MDOF Liner Design Assessment

(ANCF and NASA/Honeywell Testing)

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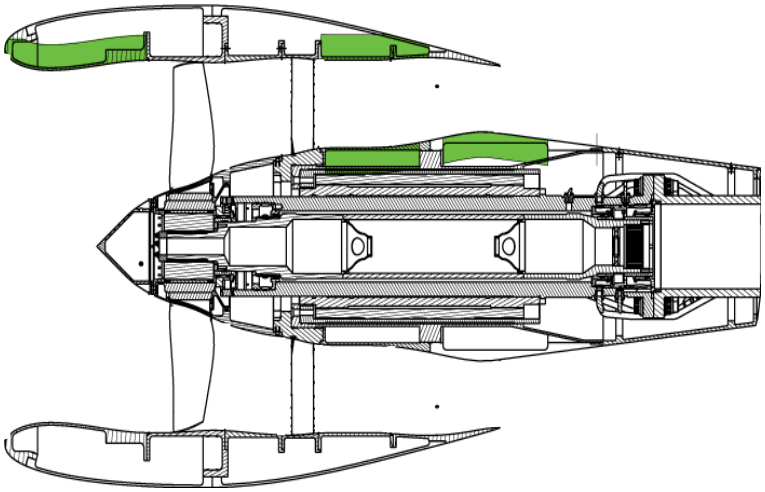
Outline

- Background
- Configurations
  - Advanced Noise Control Fan (ANCF)
  - Honeywell MDOF Liner Test
- Concluding Remarks

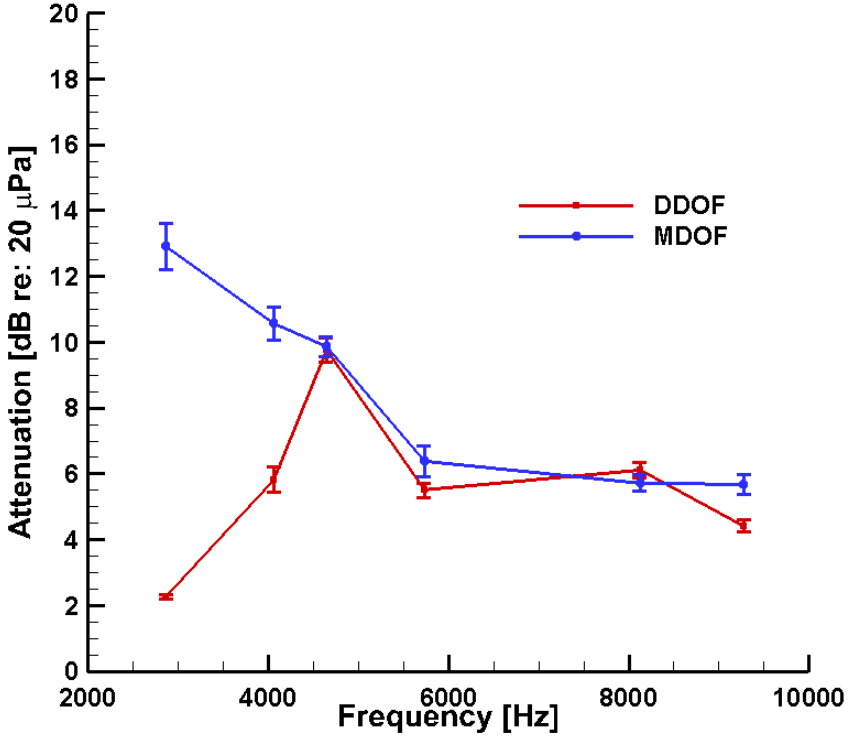
Background

NASA/GE Source Diagnostic Test (SDT) Fan



(Nark and Jones, AIAA 2012-2195)

Example Attenuation Prediction

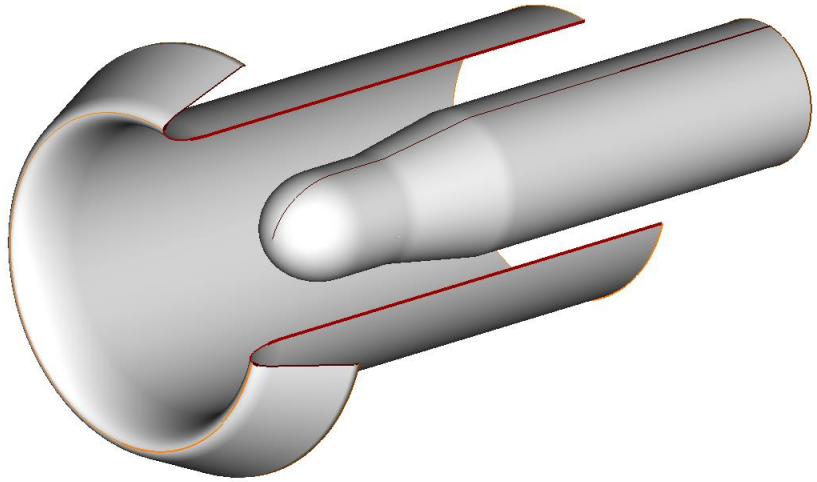


Refine acoustic propagation/radiation prediction and liner modeling approach to design/evaluate broadband liner concepts

Advanced Noise Control Fan (ANCF) Test

- No-Flow Tests
  - Drivers used as source (500-1500 Hz)
  - Two 2DOF liners:
    Constant and variable septa depth
  - In-duct testing with Rotating Rake
  - Inlet and aft configurations

