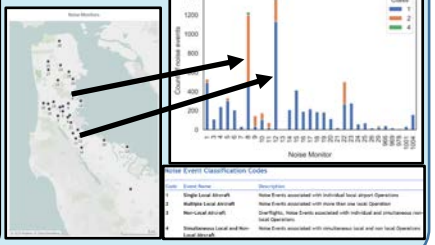
Task objectives
- Validate the noise predictions in AEDT with real world noise data

Real world data
- FOQA – High fidelity aircraft performance data with weight and thrust. Modeled in AEDT with fixed point profiles
- Noise monitoring system at San Francisco airport (KSFO)





Noise monitoring dataset
- Total of 29 fixed sensors and 5 portable sensors available for noise measurement
- Noise data available for arrival and departure events in terms of 2 metrics: SEL and LAmax
- Atmospheric data like wind speed and direction available



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