2021 REDAC Fall Meeting

Research on Operational Procedures

Presented to: REDAC NAS Operations Subcommittee

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Aircraft Technology & Operations Division (AEE-200)

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Environmental & Energy (E&E) Strategy

**E&E Mission:** To understand, manage, and reduce the environmental impacts of global aviation through research, technological innovation, policy, and outreach to benefit the public

**E&E Vision:** Remove environmental constraints on aviation growth by achieving quiet, clean, and efficient air transportation

**E&E R&D Portfolio Activities & Programs**

- **ADVANCE UNDERSTANDING OF NOISE, EMISSIONS, AND THEIR IMPACTS**
  - Vehicle operation
  - Pollutant measurement
  - Atmospheric propagation
  - Societal impacts
  - Today's Fleet of Aircraft and Helicopters
  - Drones and Advanced Air Mobility Vehicles
  - Commercial Supersonic Aircraft
  - Commercial Space Vehicles
  - Aviation Environmental Tools Suite and Communication Tools

- **ANALYSIS TO INFORM DECISION MAKING**
  - Domestic Policies
  - Aircraft and Engine Standards
  - CORSIA
  - Long Term Climate Goal Development

- **DEVELOP INNOVATIVE SOLUTIONS TO REDUCE NOISE AND EMISSIONS**
  - Aircraft and Engine Technology
  - Sustainable Aviation Fuels
  - Optimized Operations and Procedures

Over a ninety percent decrease in community noise exposure while increasing enplanements by nearly a factor of five; however, the noise experience is different than it was in decades past.
Aircraft noise from 1970s is different than aircraft noise today.

A single aircraft from the 1970s produced the same acoustic energy as 10 to 30 aircraft operations today.

A few, but relatively loud, operations in the 1970s would result in DNL 65 dB. Many, relatively quiet operations today would also result in DNL 65 dB. However, the noise experience is very different.
Recent efforts to modernize the national air transportation system have required changes in aircraft operational patterns.

While modernization is needed to increase public safety and system efficiency, the changes in operational patterns have also led to increased concern about aircraft noise.

While air space redesigns have been taking place, operations by air carriers have also increased.

Airport communities that are outside the DNL 65 dB contour are expressing concerns about aircraft noise.

Data Sources:
Brenner, M., Hansman, R. J., "Comparison of Methods for Evaluating Impacts of Aviation Noise on Communities," 2017

FAA Data on Annual Air Carrier Operations for Boston Logan International Airport
FAA Noise Research Program – Overview

**Effects of Aircraft Noise on Individuals and Communities**
- Speech Interference and Children’s Learning
- Neighborhood Environmental Survey
- Health and Human Impacts Research
  - Cardiovascular Health
  - Sleep Disturbance
- Economic Impacts

**Noise Modeling, Noise Metrics and Environmental Data Visualization**
- Aviation Environmental Design Tool
- Noise Screening
- Environmental Data Visualization
- Supplemental Noise Metrics

**Reduction, Abatement and Mitigation of Aviation Noise**
- Aircraft Source Noise Reduction
- Noise Abatement
- Noise Mitigation Research
FAA Efforts Relating to Low Noise Aircraft Operations

1. Investigation of operational opportunities for noise reduction:
   – Airlines largely determine *what* aircraft fly and *when*
   – There might be opportunities to change *where* aircraft fly (through precision navigation) and *how* aircraft are flown
   – Must consider the entirety of the airspace and ensure the continued safety of operations
   – Concepts being evaluated:
     - Route changes
     - Thrust / speed / configuration management
     - Vertical profile modifications
     - Systematic dispersion

2. Validation of noise abatement procedures
   – Operationally validate (through flight sim/testing, noise measurement, etc.) noise management concepts

3. Advancement of tools, processes, and policies
   – Execution of knowledge, guidance, & tools/options to manage noise
   – Examination of metrics to facilitate assessment/communication of noise impacts
FAA-Massport MOU

- Memorandum of Understanding signed in September 2016 established framework for cooperation between Massport & FAA to explore operational changes to mitigate noise impacts
- MIT developed noise evaluation framework (through ASCENT-23) and is applying it (through Massport funding) to BOS to build and assess procedures
- FAA and industry are providing feedback on the operational feasibility of these ideas
- MIT ideas separated into two blocks:
  - Block 1: Clear noise benefit, no equity issues, limited operational/technical barriers
  - Block 2: More complex due to potential operational/technical barriers or equity issues
Example MOU Procedures

Block 1: 15R Departure

Block 2: 33L Departure
Communicating Impacts

PRELIMINARY NOISE ANALYSIS – Not Verified

2017 Baseline Jets Only.

Population Exposure

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<table>
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<tbody>
<tr>
<td>N_{60}</td>
<td>50x</td>
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<tr>
<td>Baseline 2017</td>
<td>335,823</td>
</tr>
<tr>
<td>Divergent Headings Rev 2</td>
<td>352,775</td>
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<tr>
<td>Baseline - Dispersion</td>
<td>-16,952</td>
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Change in N_{60}

Analysis updated Oct. 17 2019 to remove Turboprops and refine lateral tracks.
Modeling/Discretization effects near airport removed.

Analysis based on peak day operations; only includes 33L departures.

N_{60} Thresholds:
60dB L_{A,max} Day, 50dB L_{A,max} Night
A Closer Look…

Baseline

Option B2

Change

Medford: Baseline

Medford: Dispersion Rev 2

Medford: Change

Delta $N_{60}$: Rev 2 - Baseline
Changing Start of Deceleration on Arrival (Delayed Deceleration Approach)

• MIT has developed analytical framework for assessing changes to aircraft speed/thrust/configuration profile; e.g., Delayed Deceleration Approach
  – Reduce noise by delaying extension of flaps (known fuel benefits)
  – Must decelerate early enough to ensure stable approach criteria

Under Flight Track Noise by Component, Representative Narrow Body Aircraft Approaches with 4,000 ft Level-Off
Engine thrust on approach is relatively low → airframe noise components more easily heard

Validation and implementation challenges remain
DDA Challenges

• **Operational validation of noise benefit**
  – Work ongoing to collect aircraft state and noise measurement data to support validation of noise modeling methodology and identification of low-noise behaviors

• **Pilot guidance**
  – Continued discussion with pilots
  – Examine DSTs: e.g., DLR Low Noise Augmentation System, A350 Flight Management System

• **Different deceleration rates for different aircraft creates ATM challenge in separating/sequencing aircraft**
  – Continued discussion with FAA ATO, ANG, and AVS
  – Current or future ATM tools that could support integration?

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Early, Mean and Delayed Deceleration (B738 arrivals into BOS)
Operational Opportunities for Reduced Climate Impact

• Addressing climate change is a national (administration) priority
• Past research: Continuous Descent Arrival, Cruise Altitude and Speed Optimization, DDA, Surface Congestion Management
• New effort: ASCENT-78 Contrail Avoidance Decision Support and Evaluation
• Ongoing coordination (internal/external) on operational opportunities for fuel/emissions reduction
• Open to ideas/discussion
Summary

• Despite considerable progress in reducing aircraft source noise and community noise exposure, aviation noise remains a concern in many areas.

• FAA is exploring operational opportunities to reduce the noise from the current fleet.

• FAA is developing tools to better assess benefits of advanced operational procedures, operationally validating and measuring concepts with potential to reduce noise, and seeking mechanisms for implementation.

• Reducing climate impact through operational efficiencies is also a high priority area.
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