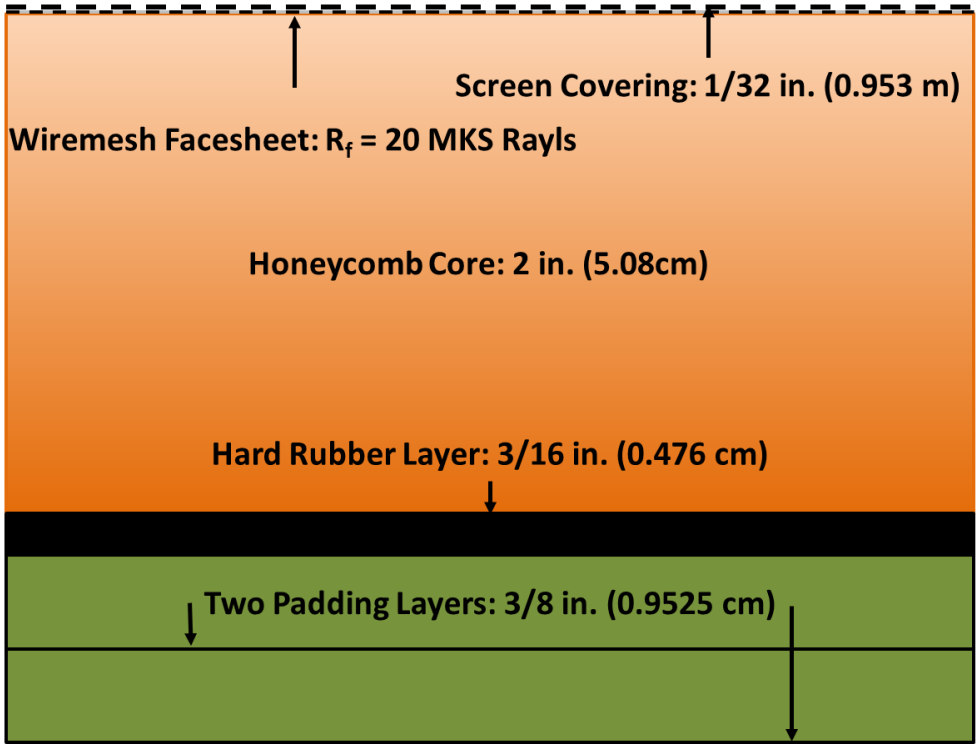
- Flow Tests
  - Fan Source
  - One liner: variable septa depth
  - In-duct (Rotating Rake) and far-field
  - Simulate segmentation via hardwall tape

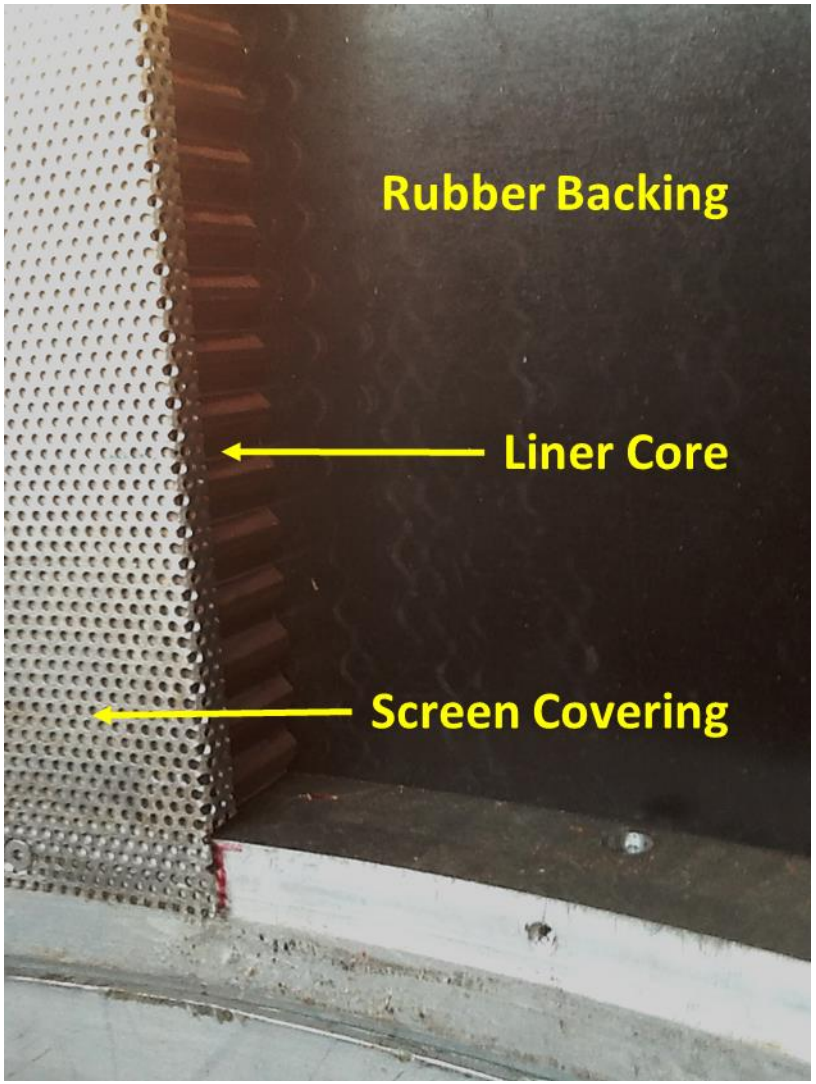


(D. L. Sutliff:, AIAA Paper 2014-3231, NASA CR-2005-213828, AIAA Paper 96-1745)

