



A Liner Optimization Study for the SDT Fan Rig

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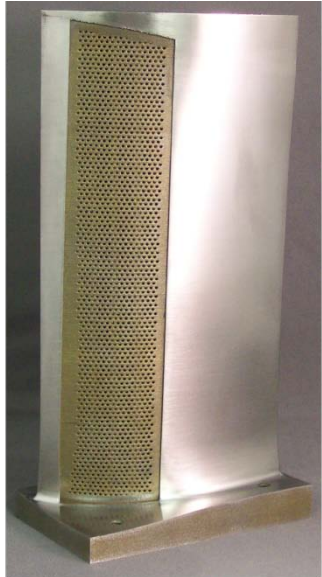
Outline

- Background
- Purpose of Study
- Test Configuration
 - Baseline NASA/GE Source Diagnostic Test (SDT) Fan
- Computational Approach
 - CDUCT-LaRC
 - Source Specification
- Preliminary Results
- Liner Design Process
- Concluding Remarks



Background

Soft Vane



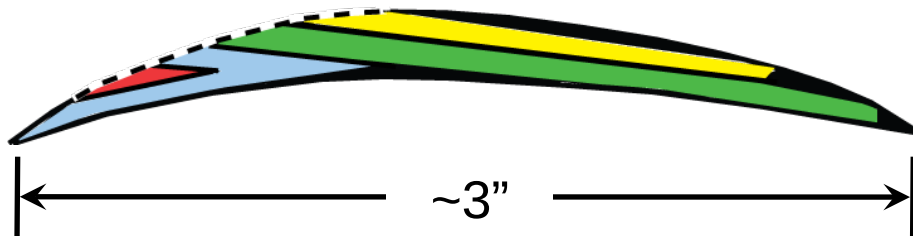
Over-the-Rotor Liner



**Scale Model Test
22" Fan Rig in GRC
9'x15' Wind Tunnel**



Soft Vane Interior



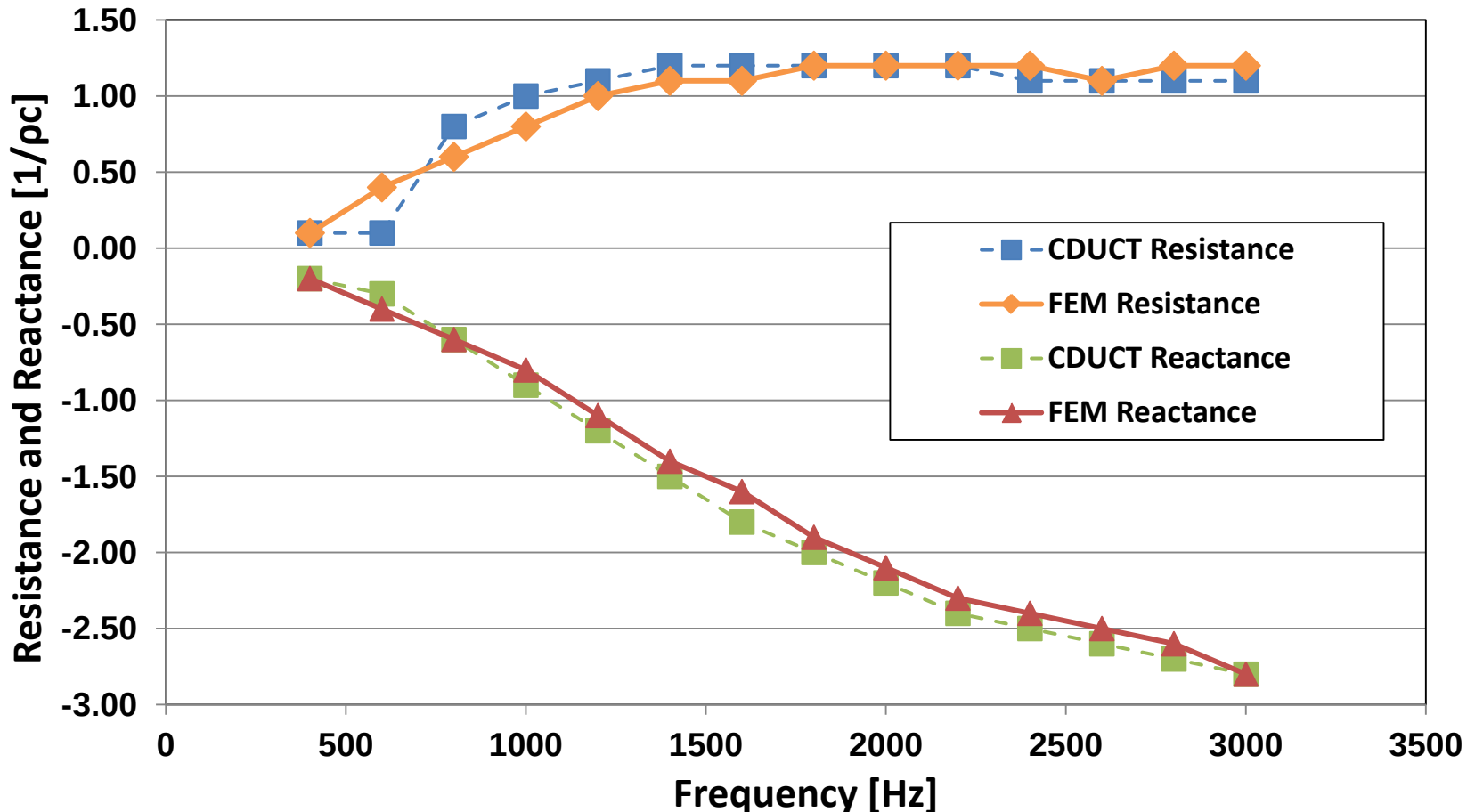
(Photos courtesy: NASA GRC)



