Core Noise Testing Plans for DGEN Aeropropulsion Research Turbofan (DART)

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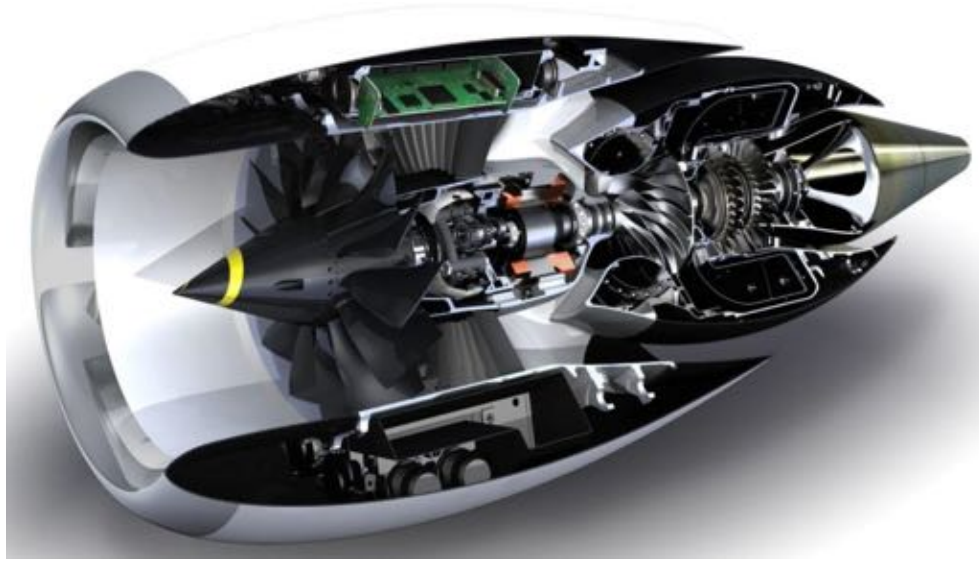

Acoustics Technical Working Group
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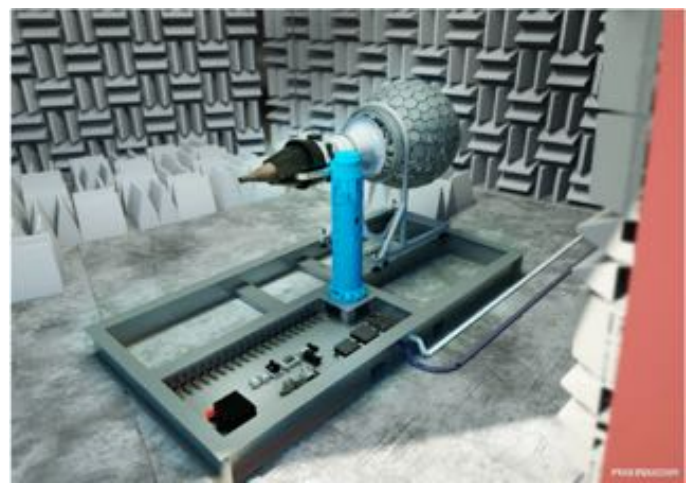
NASA Advanced Air Vehicles Program
Advanced Air Transport Technology Project
Aircraft Noise Reduction Subproject

Introduction

- DGEN 380 turbofan engine
  - Two–spool high–bypass turbofan with geared fan
  - Single stage high pressure centrifugal compressor
  - Reverse flow annular combustor
  - Single stage axial flow HPT and LPT
- Many aspects make it a suitable research platform:
  - Simple assembly allows parts to be swappable with research components
  - Additional instrumentation can be installed in modified modules
  - Relatively low operating cost offers opportunities for parametric studies