Advanced Noise Control Fan (ANCF) Test

- Liner Spool Dimension:
  - Depth: 4 in. (10.16cm)
  - Axial Length: 16 in. (40.64 cm)
- Two 2DOF liners:
  Constant and variable septa depth





Advanced Noise Control Fan (ANCF) Test

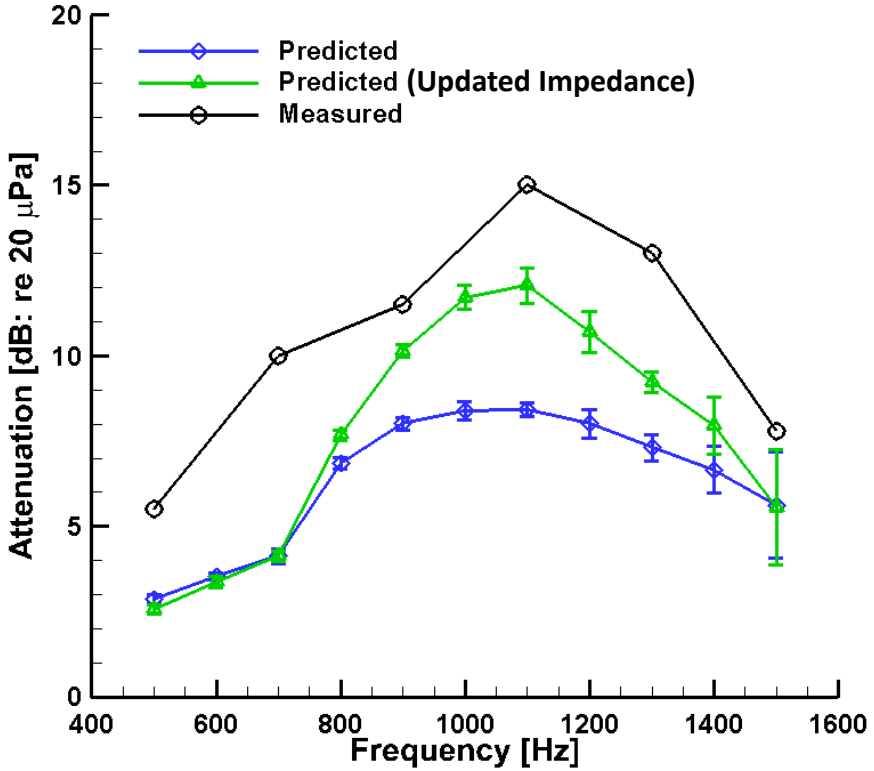
Effect of Screen Resistance: (MDOF Liner)

Liner Technology Facility (LTF) Test:

- Normal Incidence Tube measurements
  - Resistance increase of 0.04 ρc
  - Reactance virtually unchanged