Background

CDUCT-LaRC/FEM Liner Optimization Comparison

Curved Duct Test Rig (CDTR)

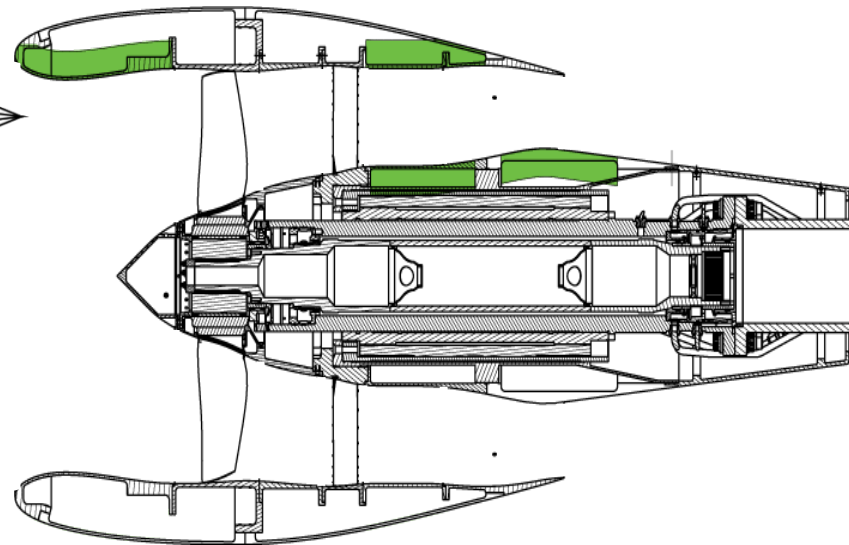
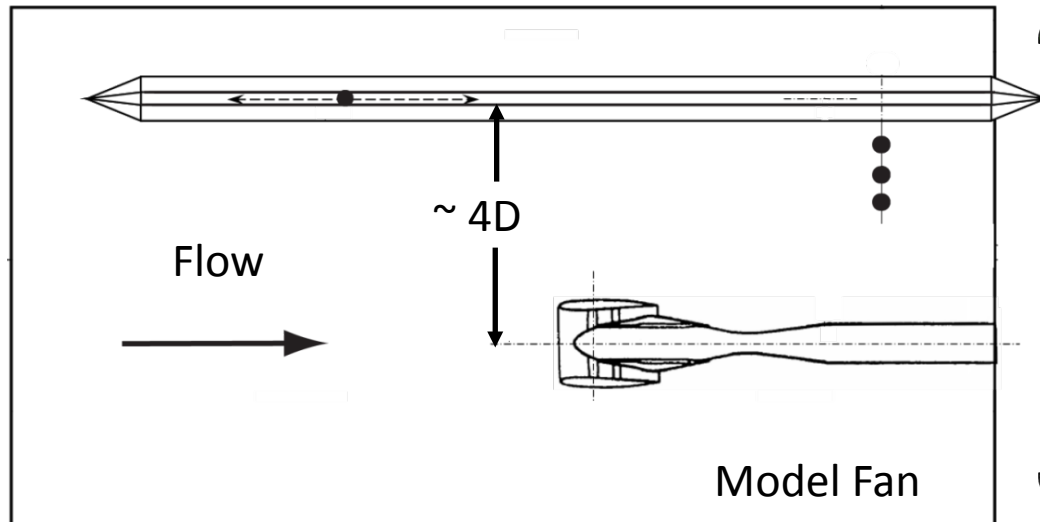


(Courtesy: C. Jasinski, C. Gerhold)



Purpose of Study

- NASA GRC 9'x15'
- NASA/GE Source Diagnostic Test (SDT) Fan
 - Baseline Configuration (22 Blades/54 Vanes)
- 51 Emission Angles (25° – 158°)



