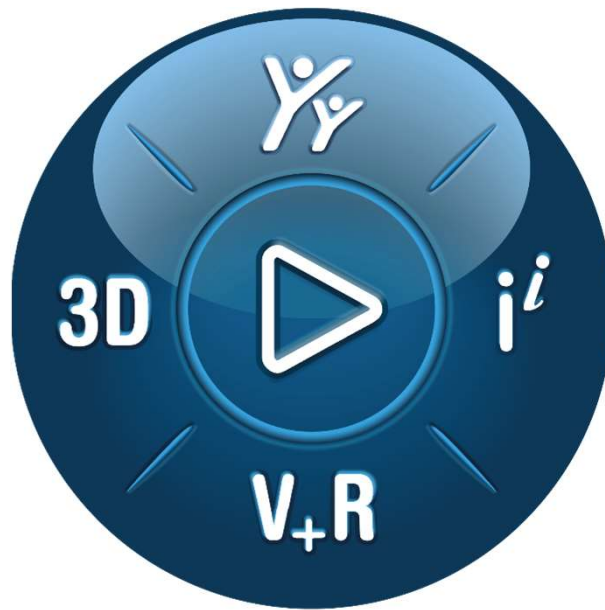


Aeroacoustic Computations of a Generic Low Boom Concept in Landing Configuration: Part 2 - Airframe Noise Simulations

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Ryan Ferris, Dassault Systèmes

Mehdi R Khorrami, NASA Langley Research Center



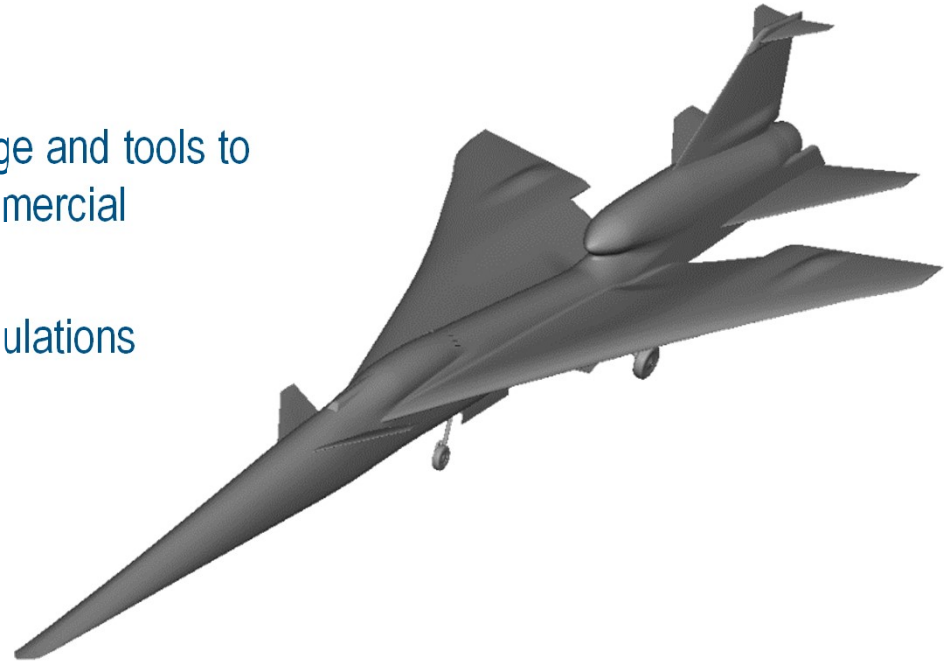
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Introduction

- ▶ Generic Low Boom Concept (GLBC)
 - ▷ Part of NASA effort to produce knowledge and tools to predict noise generated by modern commercial supersonic aircraft
 - ▷ This work focuses on aeroacoustics simulations
 - ▶ Validate FW-H process
 - ▶ Demonstrate grid convergence behavior
 - ▶ Check noise directivity
 - ▶ Verify Mach scaling laws



