Sonic Boom Display
Managing the Aircraft’s Boom Footprint

FLY SOFTLY: ADVANCES IN LOW BOOM SUPERSONICS

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RESEARCH OBJECTIVES

• Sonic Boom Display – Managing The Aircraft’s Boom Footprint
  • Provide the pilot the capability to plan and carry out a flight that allows them to reduce their sonic boom, avoid hitting populated areas, or inhibit the boom from reaching the ground all together.
  • Enable pilots to see where their sonic boom will impact the ground.
  • Display feedback to help pilots determine if the impact is acceptable.
  • Provide a guidance capability to help pilots avoid unacceptable sonic boom impacts.
  • Develop notional architecture and evaluate weather data sources to integrate into business jet aircraft.

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SONIC BOOM DISPLAY

RESEARCH AREAS: AVIONICS DISPLAY, ARCHITECTURE, & WEATHER DATA

• CONOPS & Iterative Pilot Working Groups
  • Collins Aerospace Flight Operations, Concorde Pilots, & NASA Armstrong.

• Integrated NASA prediction algorithms with a terrain database & implemented it into a research EFIS & NASA QueSST Simulator.
  • Algorithm Processing Improvements
  • Precomputed Flight Plan Prediction
  • Real-time In-Flight Prediction

• Weather Sensitivity Analysis
PILOT DECISION SPACE
MODIFY THE FLIGHT PLAN AND RESOLVE IMPACTS

- Created a Pilot Decision Space with Real-Time Prediction & Guidance
  - Automatic route impact assessment with threshold depiction
  - Mach/Altitude Options for resolutions
  - Combined Real-Time & Precomputed footprint depiction
  - Mach Cut-Off
    - Implement Mach Cut-off display elements
    - Using the “automatic trial” mode to provide the pilots the ability to see Mach Cut-off altitude.

- Waypoint Placement & Interactive Flight Planning Functions
  - Accommodate sending multiple iterations of a single parameter change for assessment.
  - Segmented impact assessment, weather monitoring, & waypoint weather data association.
  - Change Mach number & acceleration points (lateral & vertical waypoint placement) via a graphical flight plan editing function
THANK YOU.

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DELPHINS Software Development
RAY TRACE MODELING PARAMETERS

- Atmospherics (Profile)
  - Temperature
  - Wind
  - Turbulence
  - Humidity (impacts loudness)

- Aircraft Trajectory, Terrain & Topography
  - Heading
  - Speed
  - Altitude
  - Flight Path Angle
  - Acceleration

1NASA Algorithm does not model turbulence
2Requires solution of Burgers Equation
*Most Impact
CREATING A PILOT DECISION SPACE

- Capable of inserting new waypoints and controlling rate of climb/descent, Mach number, vertical & lateral placement.
  - Green: altitude change can resolve the impact
  - Red: impact cannot be resolved with altitude change
  - Grey: required change in Mach at location with impact issue

Altitude & Mach Decision Space Limits
Blue Vertical Line = 5 min Intervals

Vertical Scale & Mach Readout

Grey Line = Mach Cut-Off Profile
No Boom Altitude – Not visible in this example