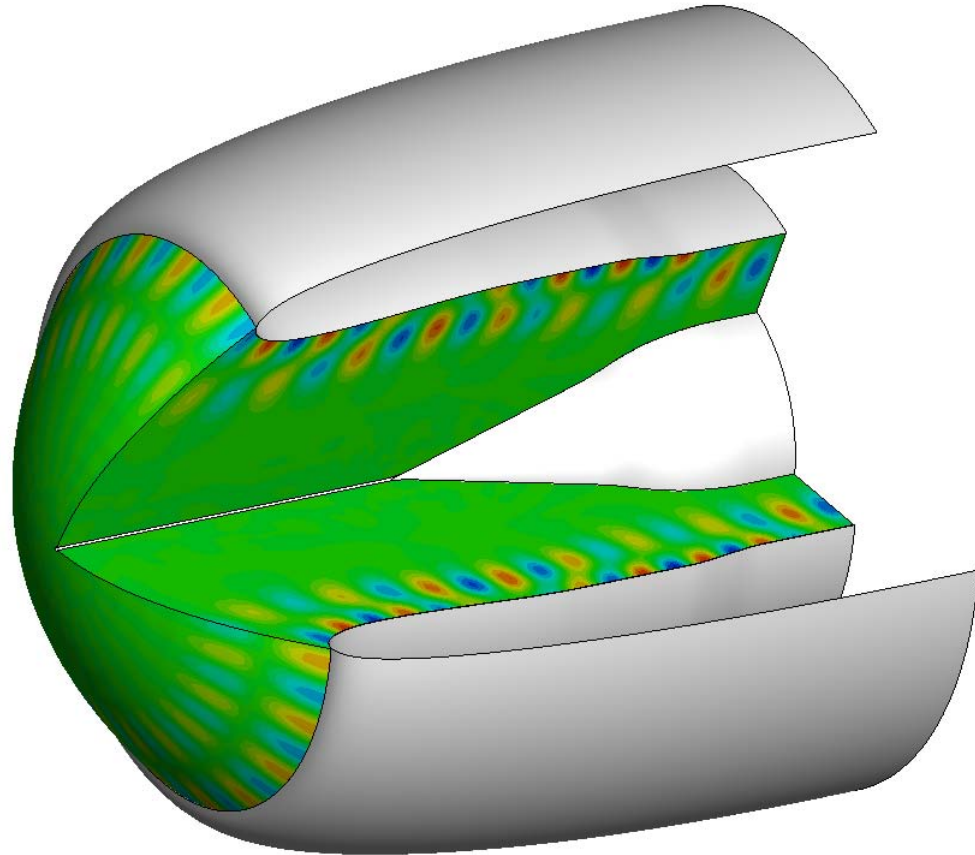
Design/Evaluate novel SDT broadband liner concepts
(Analysis: SFW Funded; Hardware and Testing: ERA Funded)



Computational Approach

CDUCT-LaRC Acoustic Propagation/Radiation

- Mean Flow: Assumed 1D Mach-Area
- Acoustic Source
 - Measured Data
 - Random Phase
 - Random Amplitude/Phase
- Acoustic Treatment:
Locally Reacting

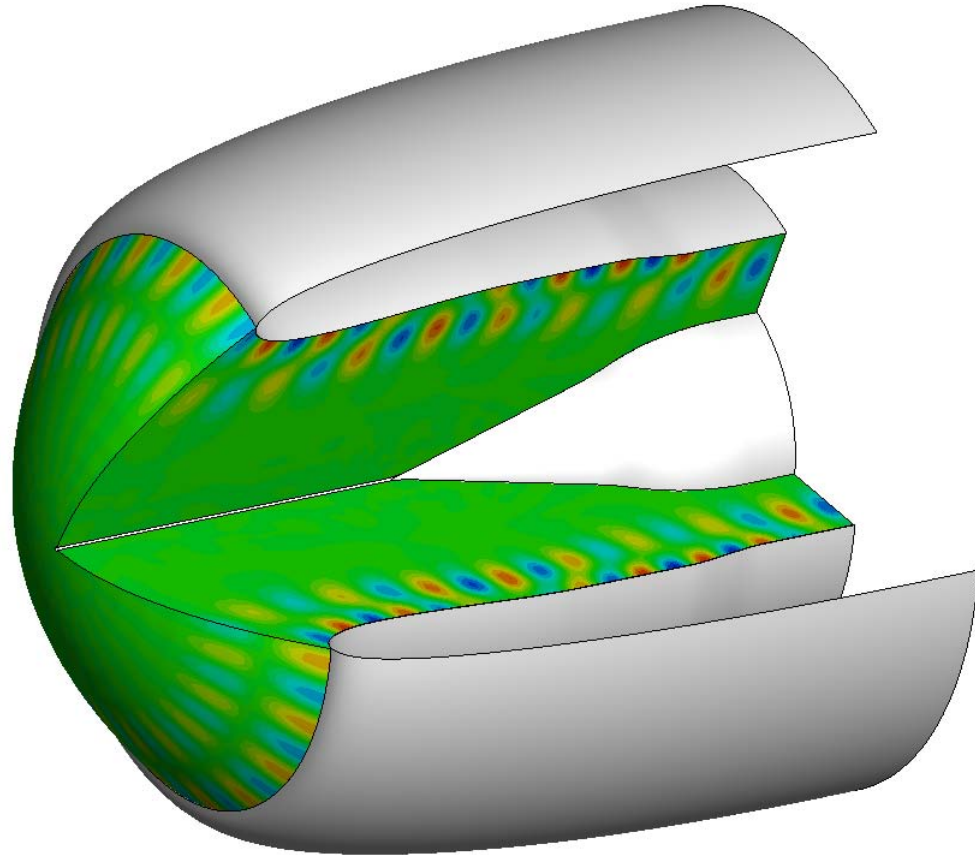




Computational Approach

CDUCT-LaRC Acoustic Propagation/Radiation

- Transmitted Acoustic Power:
Assumed normally distributed
- Student's t -distribution used to
analyze sample population
- 95% confidence intervals
inferred from sample standard
deviation and t -factor



(Zlavog and Eversman, JSV, Vol. 307, No. 1-2, 2007)