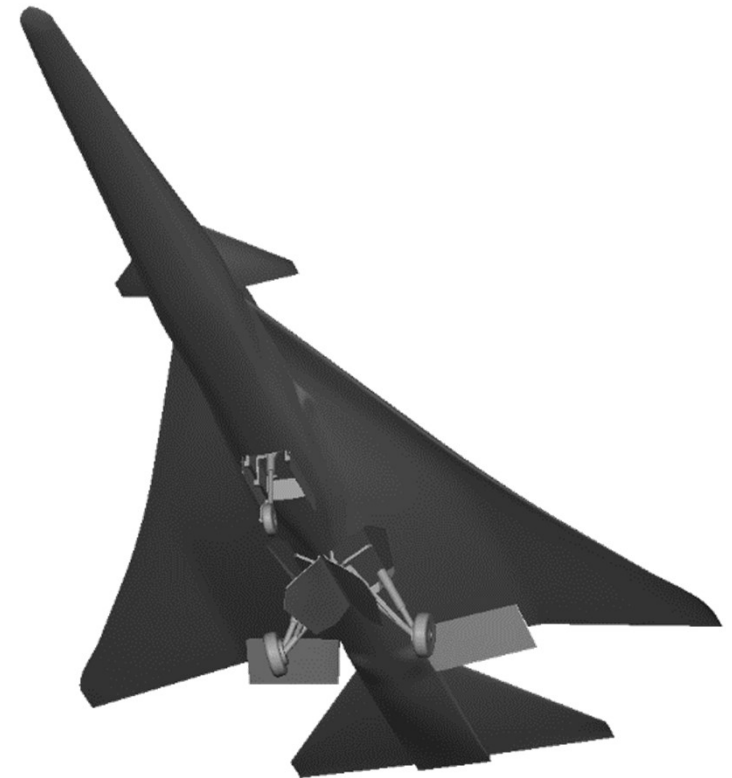
Test Cases

► Configurations studied

- ▷ 15% scale model in free air
- ▷ 9° angle of attack
- ▷ Mach=0.2, Reynolds number = 4.4×10^6

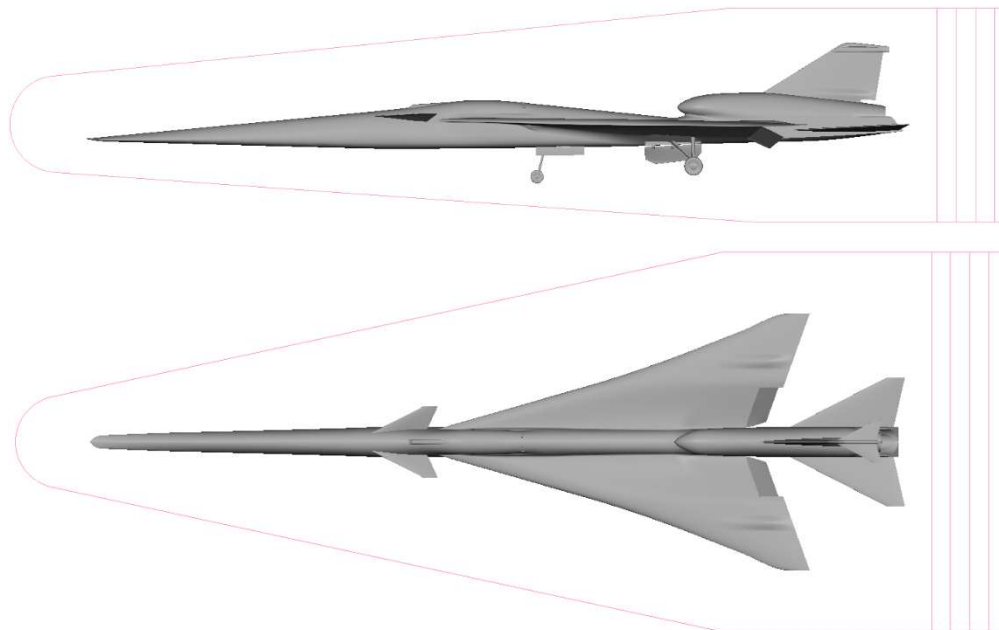
	Flap Angle	Landing Gear
Flap0-LGoff	0°	Stowed
Flap30-LGoff	30°	Stowed
Flap0-LGon	0°	Deployed
Flap30-LGon	30°	Deployed

Resolution	Smallest cell size (mm)	Number of cells
Coarse	0.13	1.5×10^9
Medium	0.09	5×10^9
Fine	0.06	17×10^9

