Plans for Upcoming DGEN Aeropropulsion Research Turbofan (DART) Testing

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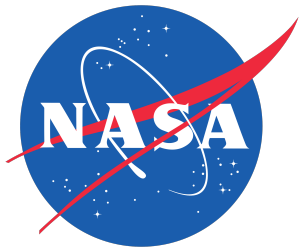

Acoustics Technical Working Group
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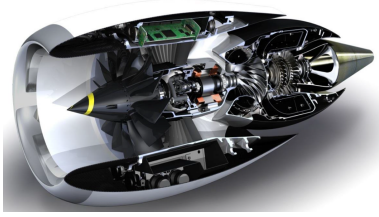
NASA Advanced Air Vehicles Program
Advanced Air Transport Technology Project
Aircraft Noise Reduction Subproject

Introduction

- DGEN380 Aeropropulsion Research Turbofan (DART)
  - Two-spool high-bypass ratio (BPR=6.8) geared (3.32 ratio) turbofan
  - Single stage centrifugal compressor and axial high-pressure turbine (52,000 rpm)
  - Wide-chord fan coupled to axial low-pressure turbine (43,000 rpm)
  - Reverse flow annular combustor
  - FADEC controls engine to ambient-temperature-corrected LP shaft speed with excellent repeatability



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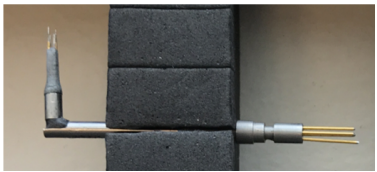
DART 2019 Test Entry Research Objectives

- DART test planned for July–August 2019
- Research objectives:
  - Intra-stage velocity field measurements via hot-wire (HW)/hot-film (HF) techniques
  - Core nozzle circumferential pressure field mapping using infinite-tube probes (ITP)
  - Exploratory noise survey of DART
  - Instrumentation group performing TRL advancement within an engine environment
- Modifications will be made to the following DART components:
  - New fan case with instrument ports for HW and HF measurements
  - Core nozzle centerbody modified with integral ITP ports

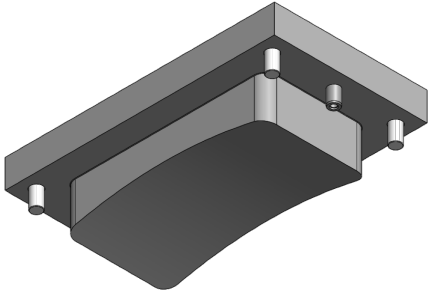
Fan Stage Flow Field Characterization Experiment

- Hot wire (low rpm) and hot film (low, moderate and high rpm) radial surveys conducted at 2 axial locations between rotor and stator to measure blade wake evolution
- Results compared between straight and L-shaped probes (below center, right)
- Total pressure and temperature measurements to assess fan performance
- POC: Gary Podboy



Fan Intra-Stage Characterization Experiment

- Modified fan case being fabricated for this research includes three instrumentation ports
- Instrumentation ports plugged during other testing, ensuring smooth fan duct to avoid extraneous noise sources
- POC: Gary Podboy



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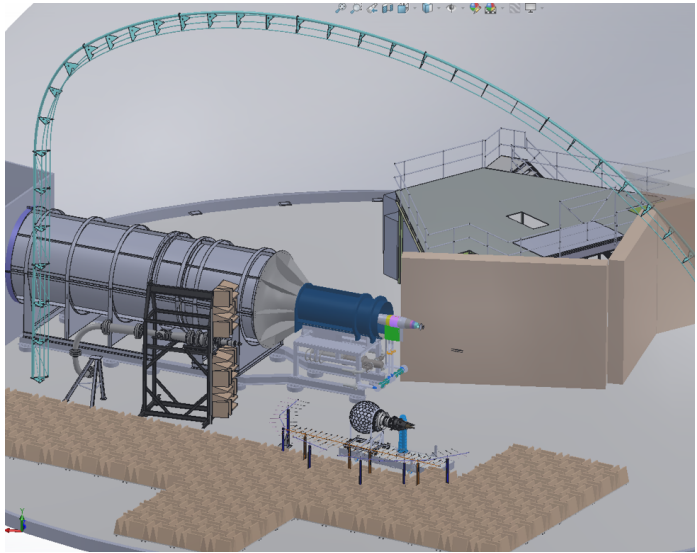
Exploratory DART Noise Survey

