

Noise Power Distance Re-evaluation

Project 43

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Project 43 Goals

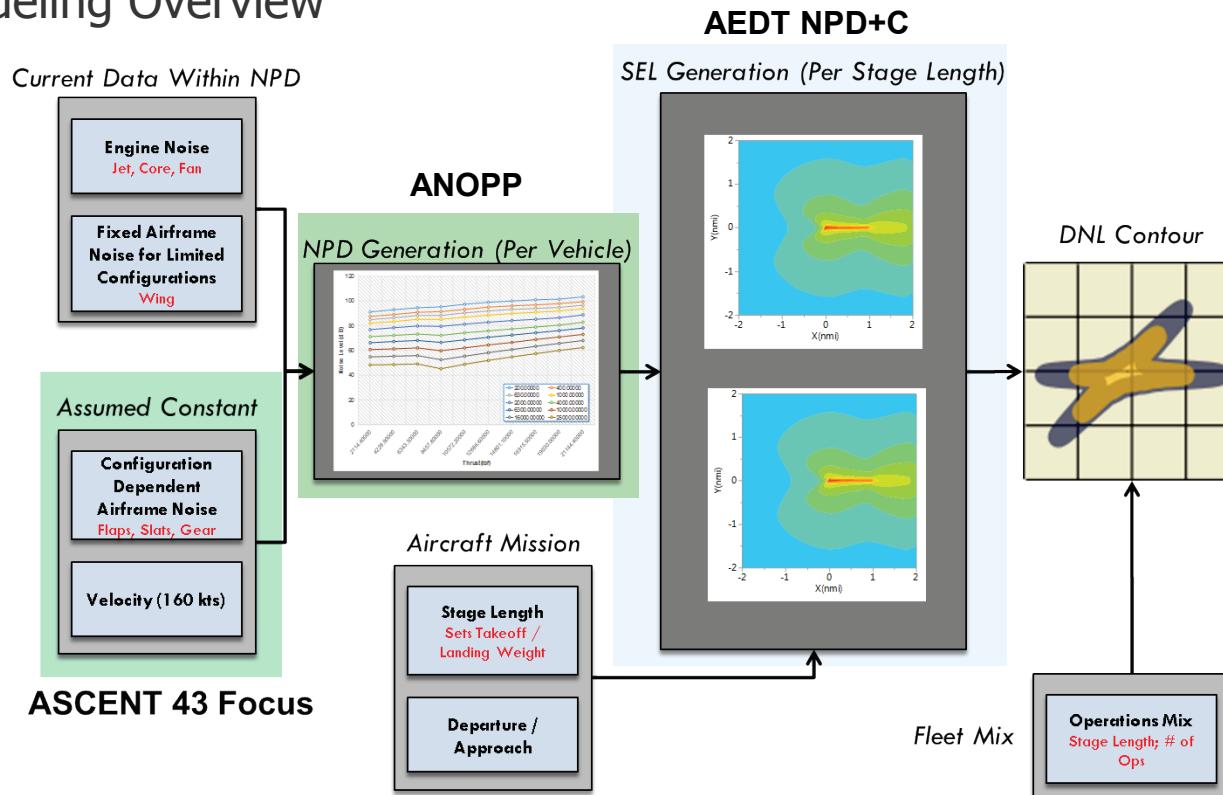


- Motivation
 - NPD method within AEDT was developed decades ago with little flexibility to account for airframe noise and speed effects
 - Away from airports and for different flight segments, assumptions become less robust
- Project Impact
 - Enhance the accuracy of AEDT through improved aircraft source noise prediction and modeling
 - Needed to support the evaluation and development of aircraft flight procedures that could reduce community noise
 - Facilitate the implementation of NextGen through improved characterization of the noise benefits it would deliver
- Objectives
 - Study representative fleet mixes and aircraft types
 - Validation against available measurement data
 - Investigate a method to effectively represent the fleet
 - Maintain compatibility with existing NPD (integrated modeling) approach

ASCENT Project 43 Overview (Year 1)



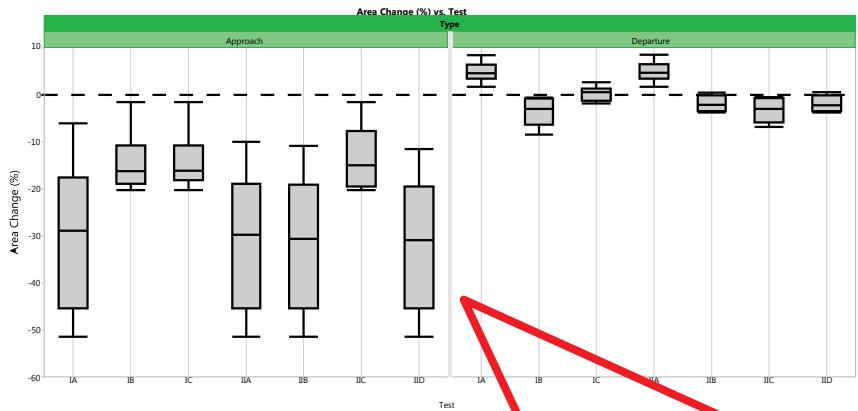
- Objectives
 - Understand the sensitivity of including aircraft configuration changes and reference speed in NPDs on resulting noise contours for 50 – 400 PAX
 - Provide physics-based recommendations on format of NPD + Configuration (NPD+C) curves for use in AEDT
 - Maintain compatibility as much as possible with existing NPD approach
 - NPD Modeling Overview