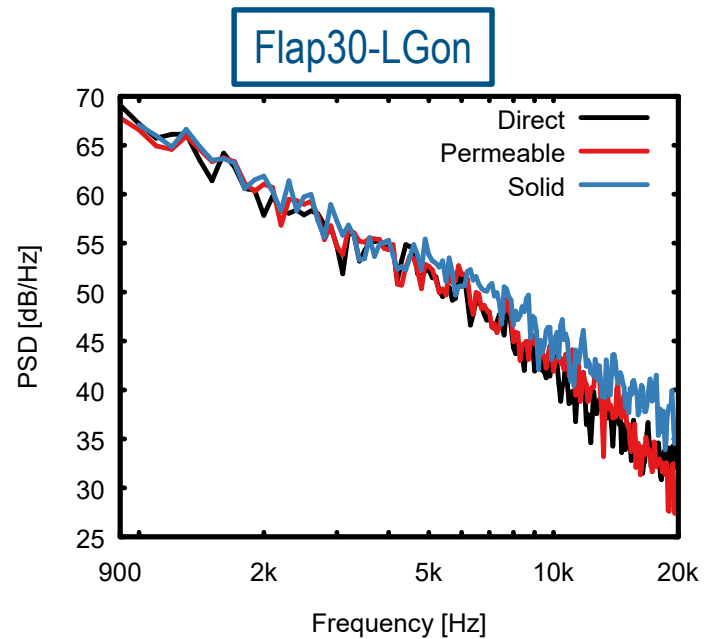
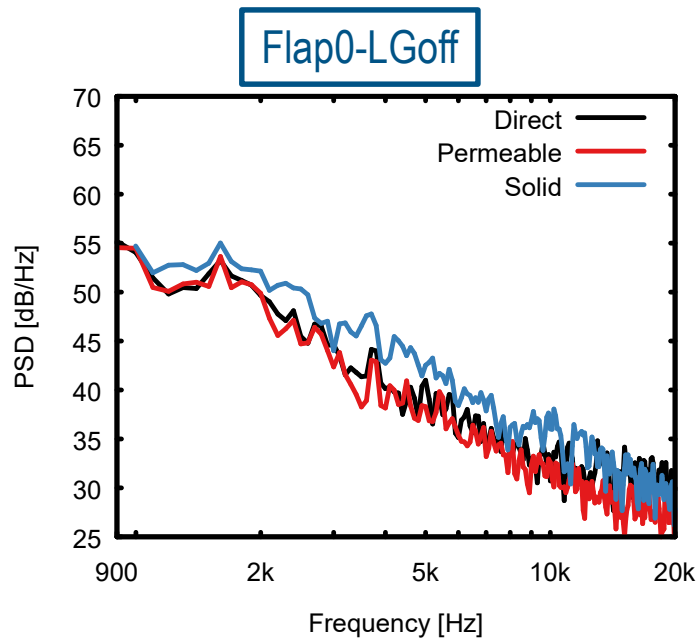


FW-H Study – Introduction

- ▶ Permeable surfaces are difficult to set up, but are more accurate
 - ▷ Comparison of permeable and solid FW-H surfaces
 - ▷ No end caps used here

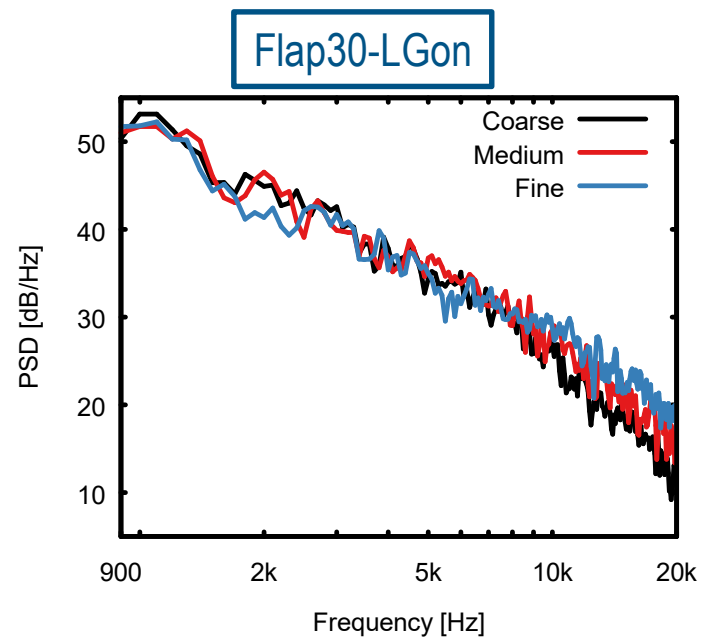
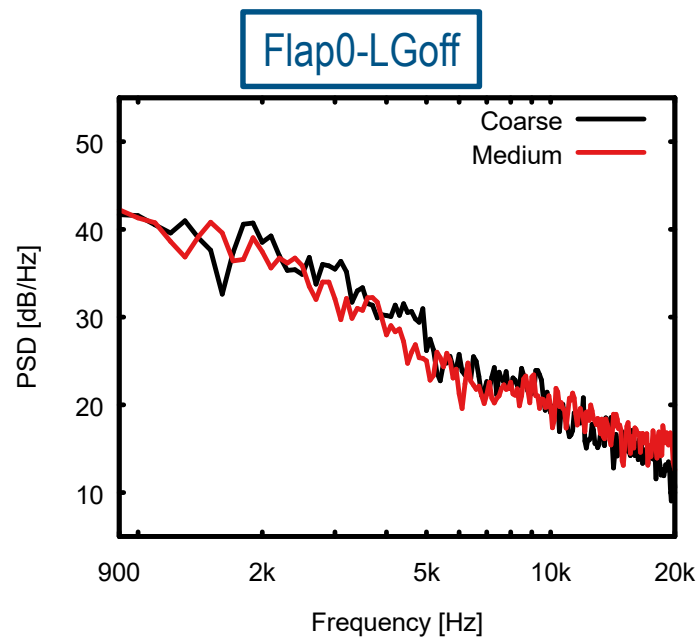


