D8 Series: Experimental Assessment of Boundary Layer Ingestion Benefit

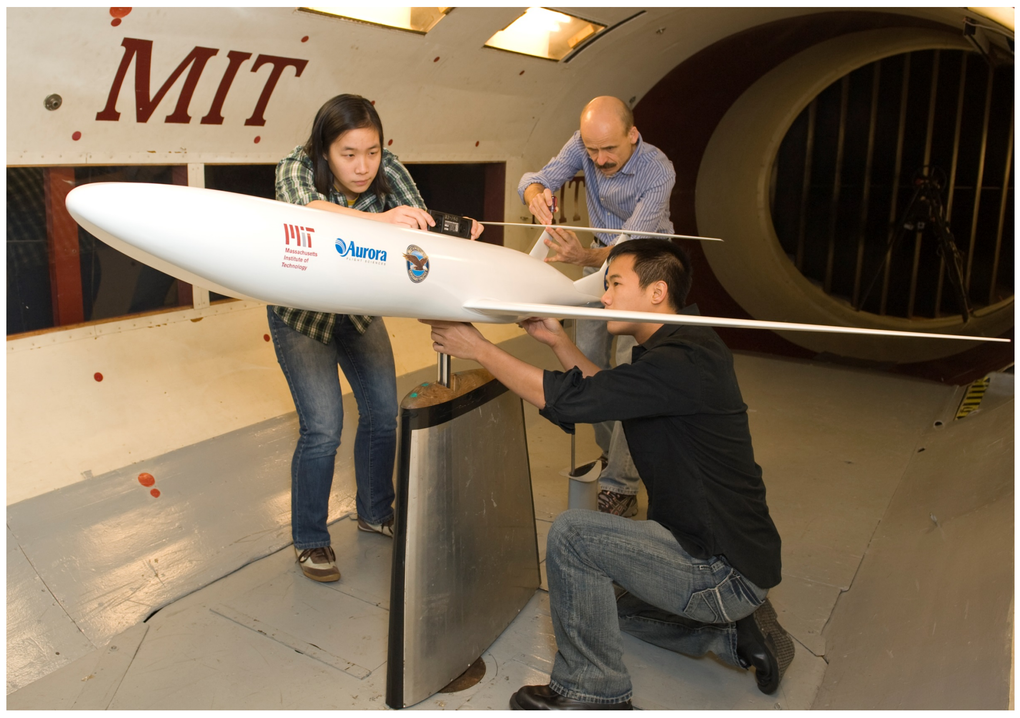
C. Casses, A. DiOrio, M. Drela, A. Espitia, A. Grasch, E. Greitzer, D. Hall, A. Huang, M. Lieu, S. Sato, N. Siu, C. Tan, N. Titchener, A. Uranga, E. van Dam

Backgrounds

- D8 series aircraft configuration offers potentially large efficiency benefit
- Experimental assessment needed to address issues with configuration
  - Unconventional design traits: “double-bubble” fuselage, boundary layer ingestion
  - Potential challenges: engine response to distortion, tail configuration aerodynamics

Goals

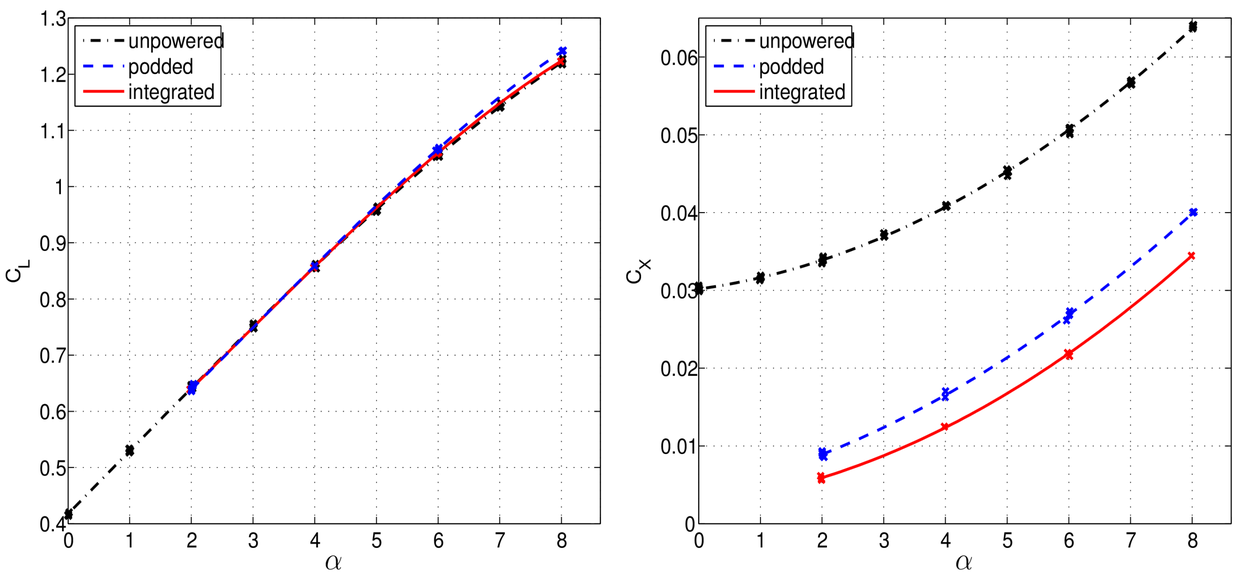
- Experimentally assess D8 series configuration performance
- Compare D8 series performance to baseline (737-800) in a traceable manner
  - Benefits of boundary layer ingestion (BLI)
  - Effect of inlet distortion on fan performance
  - Presence of unanticipated losses due to propulsion system-airframe integration