- Proceeding with in-duct and farfield comparison with measured data

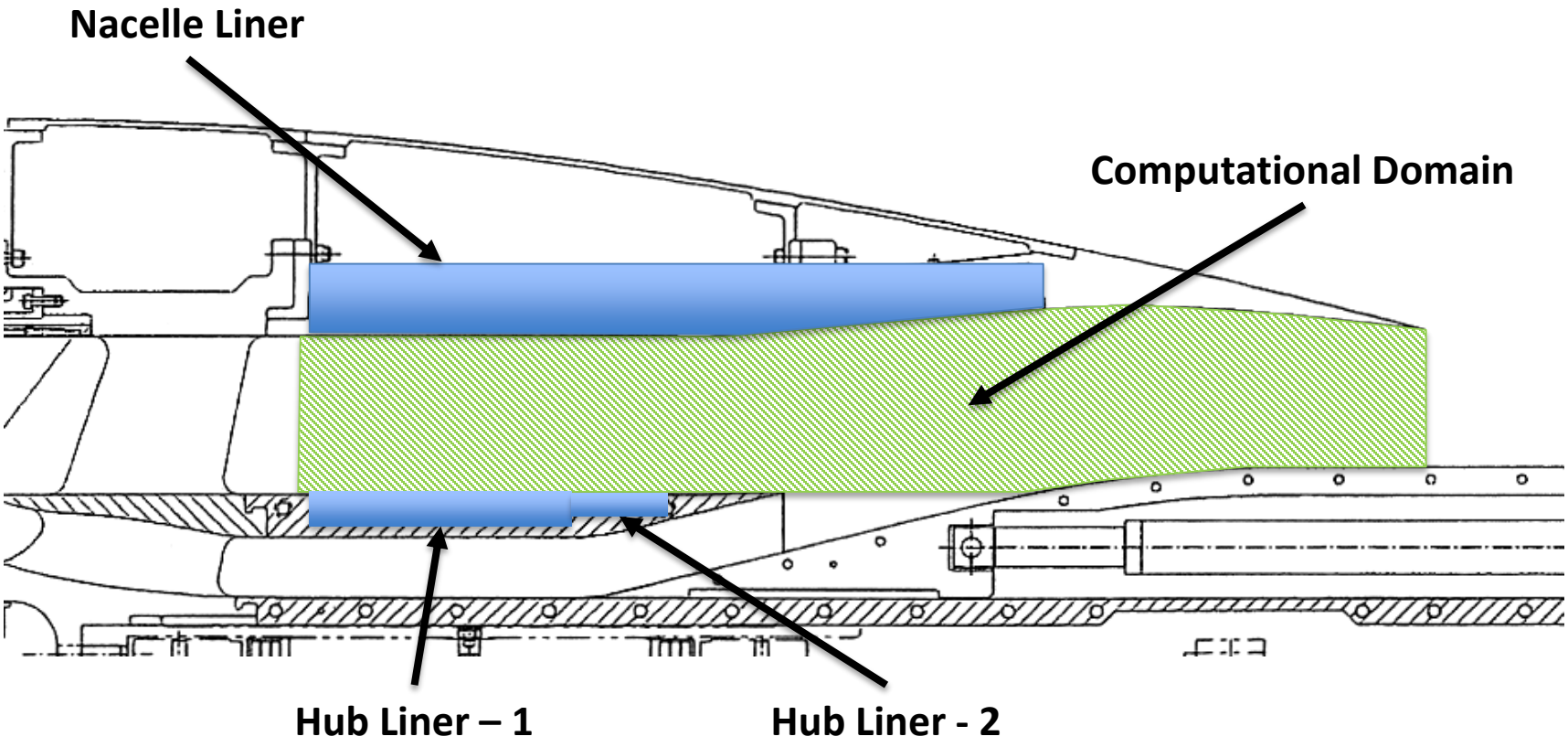
In-Duct Attenuation



Honeywell MDOF Liner Test

Design Conditions:

- One-Third Octave Band Center Frequencies (2000-8000 Hz)
- Three certification Points: Takeoff, Cutback, Sideline

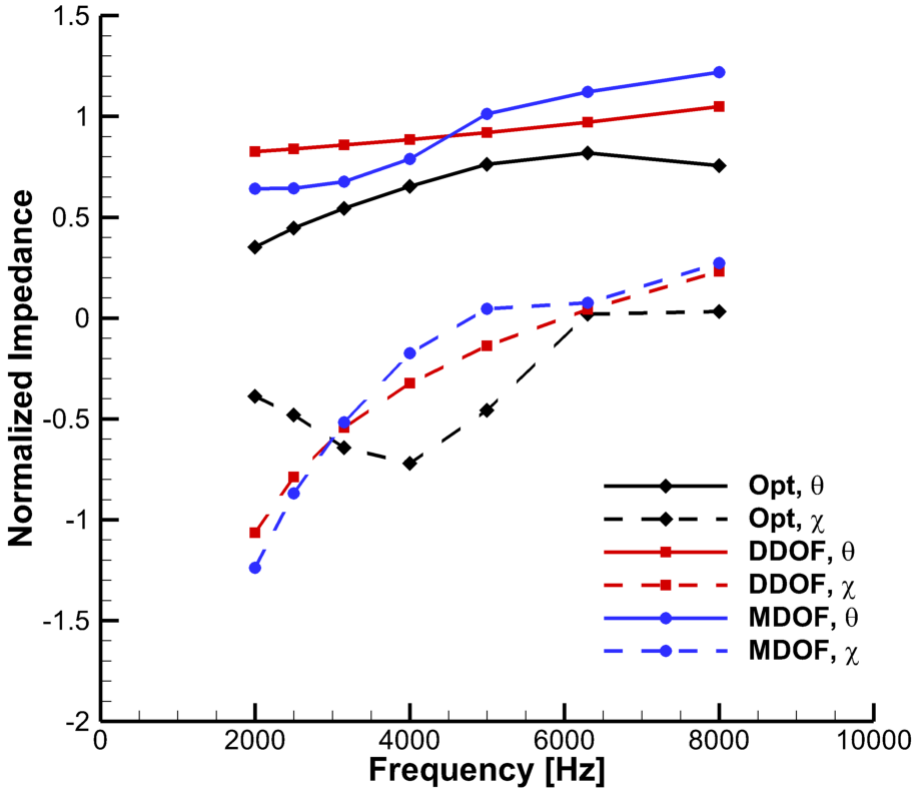


Representative Geometry: QHSF (Dittmar et. al., NASA TM—2003-212208)