FW-H Study – Results

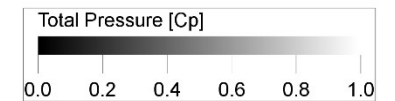
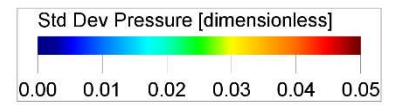
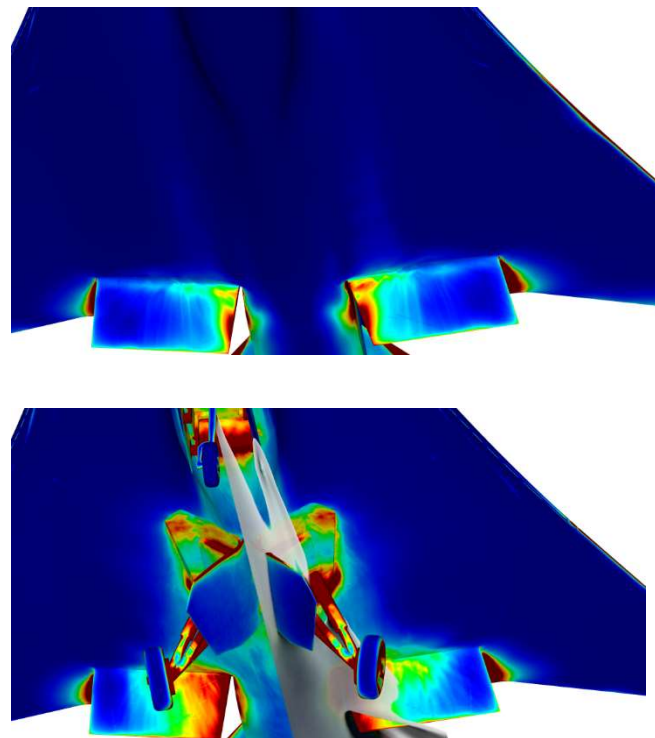
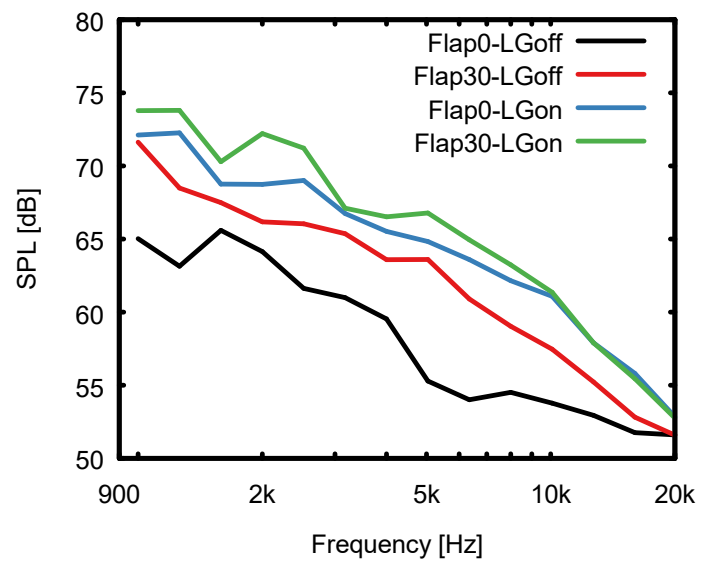