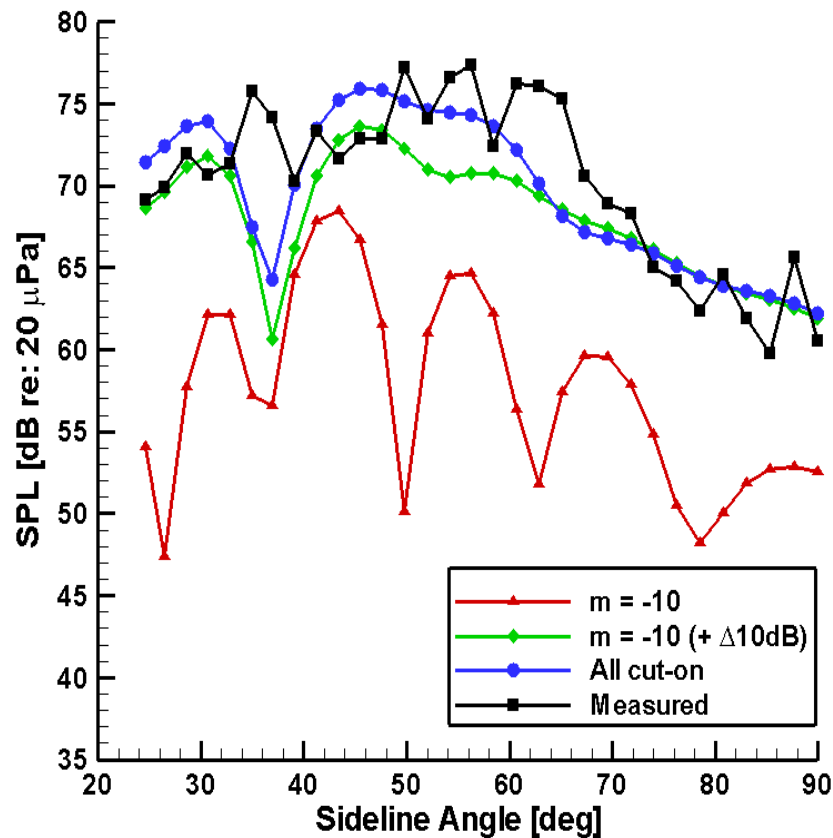
(Coleman and Steele, 'Experimentation and Uncertainty Analysis for Engineers')



Measured Source Information

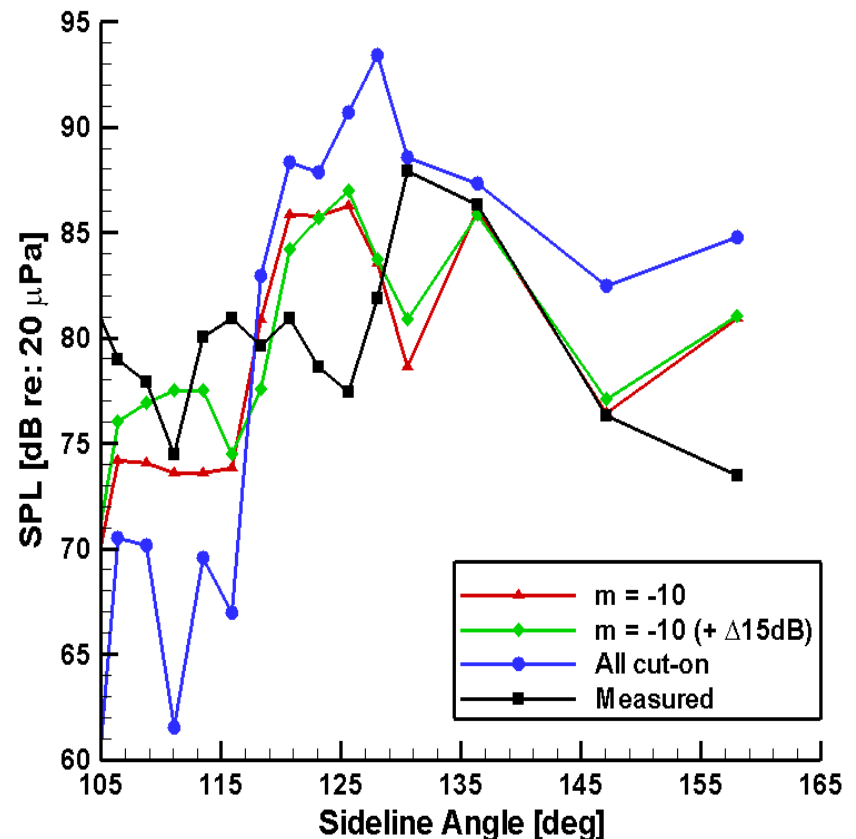
Rotating Rake Source Information (SDT: 2BPF)

Inlet



(Measurements courtesy: D. Sutliff, E. Envia)

