Core/Combustor-Noise: Preparations for Future DART Tests

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Introduction

- DGEN 380 turbofan engine
  - Two–spool high–bypass geared turbofan
  - Single stage high-pressure centrifugal compressor
  - Reverse flow annular combustor
  - Single stage axial flow HPT and LPT
  - FADEC enables excellent repeatability of test conditions

- Baseline combustor-noise data acquired in 2017
DART Test–August 2017

ITP configuration at nozzle exit

7 o'clock ITP

6 o'clock ITP
2017 DART Test Results, 60% Power

Broadband combustor–noise component

Total noise signature

Broadband combustor noise \((m = 0)\) detected up to 500 Hz with either ITP

7 o’clock ITP also detects second broadband-noise frequency range \((m = \pm 1)\)

Presently unclear why second range not detected by 6 o’clock ITP
Upcoming Test: Goals and Objectives

**Goal:** Improve understanding of DART combustor noise

**Objective:** Make additional circumferential unsteady pressure measurements in core stream

**Approach:** Replace tailcone with new instrumented part

- 8 equally spaced ITP measurement locations around tailcone circumference
- 2 high-temperature pressure transducers (P8)
Upcoming Test: Hardware Design

Modified core nozzle centerbody:

- Integrates desired circumferential array of measurement locations
- Allows “simple” removal for instrumentation access
- Additional research instrumentation integrated (P8 pressure probe)
- Bosses offer options to change configuration of installed instrumentation
Hardware Design (Cont’d)

ITP Lines
Research P8 Probe
Characterizing ITP Response

- Using impedance tube to generate known acoustic response
- Determines amplitude and phase relationship between pressure response at measurement location and remote ITP
- Plan to introduce nitrogen or shop air purge flow in later iterations
Summary

- Modified core nozzle centerbody will improve knowledge of DART core noise field at nozzle exit with additional circumferential measurement locations.
- Proposed testing, in part, will investigate the possibility that azimuthal duct modes \((m,0)\) are present at DART nozzle exit.
- ITP benchtop testing will produce amplitude/phase relationship between remote ITP and measurement location pressure.
Questions?