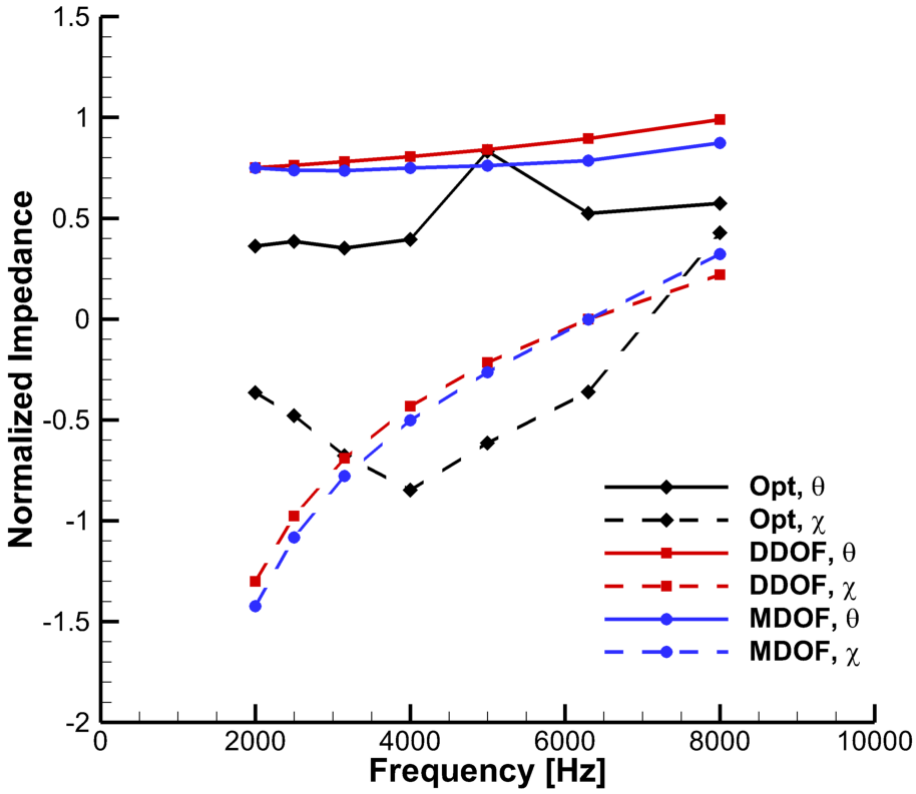
Honeywell MDOF Liner Test

Predicted Optimum/Design Impedances (Approach Condition)