Exhaust

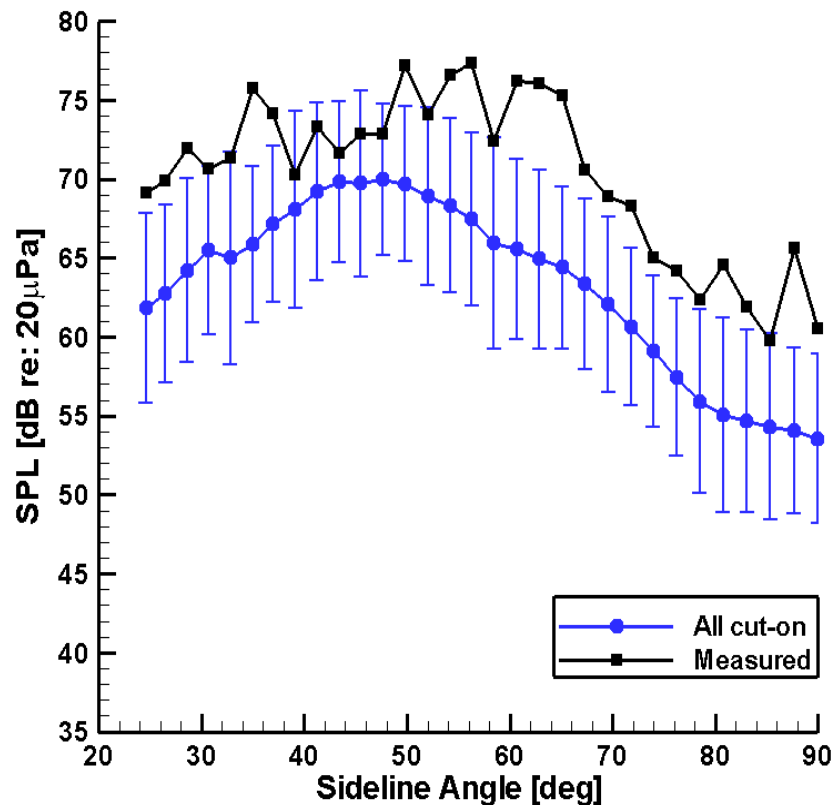




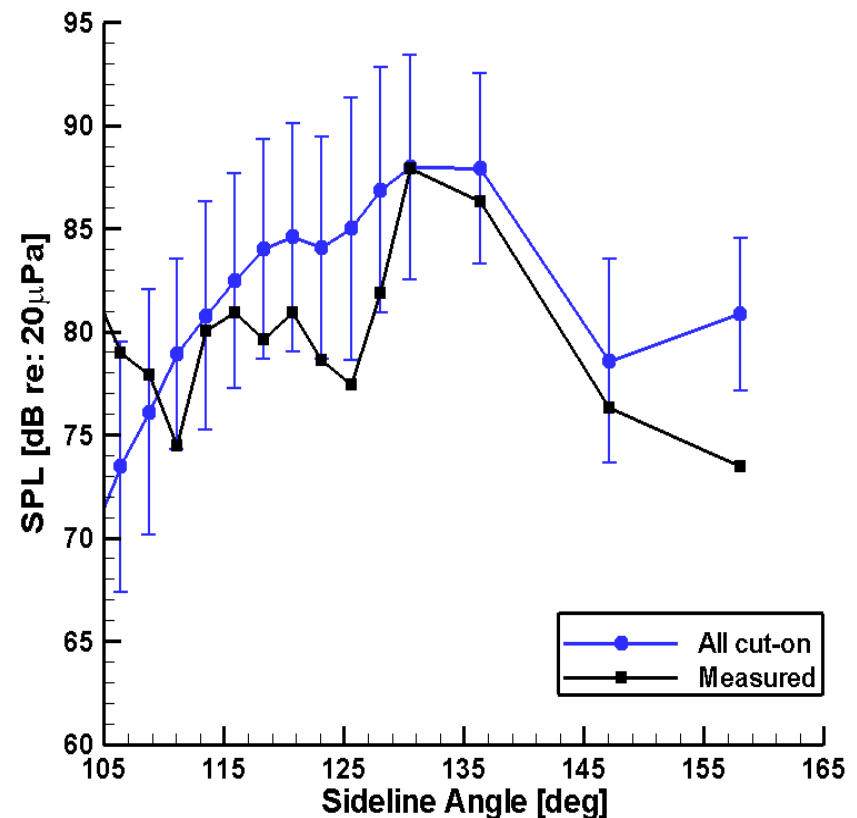
Source Phase Randomization

Random phase variation (100 Simulations) (SDT: 2BPF)

