VSPAERO SUGAR High/Volt TBW Aerodynamic Analysis

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Purpose and Outline

Purpose:
Develop process to incorporate aerodynamics into TBW conceptual design studies to allow for quick analysis capability of AATT advanced aircraft concepts

Outline:
• Background
• VSPAero Modeling
• VSPAero Setup
• Results
• Lessons Learned
• Next Steps
Advanced concept studies for commercial subsonic transport aircraft for 2030-35 Entry into Service (EIS)

Trends:
- Tailored/multifunctional structures
- High aspect ratio/laminar/active structural control
- Highly integrated propulsion systems
- Ultra-high bypass ratio (20+ with small cores)
- Alternative fuels and emerging hybrid electric concepts
- Noise reduction by component, configuration, and operations improvements

Advances required on multiple fronts…
NASA TBW Research

- NASA In-house, NIA, VT, GT
- N+3 NRA – Boeing SUGAR
  - SUGAR High (gas fueled turbofan)
  - SUGAR Volt (gas/electric parallel hybrid turbofan)
  - SUGAR Freeze (LNG fuel cell hybrid turbofan and electric rear fuselage BLI propulsor)
SUGAR High 765-095-RD

- B737 / A320 class
- 154 passenger
- 4,260 nm range
- 40,800 ft cruise altitude
- 0.70 Mach cruise
SUGAR High 765-095-RD OpenVSP Model

- Wing Body
- Mass
- Degen Geom

Mach: 0.700, Beta: 0.00000000, Alpha: 2.000
Analysis at cruise altitude
- 42,000 ft
- 11.2M Reynold’s Number
- 0.7 Mach
SUGAR High 765-095-RD VSPAero Results
SUGAR High 765-095-RD VSPAero Results

![Graph showing lift coefficient vs. angle of attack for various models: Boeing OVERFLOW, SA-RC turb, VSPAero, VSP Vorview, Vorview, VORLAX, and AVL.](image-url)
Lessons Learned

Modifications:
• Simplified fuselage
• Removed wing fairing
• Input skin friction drag

Resolution:
• Grid resolution
• Lower = faster
Next Steps

• Compare with NASA, Virginia Tech, Georgia Tech TBW design
• Incorporate recent Boeing SUGAR results
Questions?