Nacelle Liner



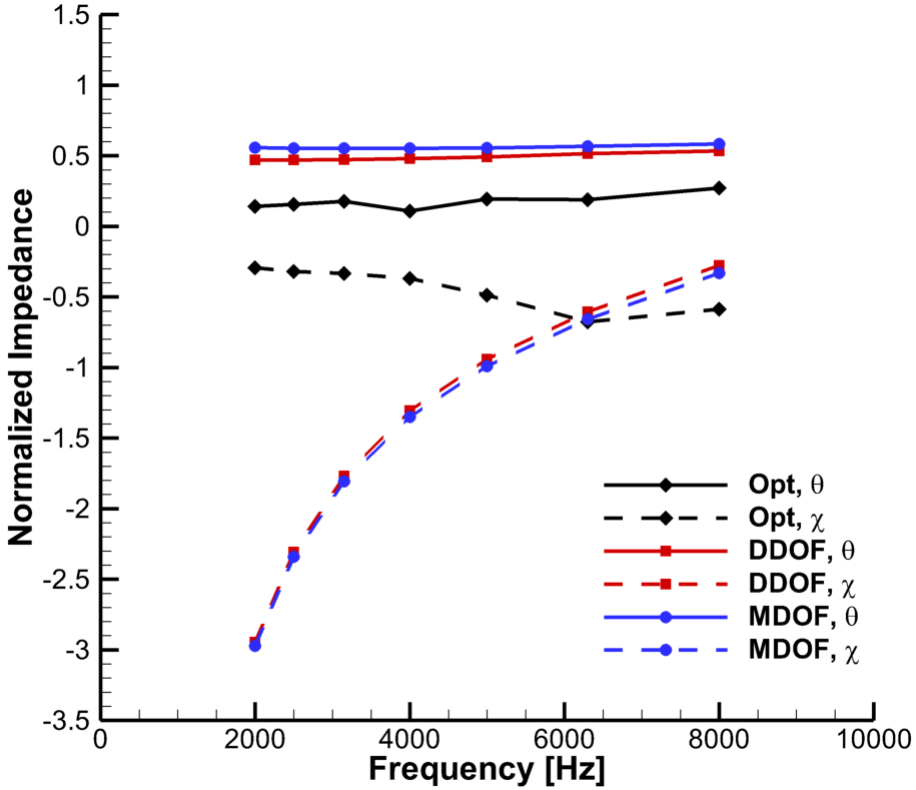
Hub Liner 1



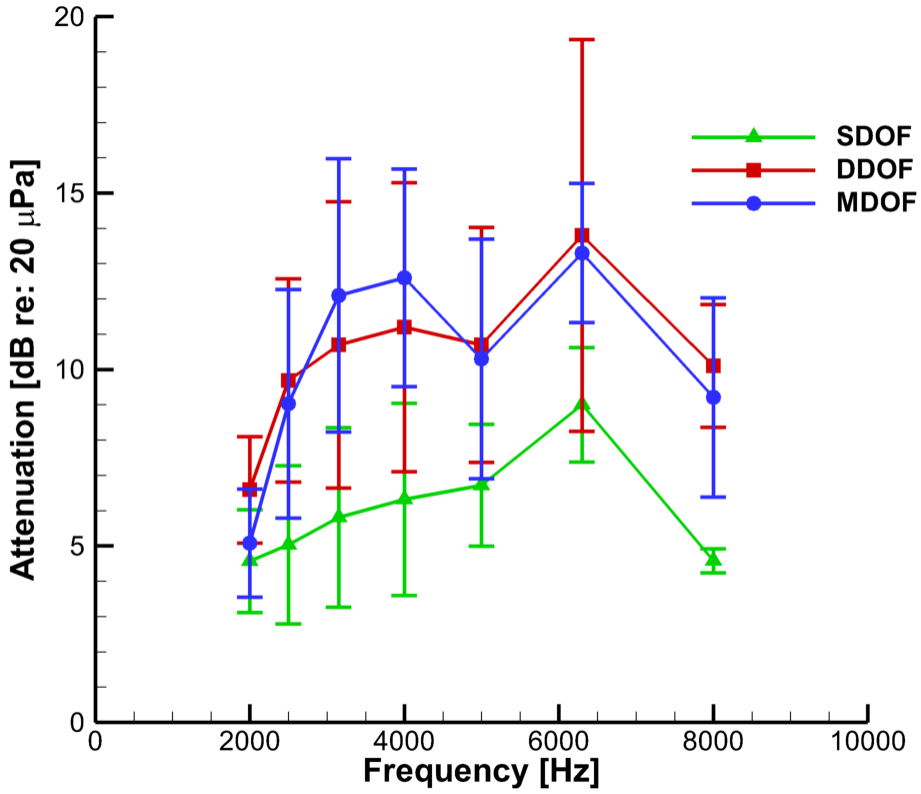
Honeywell MDOF Liner Test

Predicted Optimum/Design Impedances and Attenuations (Approach Condition)

Hub Liner 2



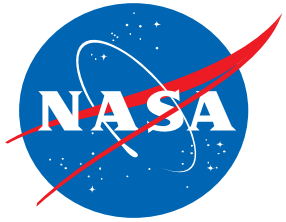
Hub Liner 2



Concluding Remarks

- Compare in-duct and far-field predictions with measured data
  - Statistical source model
  - Rotating Rake source information
- SDOF, DDOF, and MDOF liner designs using measured fan source

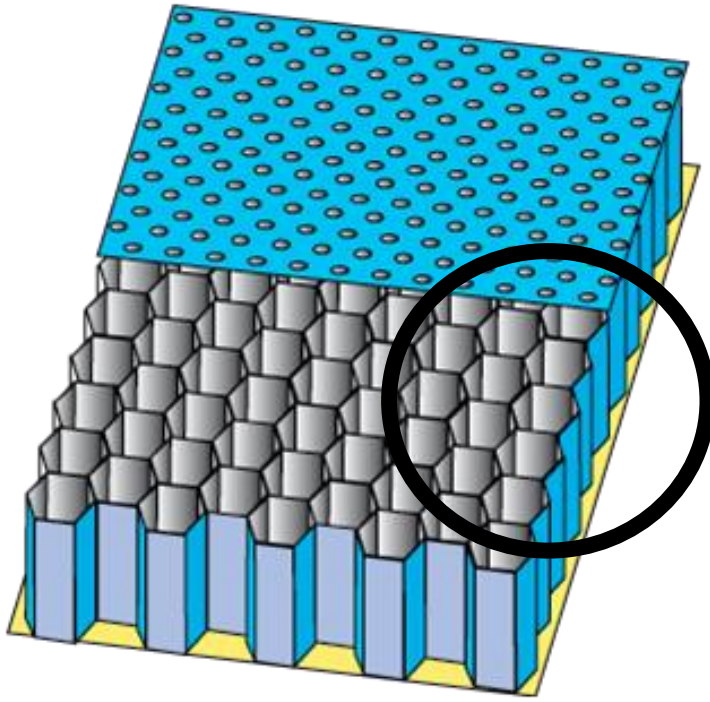
Continued validation of integrated acoustic duct propagation/radiation and liner modeling approach to MDOF liner design for complex configurations



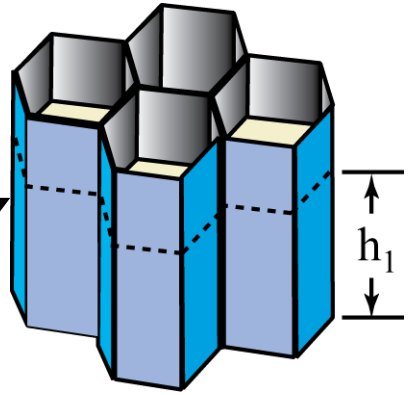
Backup Slides

Background

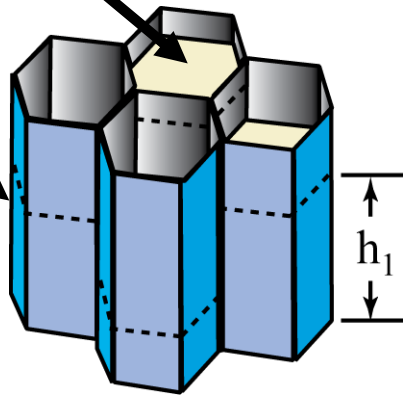
Initial Single Layer Liner



Uniform Depth (DDOF)



