

Motivation and Objectives

Motivation

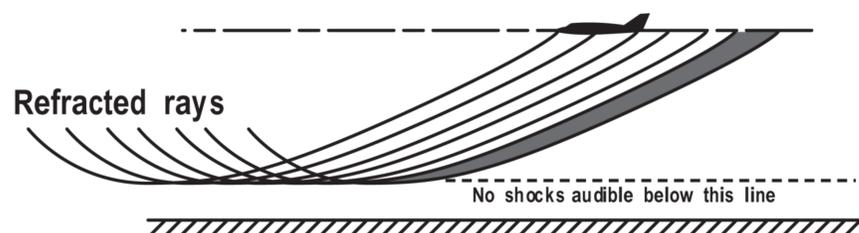
The concept of Mach cut-off was introduced by Lockheed engineers in the mid-1960s [Shurcliff, 1970]. Nowadays, Aerion Corporation and many others believe that Mach cut-off supersonic flight is both viable [Plotkin, et al., 2008] and very likely to be acceptable to the public. Additional research needs to be conducted to provide a technical basis for rulemaking regarding Mach cut-off operations.

Objectives

- Model sonic boom propagation
- Identify an appropriate metric to predict annoyance
- Determine the feasibility of measuring Mach cut-off signals on a laboratory scale
- Analyze sensitivity of ray paths to atmospheric conditions
- Evaluate technologies to facilitate Mach cut-off flight

Background

Mach cut-off occurs when sonic booms are refracted upward before reaching the ground. This phenomenon typically occurs at low Mach numbers and high altitudes (for example, $1 < M < 1.15$, $h > 35,000$ ft. under standard atmospheric conditions). Below is a ray diagram depicting this scenario.



[Maglieri et al., 2014]

Project Outline

1. Propagation Modeling

- Retrace Nicholls' propagation theory to incorporate the proposed operational parameters
- Use ray calculation to assess the previous predictions for Mach cut-off operations
- Assess the robustness of the theory to realistic atmospheric conditions

2. Sensitivity Analysis

- Using the acoustical model, observe how Mach cut-off flight would occur under various conditions
- Analyze input factors that have a significant effect on maintaining Mach cut-off flight
- Provide potential strategies for achieving Mach cut-off flight in adverse conditions

3. Human Subjective Testing

- Map descriptive words to Mach cut-off sounds
- Evaluate the effectiveness of existing metrics to predict the perception of Mach cut-off sounds
- Provide guidance for future subjective testing and assessment

4. Laboratory Experiment Design

- Determine the feasibility of laboratory-scale measurements of Mach cut-off
- Evaluate if turbulence-scattered energy increases the Mach cut-off sound heard on the ground, if viable

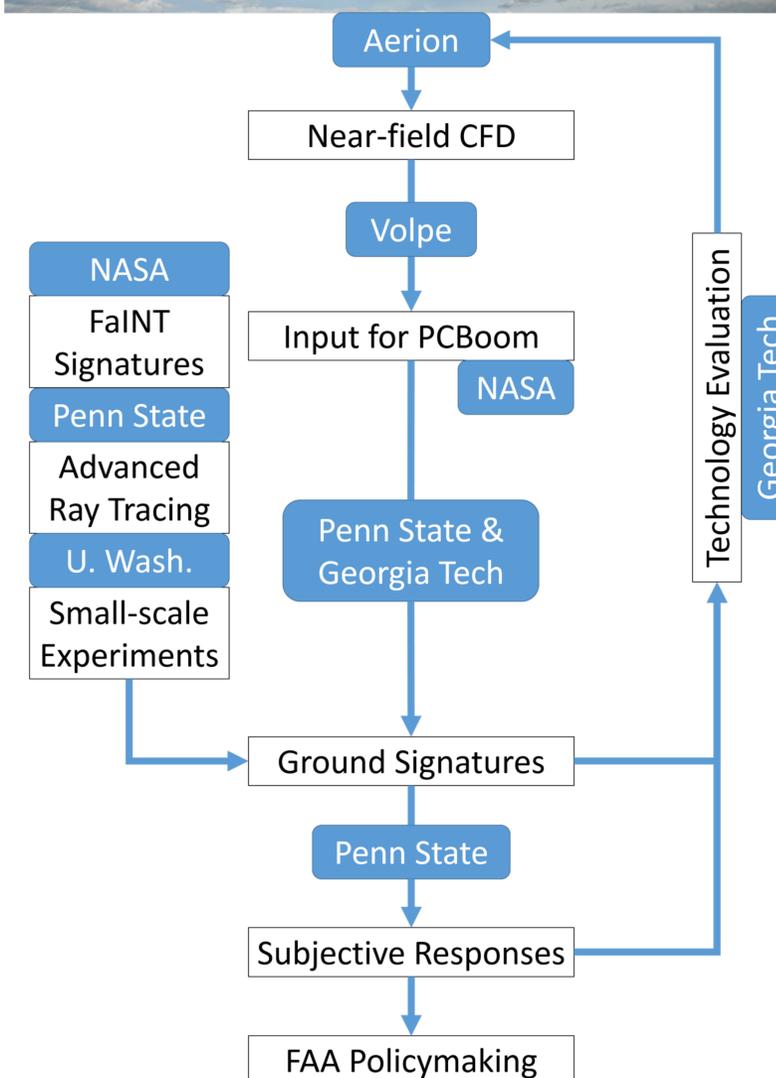
5. Technology Evaluation

- Using the sensitivity analysis, determine which factors are most important to achieving Mach cut-off conditions
- Assemble a strategy for required capabilities of current/future technologies

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Initial Project Flow



This project has just started