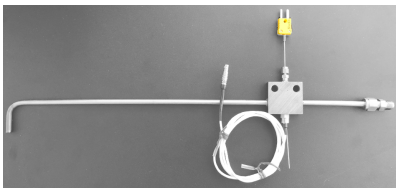
- Several objectives to understand DART's noise sources:
  - Preserving directivity of measurements propagated to geometric far-field
  - 2017 data suggest DART is aft-dominant, so studies of inlet noise may benefit from a barrier wall (size and placement will be determined)
- These objectives may be addressed using:
  - AAPL 24-microphone overhead array
  - Linear sideline array of 61 mics at varying distances from DART centerline
  - Aft barrier wall to be used in conjunction with sideline array
  - Phased array to better determine source location as a function of observer angle
- POC: Cliff Brown

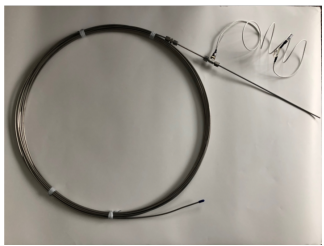
Overview of DART in AAPL

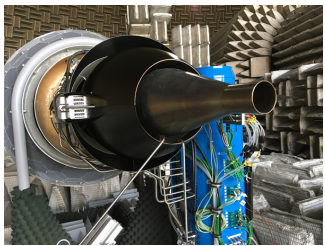


Core/Combustor Noise Research

- Circumferential array of 8 unsteady pressure measurements in an infinite-tube probe (ITP, below left, center) configuration at core nozzle to improve understanding of DART combustor noise
- ITPs allow remote measurement of pressure in extreme environment unsuitable for transducer exposure
- Modified exhaust tailcone incorporates 8 surface ports for ITPs
- POC: Devin Boyle and Lennart Hultgren

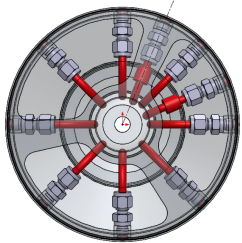


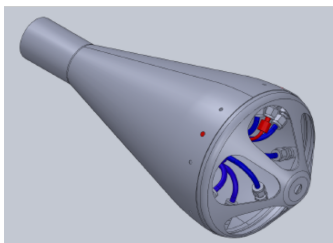


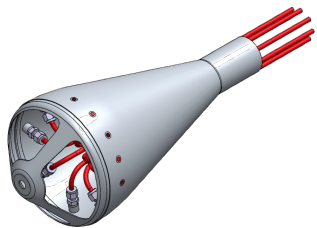


Core/Combustor Noise Research, Continued

- Measurements on engine made simultaneously with mid- and far-field microphone locations at aft polar angles from ∼110-140° at 10 ft and about 38 ft, respectively
- Sideline array data complementary to core/combustor noise research as source separation technique
- POC: Devin Boyle and Lennart Hultgren







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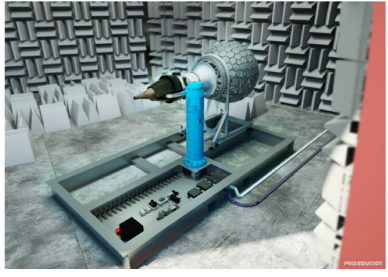
Summary

- DART 2019 test will build on knowledge and observations of previous testing
- Increasingly invasive testing involving modified engine components
- Current status: hardware acquisition and late-stage test planning underway



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Questions?