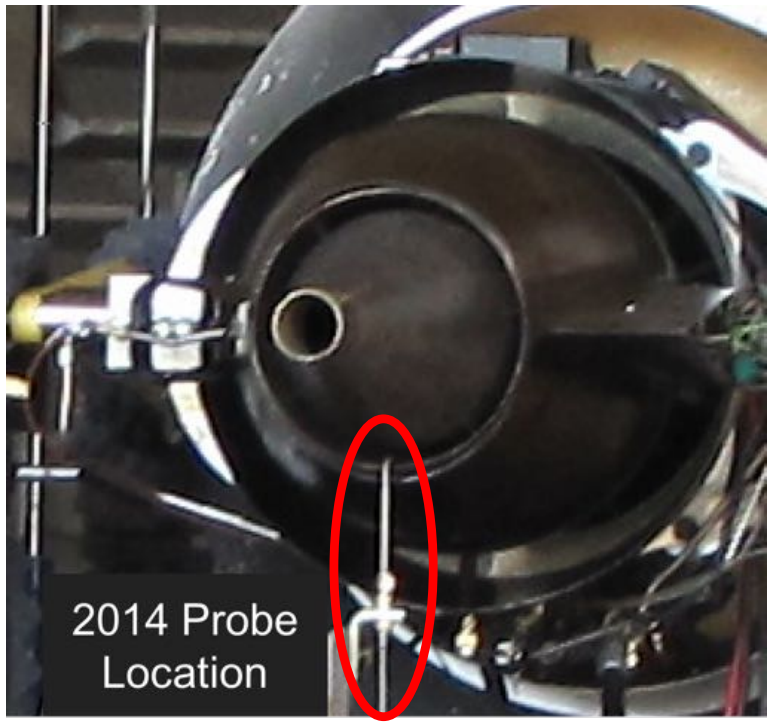
Upcoming Test Activities

- Summer 2017 – Repeating set points used in July 2014 DGEN test at GRC Aero–Acoustic Propulsion Laboratory (AAPL)
- Aft part of AAPL overhead array proposed for far–field measurements
- Mid–field microphones at distance and angles similar to 2014 DGEN test
- Core exhaust unsteady pressure measurements
- Establishing core noise baseline for new engine
- Repeating measurements taken in 2014 to compare



Test Instrumentation–July 2017

- Microphones mounted in aft overhead array 90°– 160°at about 45 ft from core nozzle
- One mid–field microphone as in 2014 test
- Two core exhaust–mounted high–temperature unsteady pressure transducers