Inlet



Exhaust

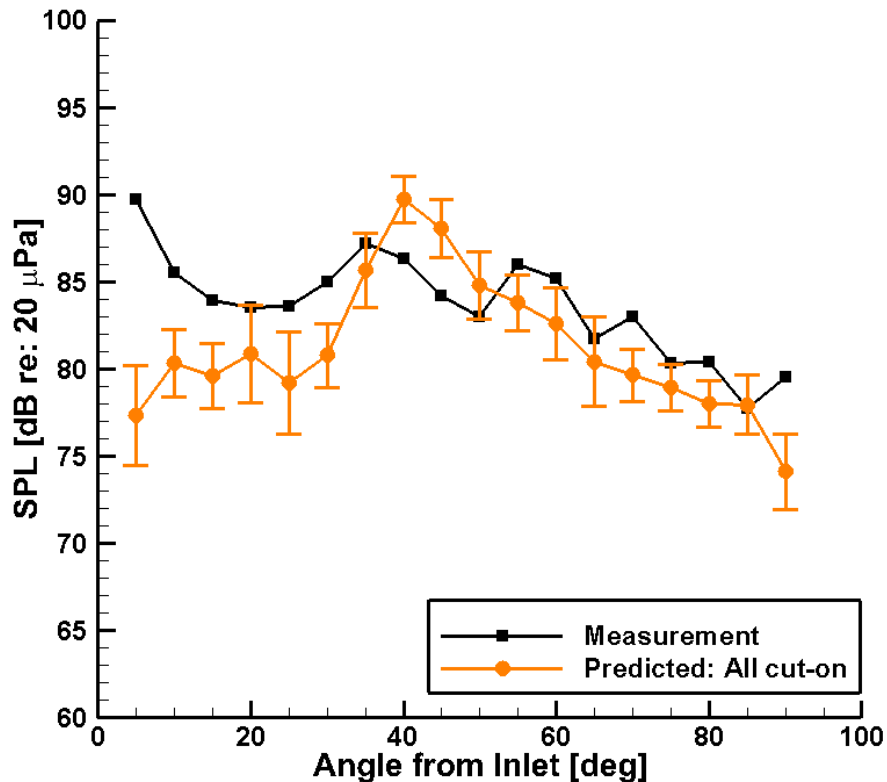




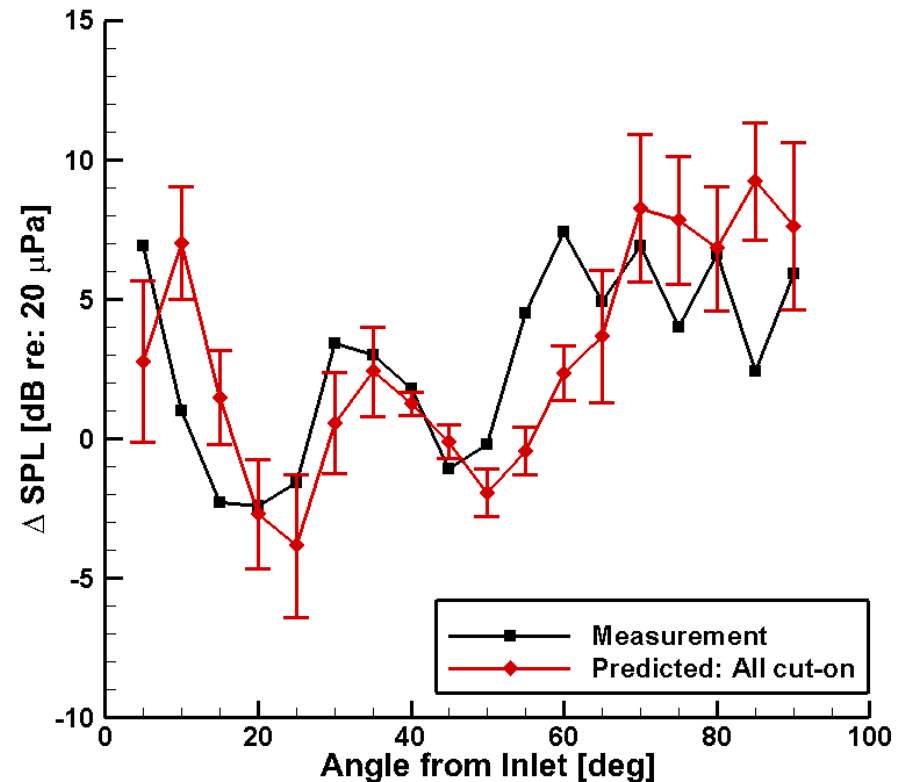
Source Amplitude/Phase Randomization

Random amplitude and phase variation (32 Simulations) (EVNERT: BPF)