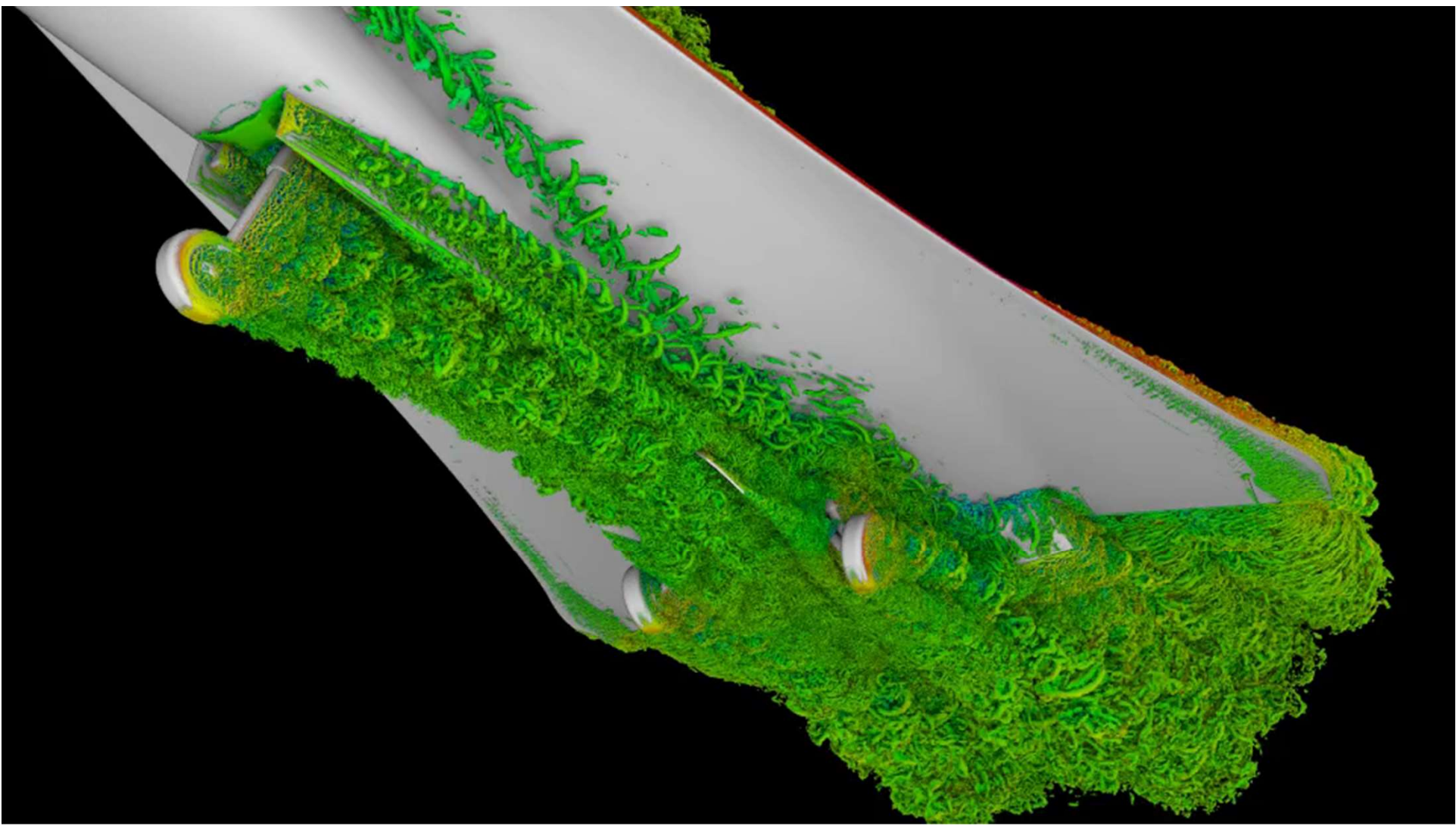
Resolution Study

- Fairly converged results up to ~10kHz

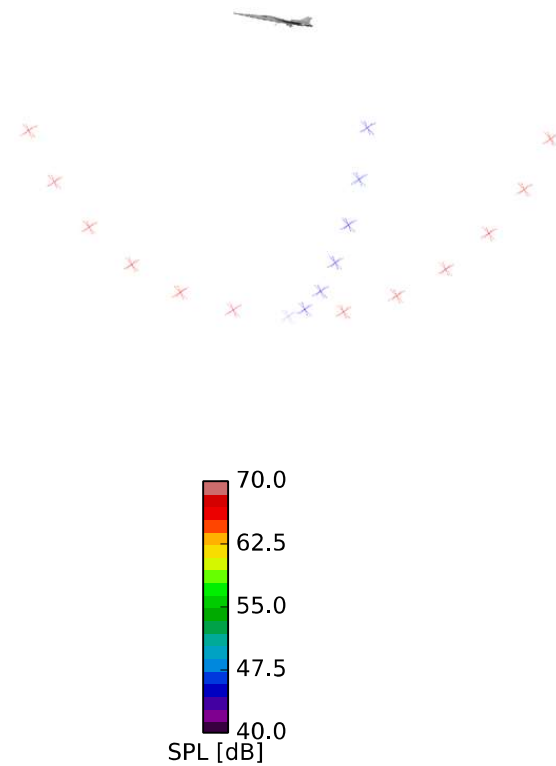
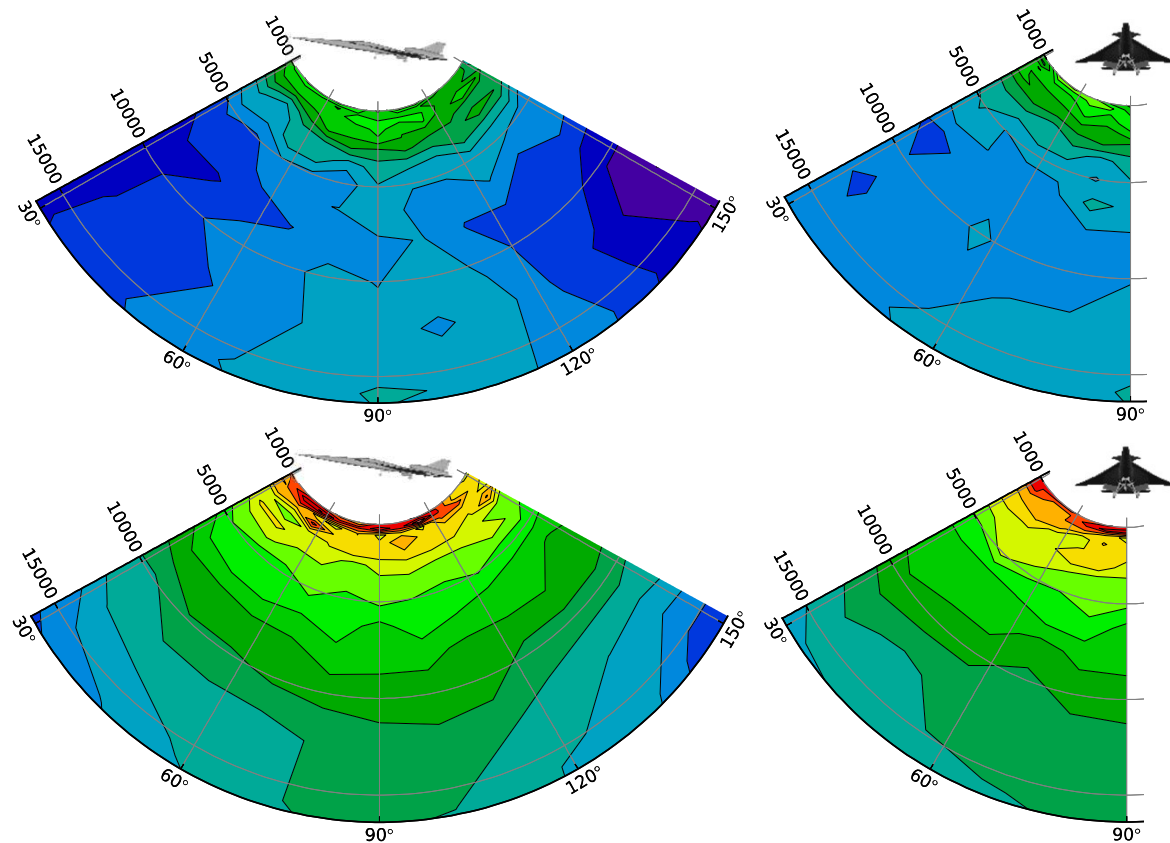