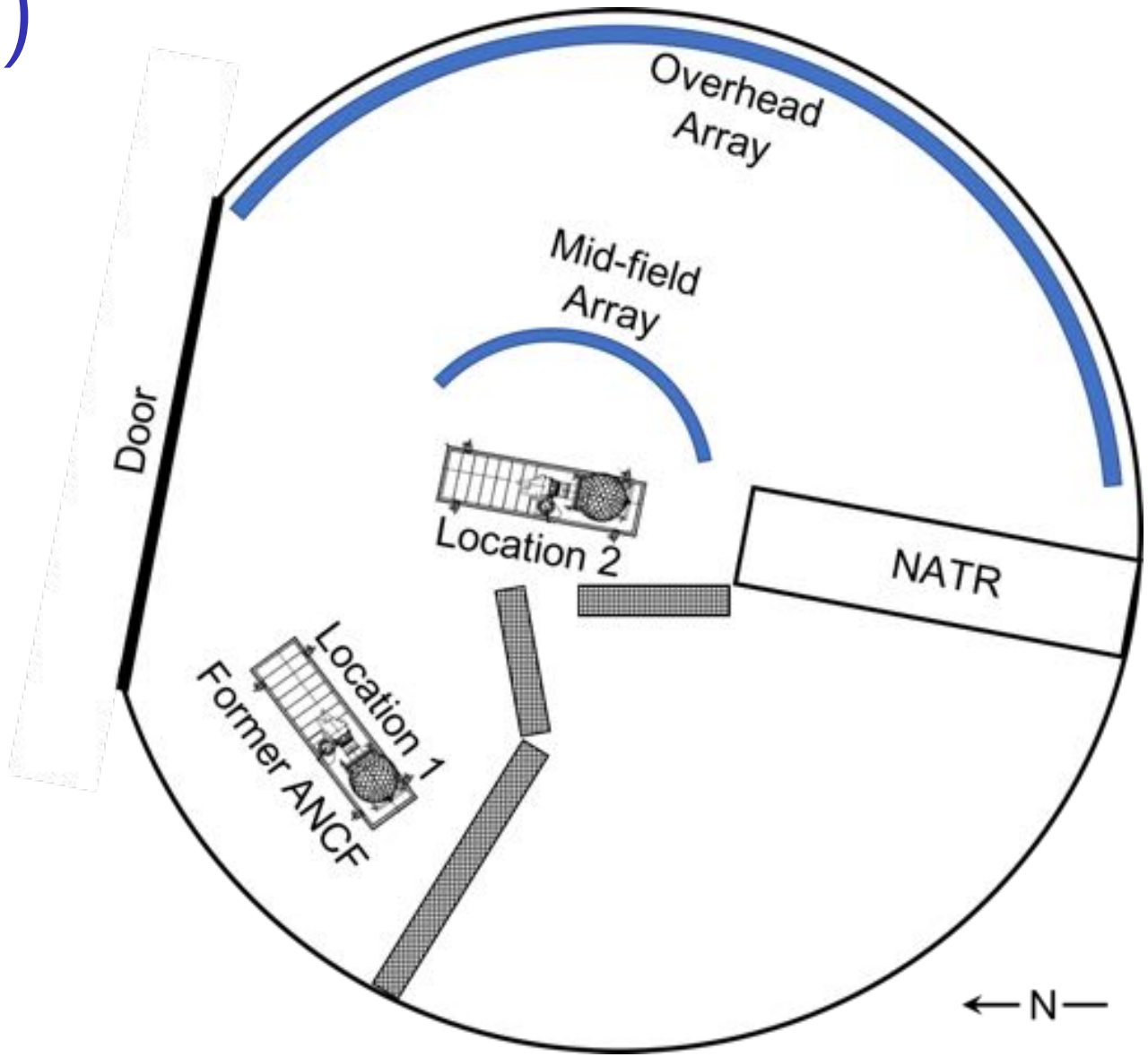


Results From 2014 Test in AAPL

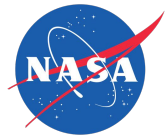
- Two–signal coherence method used to isolate combustion noise contribution to total noise[1]
- Broadband combustor noise was detected primarily at frequencies below about 500 Hz

[1] L. S. Hultgren. "A First Look at the DGEN380 Engine Acoustic Data From a Core-Noise Perspective". In: *NASA/TM—2015-218924* (2015).

Aero–Acoustic Propulsion Laboratory (AAPL)



