DGEN Aeropropulsion Research Turbofan (DART) Test Plans

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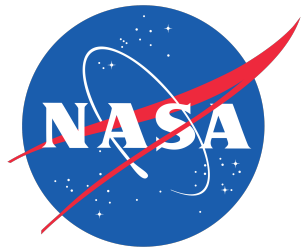

Acoustics Technical Working Group
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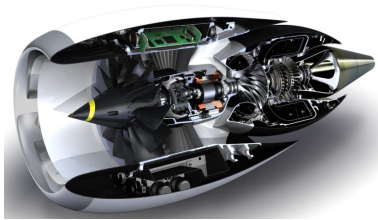
NASA Advanced Air Vehicles Program
Advanced Air Transport Technology Project
Aircraft Noise Reduction Subproject

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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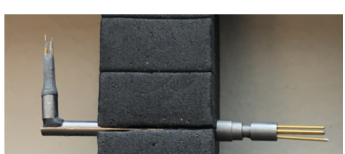
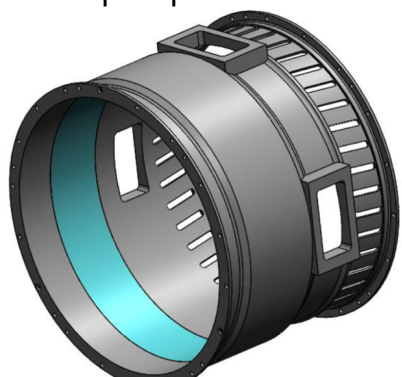
DART 2019 Test Entry Research Objectives

- DART test planned for March-April 2019
- Research objectives:
  - Obtain initial set of rotor wake data on DART to compare with CFD
  - Exploratory noise survey of DART
  - Core nozzle circumferential pressure field mapping using infinite-tube probes (ITP)
  - 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 Intra-Stage Velocity Measurement Experiment

- Hotwire (low rpm) and hotfilm (low, moderate, and high rpm) radial surveys conducted at 2 axial locations between rotor and stator to measure blade wake evolution.
- Compare results obtained with straight and L-shaped probes.
- Instrumentation ports plugged during other testing to ensure smooth fan duct, avoiding extraneous noise sources
- POC: Gary Podboy

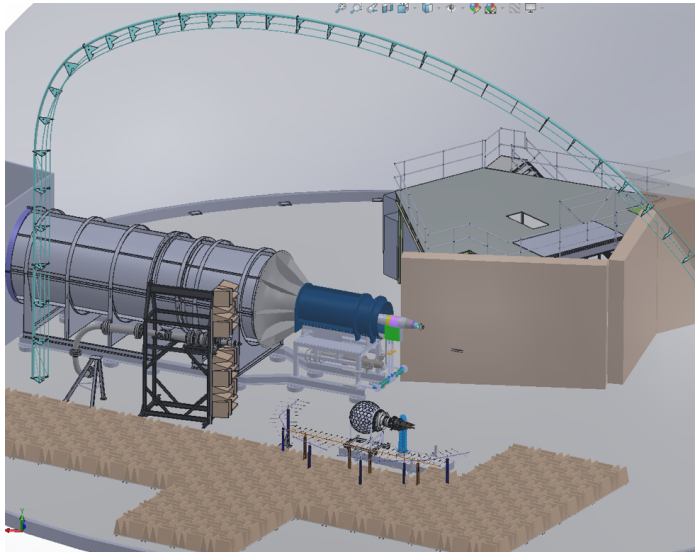




Exploratory DART Noise Survey

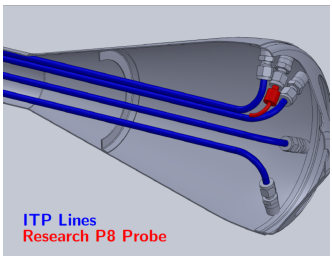
- Several objectives to understand DART's noise sources:
  - Preserving directivity of measurements propagated to geometric far-field
  - 2017 data suggest DART is aft-dominant, so studies of inlet noise may benefit from a barrier wall (whose size and placement will be determined)
  - Determine the azimuthal variation of DART's sound field
- These objectives may be addressed using:
  - AAPL 24-microphone overhead array
  - Sideline array of 30-70 mics at varying radial distances from DART
  - Aft barrier wall to be used in conjunction with sideline array
  - Translating phased array to better determine source location as a function of observer angle
  - Spherical microphone array around engine
- POC: Cliff Brown

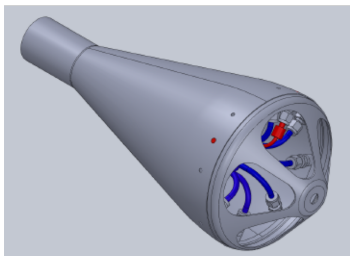
Overview of DART in AAPL

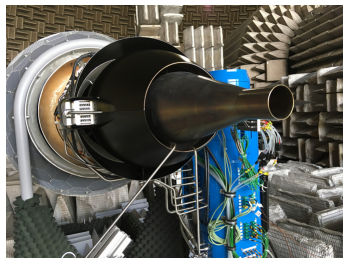


Core/Combustor Noise Research

- Adding circumferential array of 8 unsteady pressure measurements in an infinite-tube probe configuration at core nozzle to improve understanding of DART combustor noise
- Measurements on engine made simultaneously with mid- and far-field microphone locations at aft polar angles from $\sim$110-140° at 10 ft and about 38 ft, respectively

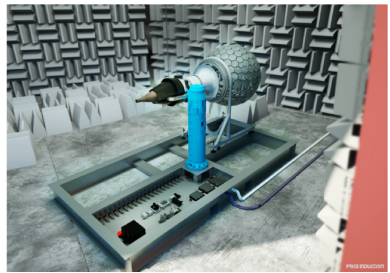






Summary

- DART 2019 test will build on knowledge gained through previous testing
- Increasingly invasive testing involving modified engine components
- Test planning and requirements development underway



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Questions?