Hardwall

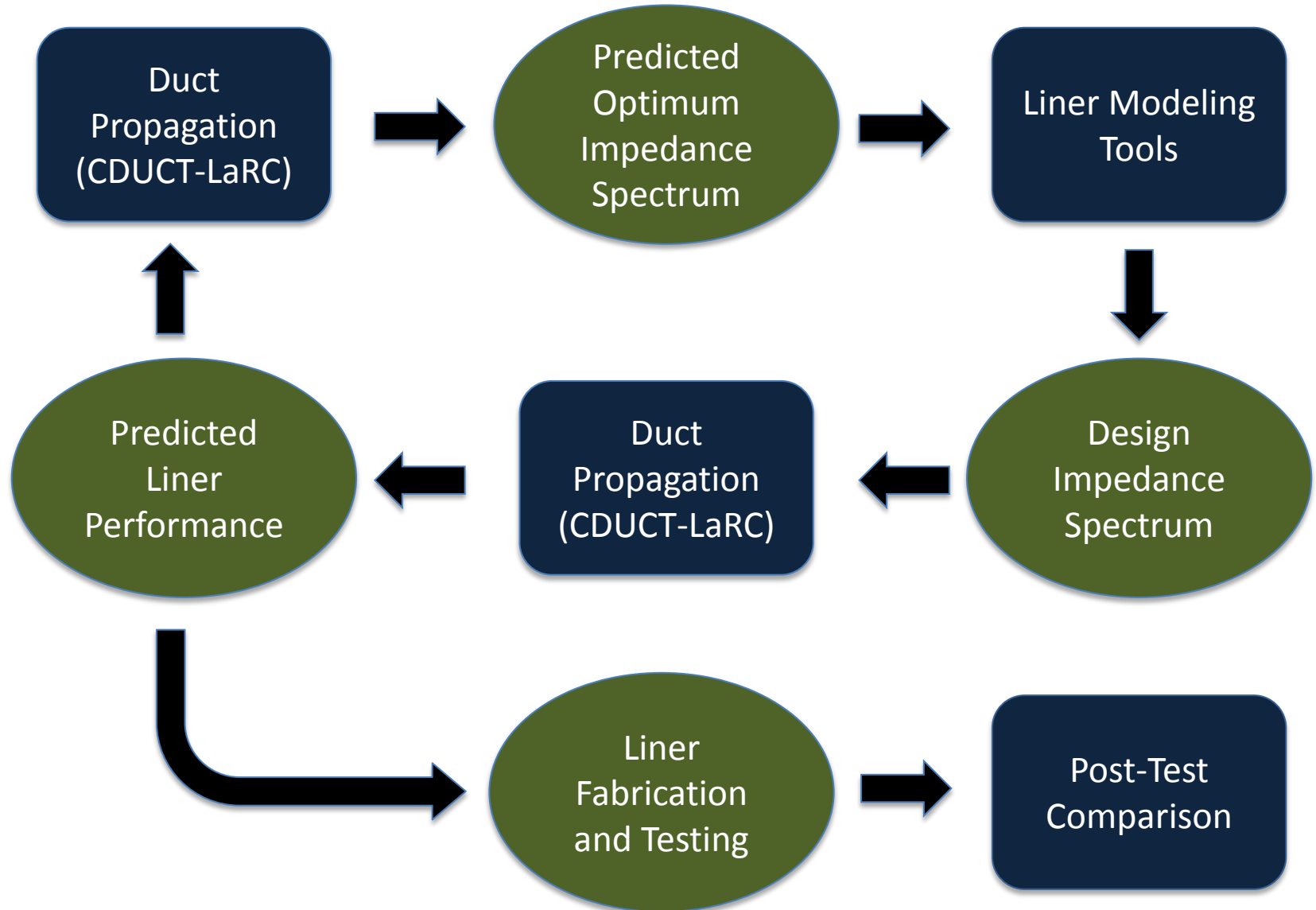


Hardwall - Seamless





Acoustic Liner Design/Evaluation

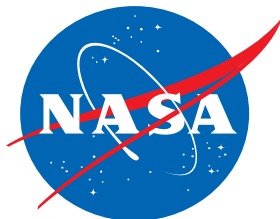




Concluding Remarks

- Further investigate the applicability of random source amplitude and phase variation
- Set groundwork for future comparison with other duct propagation codes
- Involvement throughout design and testing

Excellent opportunity to perform an integrated study of duct acoustic propagation/radiation and liner modeling tools for a realistic configuration