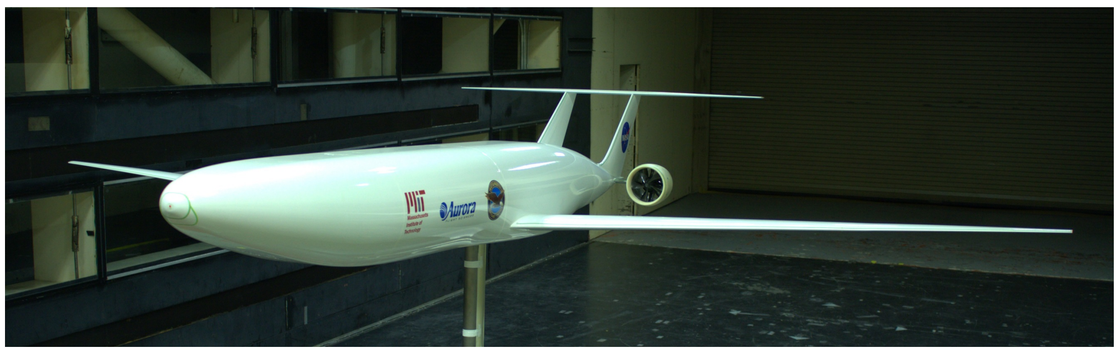
1:20 Unpowered model in MIT Wright Brothers Wind Tunnel (2011) and 1:11 Integrated model NASA Langley Research Center 14’x22’ Wind Tunnel (2013)

1:11 Powered Airframe Experiments

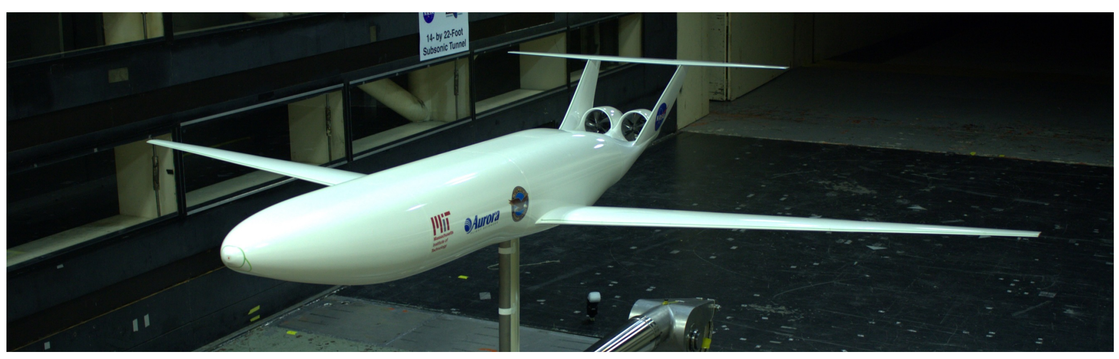
- Purpose: back-to-back comparison of podded propulsor (non-BLI) and integrated (BLI) configurations to assess BLI benefit
- Experimental setup: propulsor power sweeps, flow field surveys
- Experiments were carried out using a commercial off the shelf fans
- Measurements: forces and moments, propulsor mechanical energy flow rates