Configuration Study



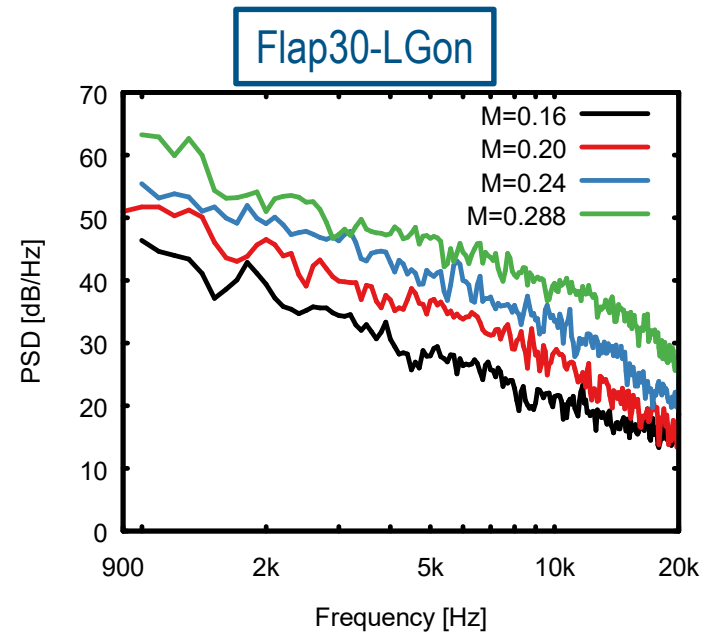
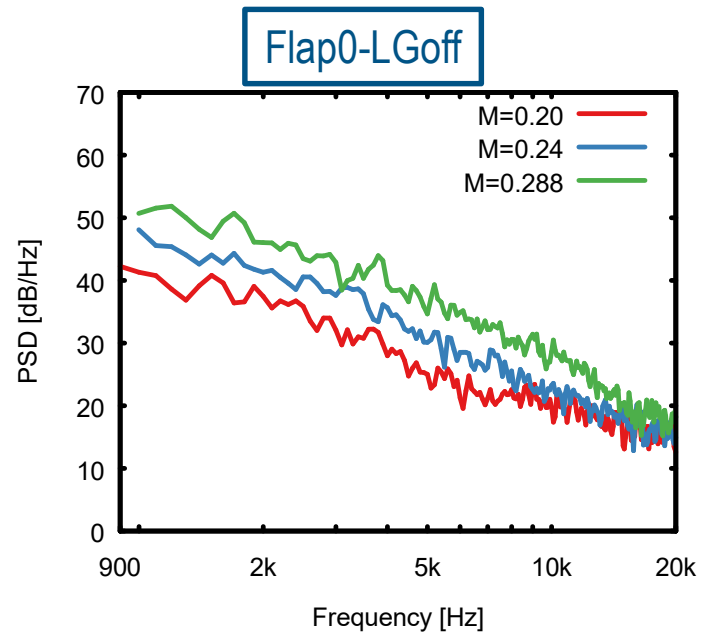