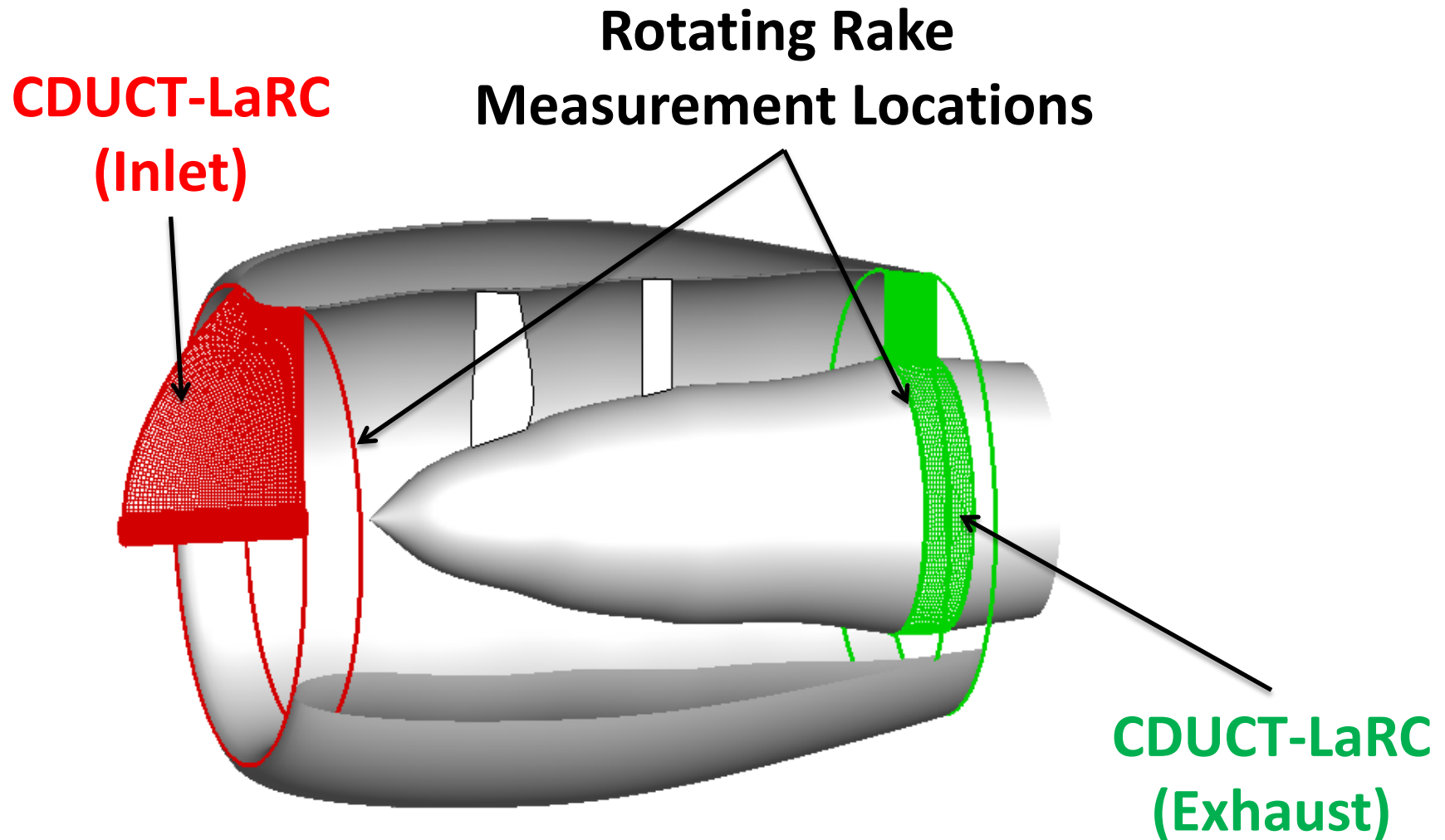




Backup Slides



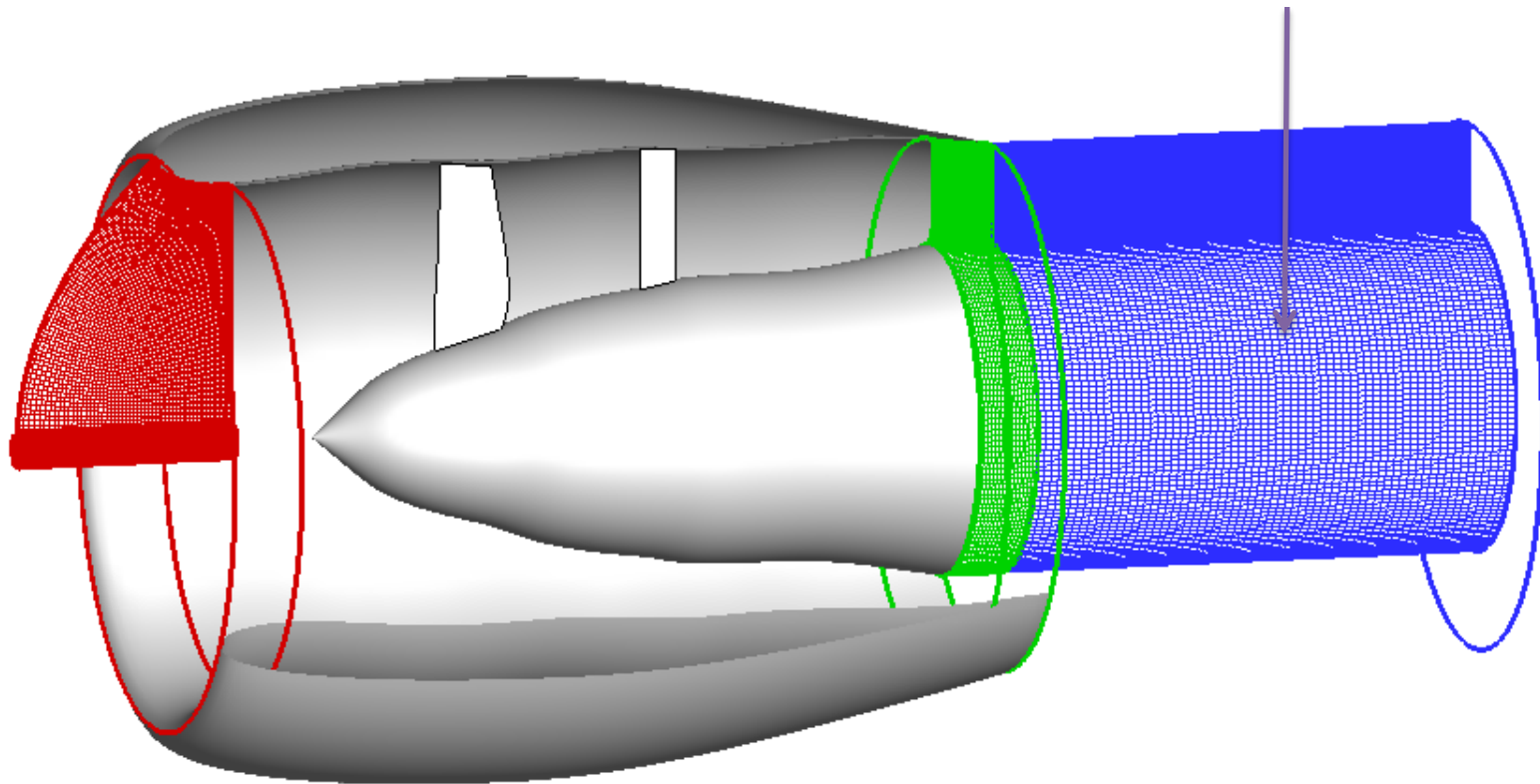
Computational Approach





Computational Approach

**CDUCT-LaRC
(Shear Layer)**





Computational Approach

**CDOCT-LaRC
(FW-H Surface)**