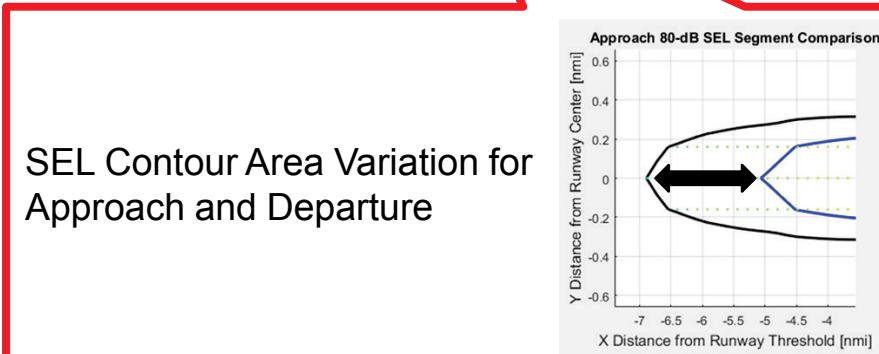
Summary of Key Findings (Year 1)



- Examined six aircraft classes ranging from regional jet to large wide-body
- Found effect of flight velocity on source noise to be main source of difference
- Flap noise secondary contributor
- Major differences occur during approach
 - Engine noise near maximum power dominates during departure



SEL Contour Area Variation for Approach and Departure



Grouping	Study	Parameters
Baseline	0	Baseline NPD
Main Effects	I.A	Include only speed
	I.B	Include only flaps/slats
	I.C	Include only gear
Cross Terms	II.A	Speed + Gear
	II.B	Speed + Flaps
	II.C	Gear + Flaps
	II.D	Speed + Gear + Flaps

Year 2 Project Goals



- Goal
 - Provide a method for expanding and implementing NPD+Cs into AEDT
- Project Impact
 - Previous year study was performed using existing detailed analysis models (ANOPP2)
 - Not practical to create detailed ANOPP2 models for every AEDT database vehicle
 - Develop a method to facilitate implementation correction functions to database NPD+Cs
- Objectives
 - Quantify sensitivity of corrections to aircraft configuration as well as aircraft and engine design inputs
 - Understand the sensitivity of configuration and design inputs in order to develop correction factors
 - Study sensitivities to various noise sources
 - Develop correction functions for NPD+Cs
 - Validate correction functions with ANOPP2 or data (if available)

Various Options and approaches



Integration Approach	By	Benefits	Challenges
Multiconfiguration NPDs (working w. mfgrs)	Euro-Ctrl	<ul style="list-style-type: none"> From manufacturers. Considered to be well validated. 	<ul style="list-style-type: none"> Only limited models so far. Challenges to cover fleet, esp. with out of production a/c models
NPD+C directly from ANOPP	GT tried this	<ul style="list-style-type: none"> The process is easy to understand Consistent method for generating NPD+C 	<ul style="list-style-type: none"> Complex input parameters and delicate balance of the parameters Validation is still needed Large model library required
NPD+C via correction functions based on ANOPP	GT (Proposed approach – year 2)	<ul style="list-style-type: none"> Able to create NPD+C sets from simpler inputs (available within AEDT). No need to create ANOPP models for each a/c type. 	<ul style="list-style-type: none"> Need to consider wide condition ranges/rank orders Validation of NPD+Cs Industry buy-in

Motivates Simpler Implementation Approach – Focus of year 2

Upcoming Validation Work



- Task 1: Investigate Impact of Frequency Content on Standard NPD
- Task 2: Investigate Impact of Frequency Content on NPD+C
- Task 3: Validate NPD+C Approach Using BANOERAC Data
- Task 4: Validate NPD+C Approach Using Vancouver Airport (YVR) Data

Validation Approach



Two Datasets – Collaborate with Penn State

Dataset	Flights	Aircraft / Engine State	Noise Directivity	Propagation Information	Noise At Receiver
BANOERAC	Many Enroute / Some Climb/descent	*	May contain shock-cell noise	Limited weather	4" and ground mics
YVR Data	Typical A/C mix, terminal area ops	*	*	Limited weather	Noise monitor terminals

- No direct information. But can be derived from careful processing and analysis of trajectory data using AEDT and EDS (FLOPS / NPSS)
- Exact process depends on dataset content
- Also requesting airline operational data

Validation Collaboration and work



BANOERAC

- Run AEDT in sensor path mode to match dataset
- Use EDS to compare NPD vs. NPD+C for selected vehicles
- Support PSU with ANOPP models of selected vehicles

YVR Data

- Seek to access airline operational data
 - Run AEDT following ground tracks and sensor path tracks; use 3a options for weight/thrust
 - Run EDS model for selected aircraft
 - Compare NPD and NPD+C vs. data
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- Look for other available noise monitor data

Next Steps



We had been waiting for FY18 research funding to start the future work – Funds in – starting now!

- Complete correction function approach
- Gain agreement to access BANOERAC and YVR data
- Begin analysis of above datasets

Acknowledgements



- FAA & Volpe for valuable feedback
- Juliet Page and Eric Boeker for invaluable insight into prior work

Publications

- "Investigation of Aircraft Configuration and Speed on Traditional Noise-Power-Distance Curves" – Submitted to NOISE-CON 2019
- A-21 meeting in DC (June 12 – 13) – coordinate with industry and European efforts

Participants

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- GT Students:
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