R_f

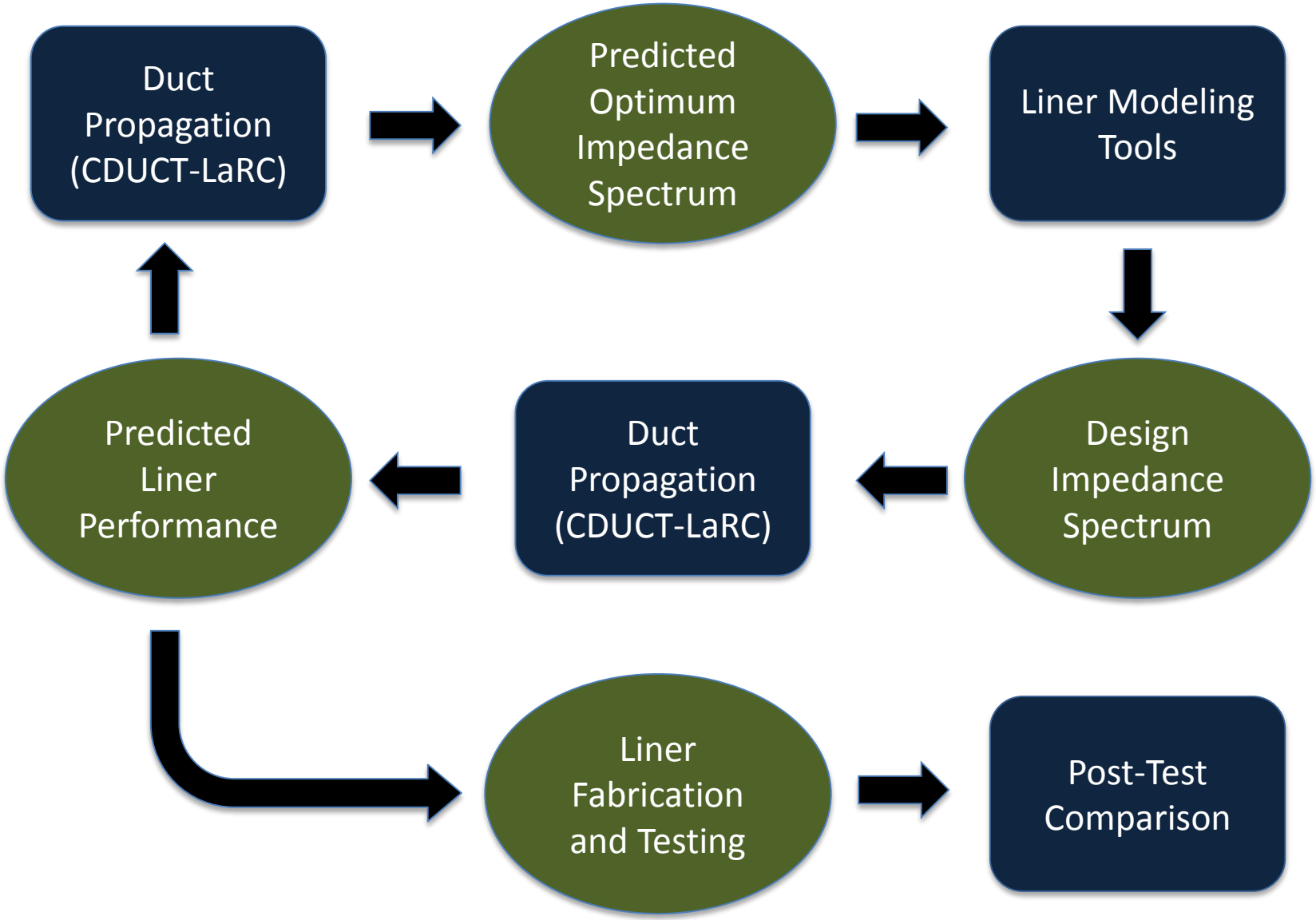


Variable Depth (MDOF)

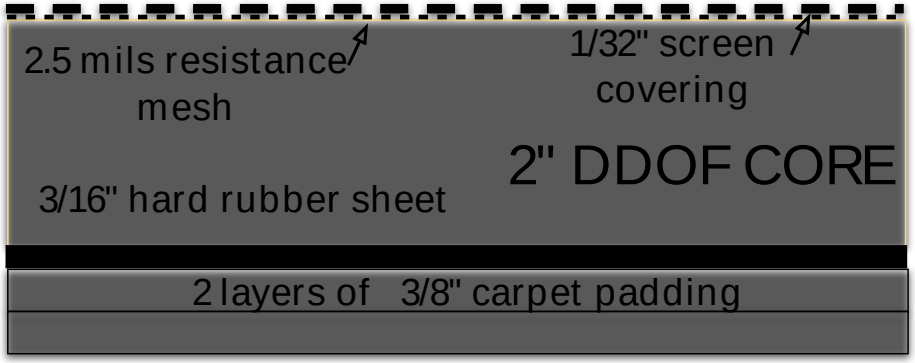
h_1 (in)*	R_f (MKS Rayls)*
0.2 – 1.8	600 - 1200