Directivity Study



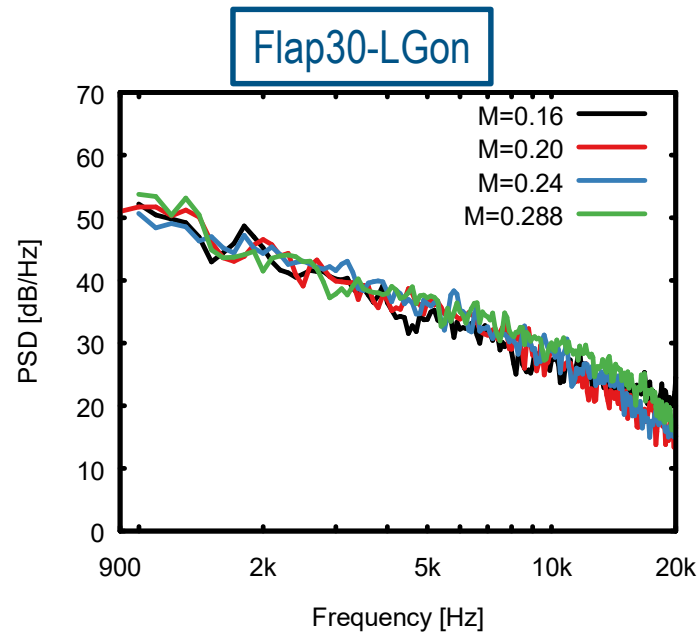
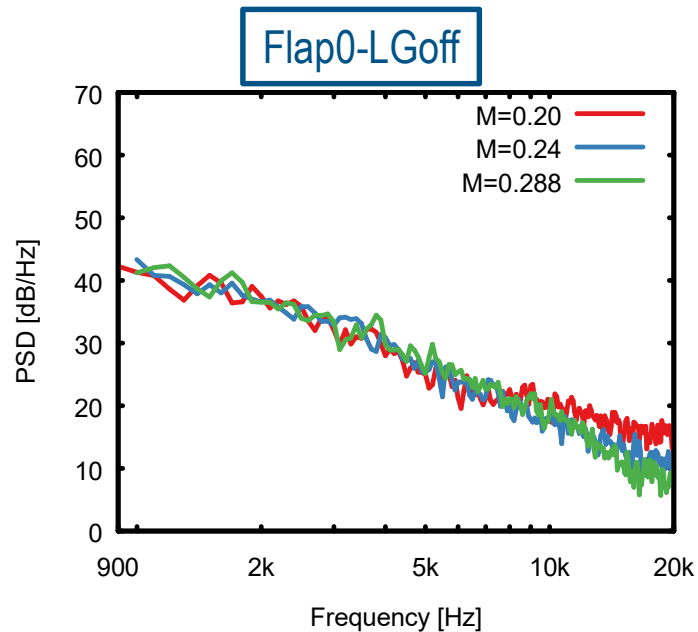
Mach Study

► No corrections applied



Mach Study

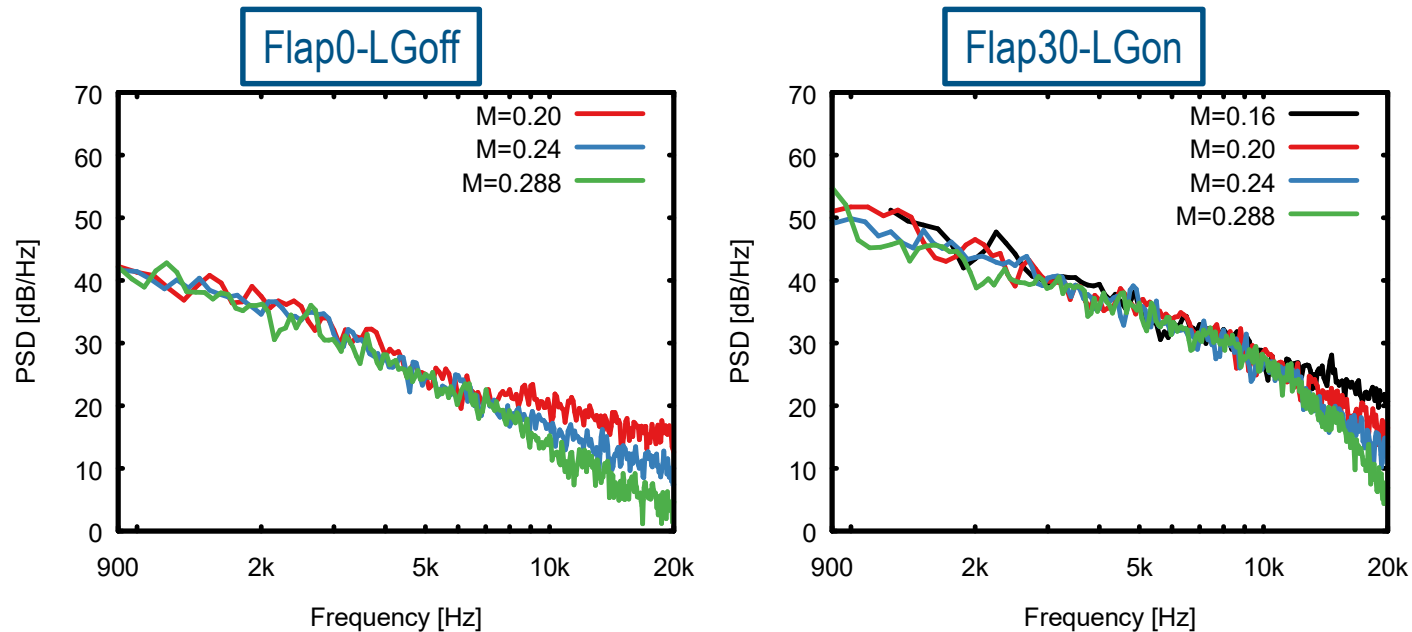
- Mach number corrections assuming M^6 scaling