Aerodynamic curves for the D8-series aircraft

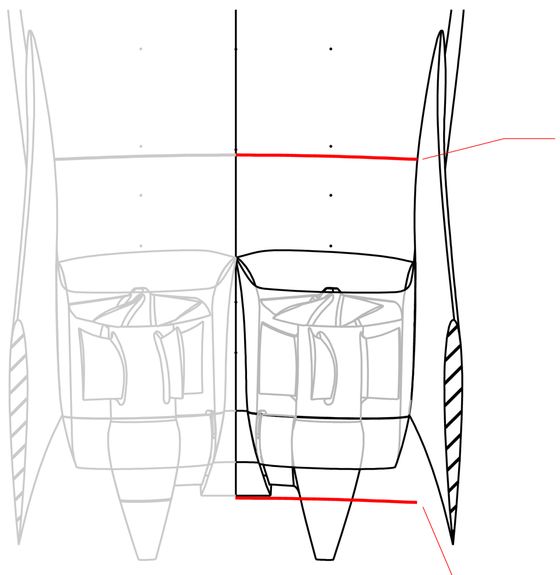


Podded (non-BLI) configuration

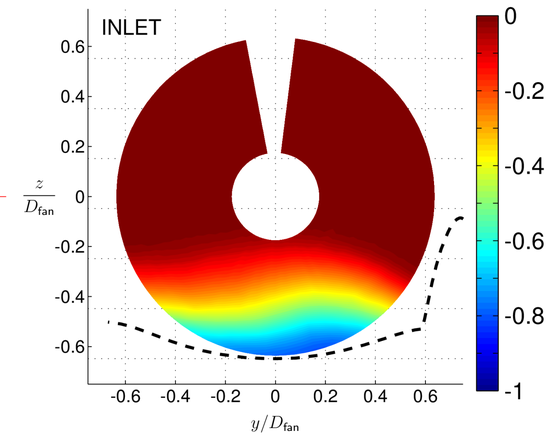


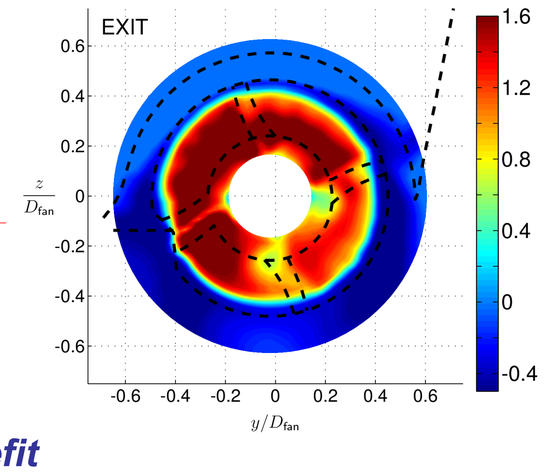
Integrated (BLI) configuration

Experimental Total Pressure Surveys (Right Propulsor)

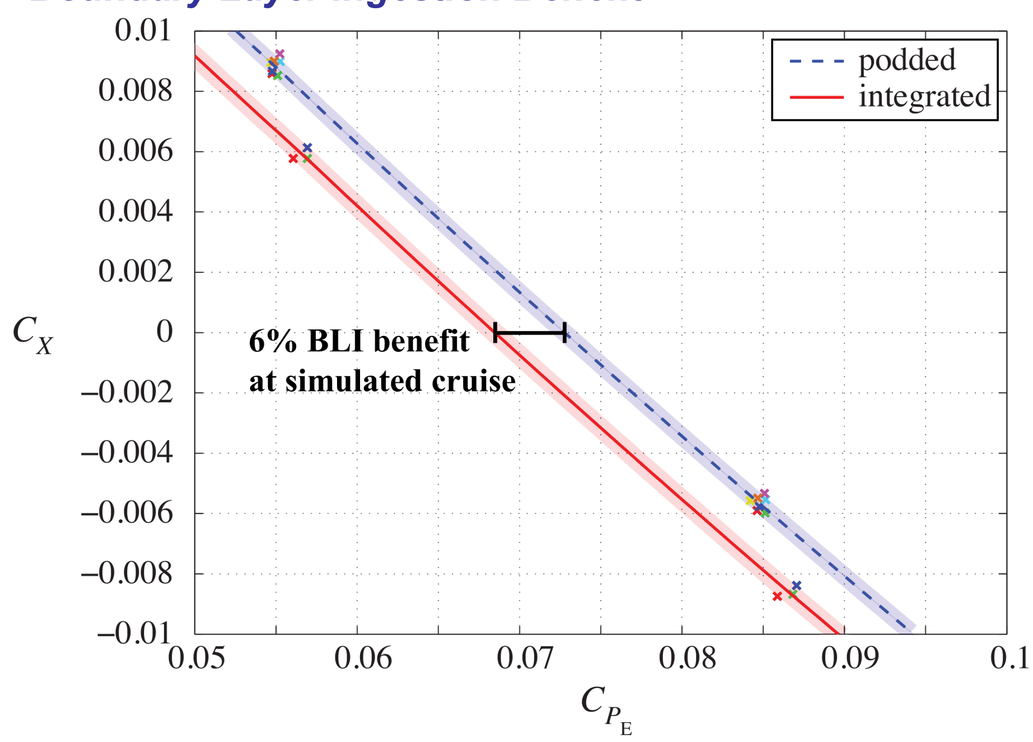


Integrated Configuration
$V_\infty = 70$ mph
$\Omega = 11{,}000$ RPM
$\alpha = 2°, \beta = 0°$





Boundary Layer Ingestion Benefit



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