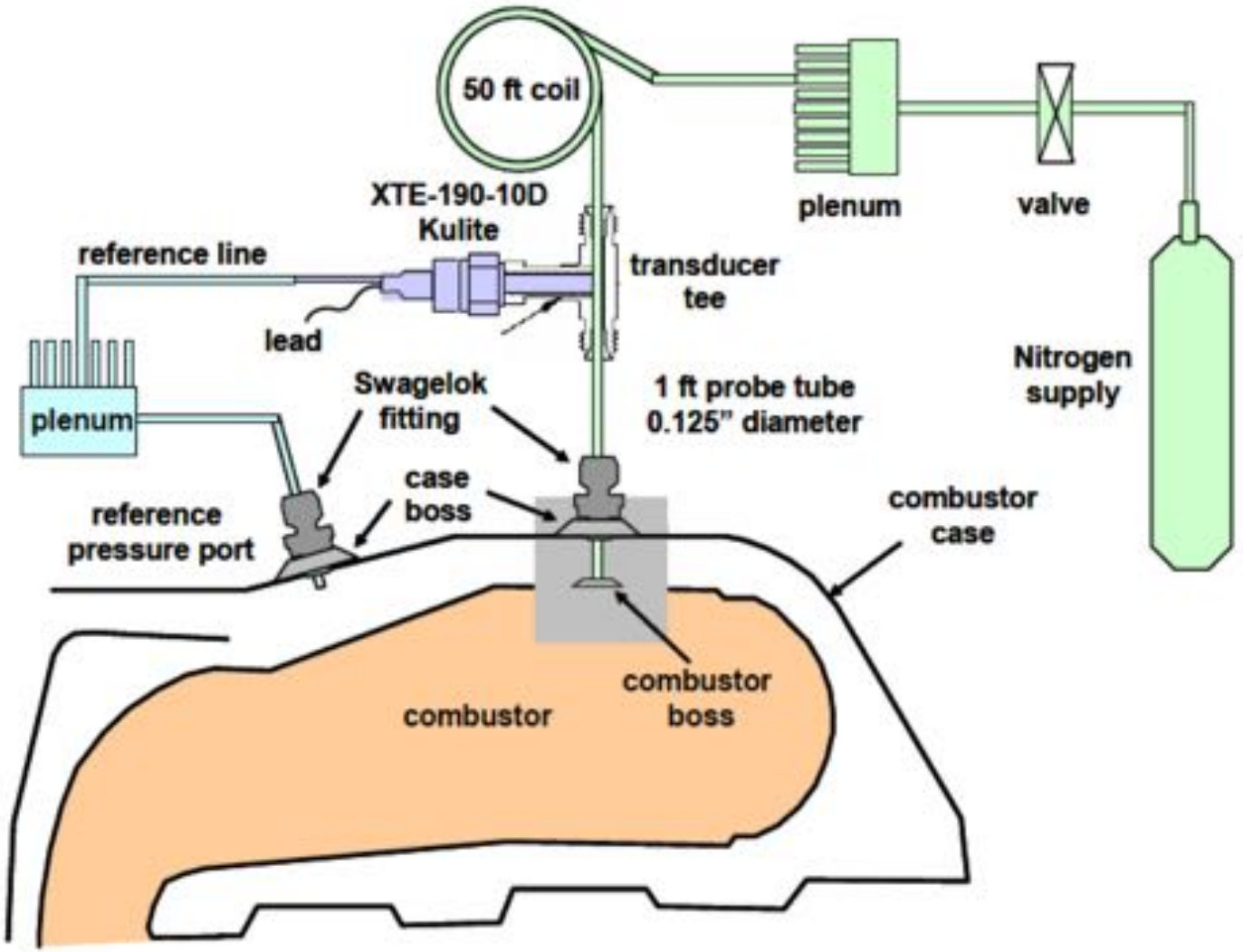
Combustor Instrumentation Bench Test



- Semi–infinite unsteady pressure probes for high–temperature pressure measurement within combustor and core duct/nozzle
- Nitrogen purge cooling for operation in very high temperature environment
- Need to establish frequency compensation and time delay corrections of such instrumentation
- Well established technique[2]
- Shakedown/refinement of instrumentation and source–separation methods

[2] A. M. Karchmer. "Identification and Measurement of Combustion Noise from a Turbofan Engine Using Correlation and Coherence Techniques". In: *PhD Thesis, NASA TM—73747* (1977).

Semi-Infinite Unsteady Pressure Probe



D. Weir. In: *NASA/CR—2008-215225* (2008), p. 321

Looking Forward

- Core noise baseline: piggyback on inlet liner test planned for Summer 2017
- Benchtop testing in Fall 2017: preparation for future DART tests–instrumentation and technique refinements
- Adding tailpipe to core nozzle in 2019 to test hot liners using circumferential and axial arrays of differential pressure transducers
- These goals are enabled by the modular engine design that allows modified components to be installed for testing then removed, restoring the engine to baseline configuration

Questions?