$$PSD_M = PSD_0 + 6 \times 10 \log \left(\frac{M_{ref}}{M} \right)$$

Mach Study

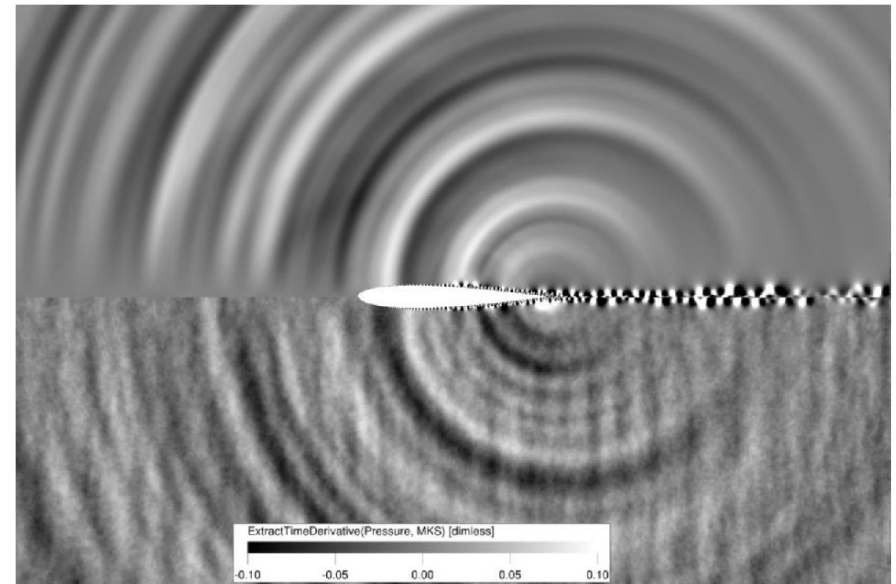
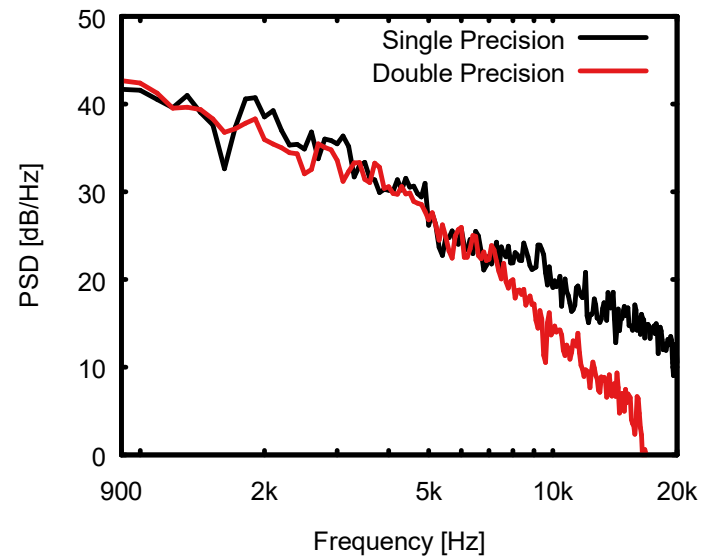
- Mach number corrections assuming M^6 scaling and Strouhal scaling



$$f_{St} = f_0 \frac{M_{ref}}{M} \quad PSD_{Mst} = PSD_M - 10 \log \left(\frac{M_{ref}}{M} \right)$$

Noise Floor Analysis

► Coarse grid, Flap0-LGoff



Ribeiro et al.
*Direct Numerical Simulation of an Airfoil with
Sand Grain Roughness on the Leading Edge*
NASA TM-2016-219363.

Conclusions

- ▶ Permeable FW-H formulation
- ▶ Grid convergence
- ▶ Landing gear and flap interactions
- ▶ Mach scaling
- ▶ Noise floor
- ▶ Future work

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