ANCF at UND
Commissioning Test Highlights
GRC AAPL vs UND White Field

Acoustics Technical Working Group Meeting
Langley Research Center
10-April-2019

Dan Sutliff / NASA GRC Acoustics Branch

National Aeronautics and Space Administration
Aeronautics Research Mission Directorate
Advanced Air Vehicles Program
Advanced Air Transportation Technology Project
Aircraft Noise Reduction Technical Challenge
The Advanced Noise Control Fan:
A 20 Year Retrospective of Contributions to Aeroacoustics Research"
Problem:

• 1994 – 2013: Low-TRL significant and prolific collaborative research performed on ANCF enabled the advancement of multiple noise technologies. (NRAs/SBIRs/AARC/STTR/SRF, etc).

• 2014 – 2016: Funding structure is limited – more emphasis on broadband. Innovative approaches were needed to maintain the capabilities of the ANCF rig for advancing low-TRL fan acoustic research.

Solution:

• Develop a formal relationship with a university to provide relevant research and STEM opportunities in the area of fan acoustics.

• Partner university will operate the (ANCF) at their location.

Activity:

• SAA developed and signed in 2016

• ANCF & 75 crates/tubs/boxes of supporting equipment transferred to ND in summer of ‘16.

• 1st test at ND in Feb 2017 – linear array of ground mics (Knowledge transfer).

• Commissioning Test in September 2018 (Pole mics and wedges borrowed from AAPL as well as circular array of ground mics at multiple radii).
DISASSEMBLY
JUST A LITTLE SWEEPING UP...
DAILY MOVEMENT to/from TEST SITE

0.44 mile path

Storage at AMP

Test site

Courtesy: Google Maps

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Courtesy: Scott Morris & Scott Bilka / UND
EXITING AMP
DAILY MOVEMENT to/from TEST SITE
AMP Building -> White Field Lab Test Area
**COMPARISONS**

**GRC AAPL**
- Data acquired in 2008
- Rig CL @ 10’
- Indoor facility (mostly)
- Wall in close proximity
- Fixed location of rig
- Very low background noise
- Pole mounted microphones @ duct CL

**UND White Field**
- Data acquired in 2018
- Rig CL @ 8’
- Outdoor facility
- Nothing in front
- Rig moved from storage daily
- Wind & traffic background noise
- Pole mounted microphones @ duct CL
  *ground mics re-sited daily*
DIRECTIVITY

(a) 1st Harmonic Band
(b) 2nd Harmonic Band
(c) 3rd Harmonic Band

BB PWL Directivity

Tone PWL Directivity

(a) 1st Harmonic
(b) 2nd Harmonic
(c) 3rd Harmonic

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1/3rd OCTAVE SPECTRA

(a) Full

(b) Broadband

POLE MIC STANDS

@AAPL

@ND

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For practical operational reasons:
- UND will be using ground plane microphones.
- Unable to place in geometric farfield.

Azimuthal effects arise in this case in terms of direct comparisons – however that is an opportunity.

<table>
<thead>
<tr>
<th>NAME</th>
<th>POLE ANGLES 12 ft</th>
<th>GROUND ANGLES 12ft.</th>
<th>GROUND ANGLES 20ft.</th>
<th>GROUND ANGLES 25ft.</th>
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GROUND MIC DIRECTIVITY

(a) 1\textsuperscript{st} Harmonic Band

(b) 2\textsuperscript{nd} Harmonic Band

(c) 3\textsuperscript{rd} Harmonic Band

Courtesy: Kelvin Figueroa-Ibrahim / UND
1/3rd OCTAVE SPECTRA

(a) Full

(b) Broadband

POLE

GROUND

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OBSERVATION

• Successful Handover of ANCF to UND
  – Usage by external customers / AATT

• Farfield Acoustic Levels Remarkably Similar
  – Slightly higher levels at AAPL(2008) compared to UND
    (Probably inverse of increase noted when ANCF was moved from center of AAPL to ‘enclosed’ FF arena - wall in front creating extra turbulence)

• Pole vs Ground Microphone measurements
  – variations due to distance (i.e. closer than typical)
  – potential for exploration of alternate methodologies

• Outdoor Testing Challenges – Learning Environment
The End of the Beginning

Thanks to GRC Team:
John Lucero, Mark Jacko, Lenny Smith, Bruce Groeing, Ed Myslewick
T-FOME crew at AAPL

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Tamuto Takakra
Michael Bilka
Rusty Collins
Mark Ross
Kelvin Figueroa-Ibrahim
White Field Lab Team

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