*Nominal Values

Computational Approach

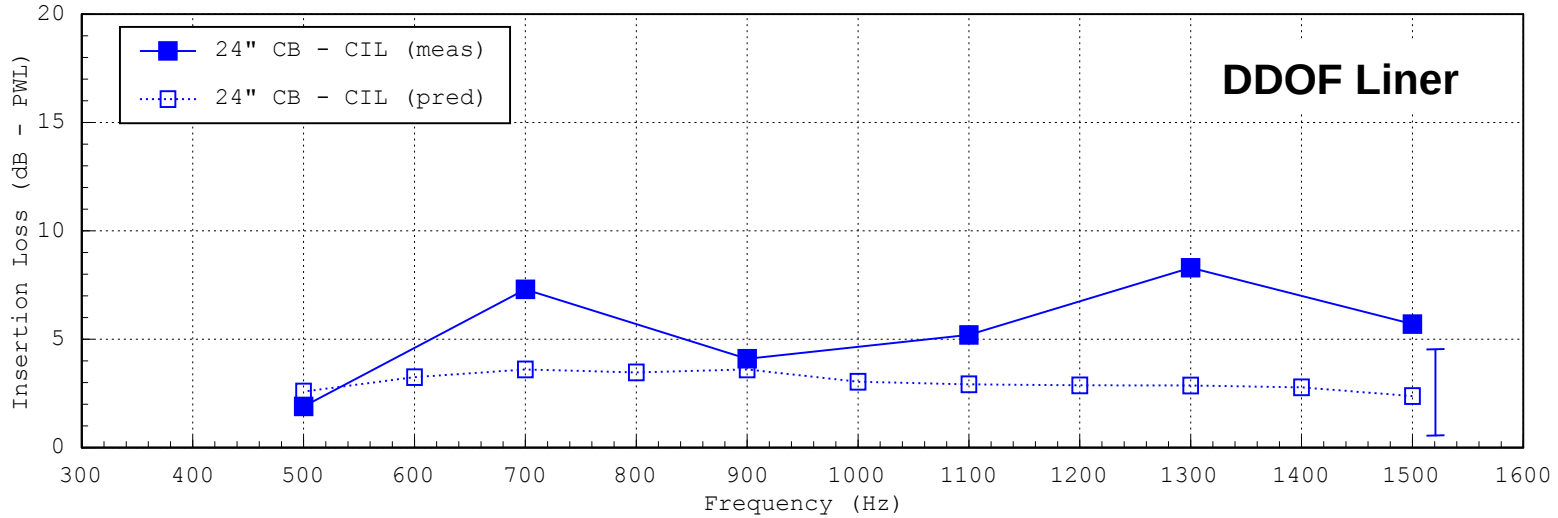


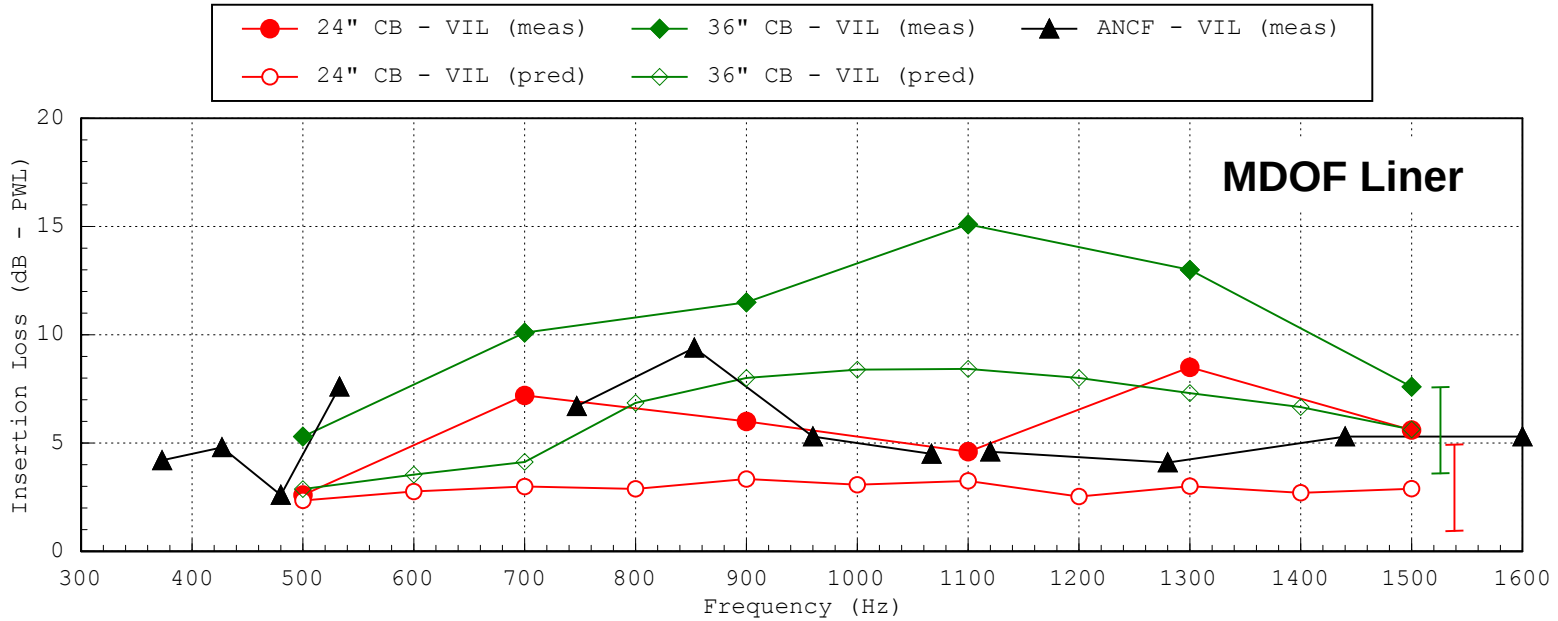
Advanced Noise Control Fan (ANCF) Test



Cross-Section Schematic of Liner Assembly

Liner Build-up Photographs


24" CB - CIL (meas)
24" CB - CIL (pred)
DDOF Liner
Insertion Loss (dB - PWL)
Frequency (Hz)
0
5
10
15
20
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600


24" CB - VIL (meas)
36" CB - VIL (meas)
ANCF - VIL (meas)
24" CB - VIL (pred)
36" CB - VIL (pred)
MDOF Liner
Insertion Loss (dB - PWL)
Frequency (Hz)
0
5
10
15
20
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

Honeywell MDOF Liner Test

Test Article Impedance Testing

(Dual-Waveguide Normal Incidence Tube)

- Liner impedances compare favorably with design values