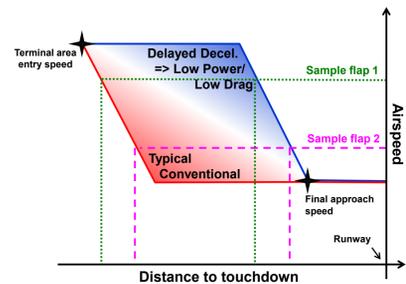


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Joseph Dipardo, FAA

Principal Investigators: R. John Hansman, MIT
Philip Morris, Penn State University (PSU)

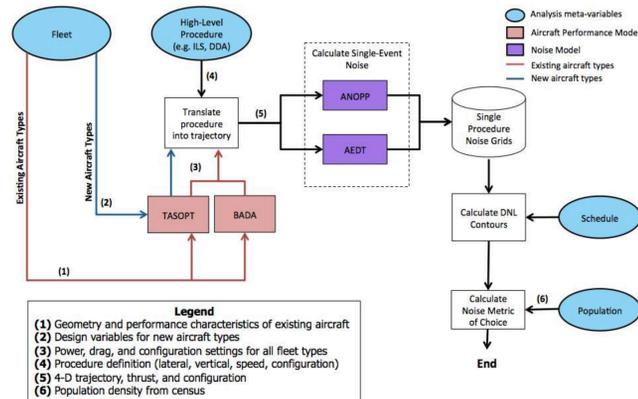
Motivation

- Advanced operational procedures have the potential to reduced aircraft noise and associated population exposure
- Traditional aircraft noise analysis assumes that engine noise dominates aerodynamic noise on approach, may not be valid with modern engine technology
- Current analytical approach does not fully capture noise impacts from aircraft configuration or other operational techniques with potential noise benefits



Example advanced operational procedure: Delayed Deceleration Approach (DDA) for reduced approach-phased throttle use

Analysis Method



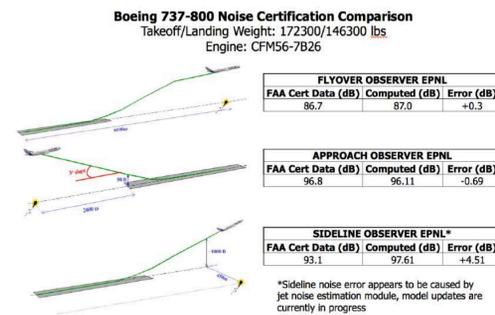
Acknowledgments

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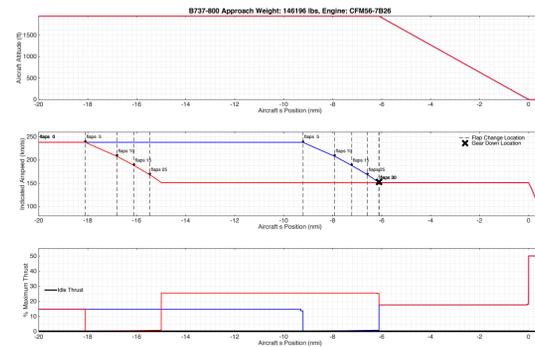
Acknowledgement to: Chris Dorbian, Stephen Merlin, and Joseph Dipardo (FAA); Luke Jensen, Jacqueline Thomas, Cal Brooks, Morrisa Brenner, and Sandro Salguero (MIT); Tom Reynolds and Lanie Sanberg (MIT Lincoln Labs)

Procedure Analysis Capability

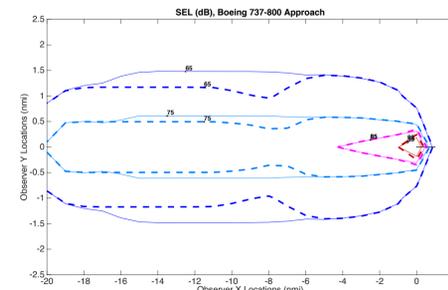
- Simulation capability has been developed to generate and evaluate custom arrival and departure procedures, defined by:
 - Latitude/Longitude
 - Altitude/Vertical Speed
 - Thrust
 - Aircraft Configuration
- Noise model outputs (from NASA ANOPP) compared against FAA noise certification database:



Example Profile Definition: B737-800 DDA

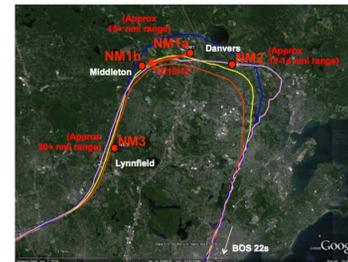


Result: Single-Procedure Noise Contour



Modeling Arrivals at Boston Logan Airport

- Noise measurement campaign in collaboration with MIT Lincoln Laboratories

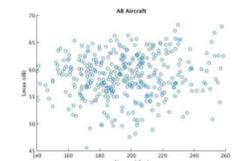


- 3 measurement locations on approach path to Runway 22L

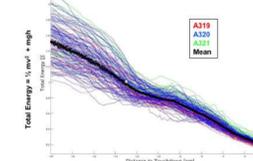
- Bruel & Kjaer Noise Sentinel on-demand mics provide continuous sound pressure level data

- Correlated overflight noise events with specific flights in post-processing
 - Identified flights using timestamps and radar records from PDARS
 - Converted groundspeeds to true airspeeds with wind correction from NOAA NARR weather model
- Calculated total energy trend for each arrival

Single-Event Noise Scatter (All Fleet Types)

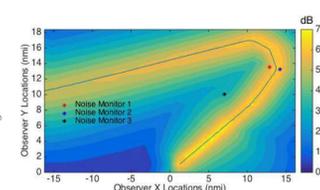
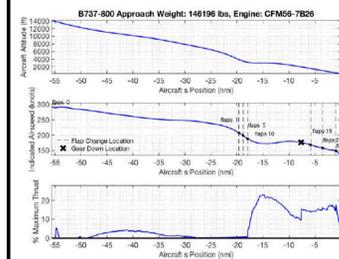


Variance in Total Energy on Approach (A320 Family)



Noise Evaluation using AEDT and ANOPP

- For a single aircraft type, variance in noise measurements on the order of 10db was evident in the measured data
- Noise models may help to diagnose potential causes for the noise variance, but require detailed thrust profiles
 - BADA4 is used to estimate drag and thrust for input to the noise model based on PDARS radar logs



Current Results and Observations

- Advanced operational procedures have been modeled using a combination of aircraft performance (TASOPT) and noise analysis (ANOPP) tools
 - No single off-the-shelf noise analysis tool adequately captures aircraft performance and dynamics
- Arrival and departure profile definitions impact noise contour geometry and absolute levels at specific observer locations
 - Noise metric selection may drive total magnitude of impact
- Scatter on the order of 10dB in maximum sound pressure level has been observed in noise measurement campaigns (investigating cause)

Next Steps

- Generate detailed thrust profiles for all flights in Boston noise measurement campaign for evaluation with ANOPP
 - Compare noise model noise predictions with measured data to improve modeling fidelity and diagnose potential causes for observed variability
- Evaluate impact of sample DDA procedures on different noise metrics, including single-event and cumulative metrics
- Use detailed aircraft performance model to evaluate a variety of procedures and aircraft type combinations for flyability and operational feasibility
- Investigate steep approaches and reduced-thrust departures for feasibility, speed management implications, and environmental impact

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