CARE
Cavity Acoustics and Rossiter Modes

15.10.2020 – Stockholm

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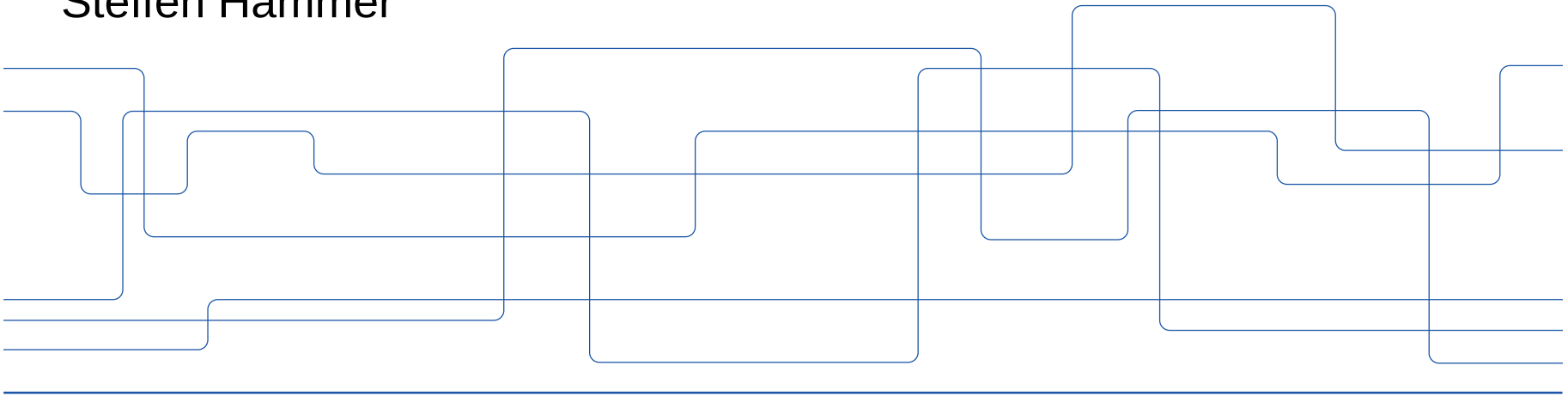
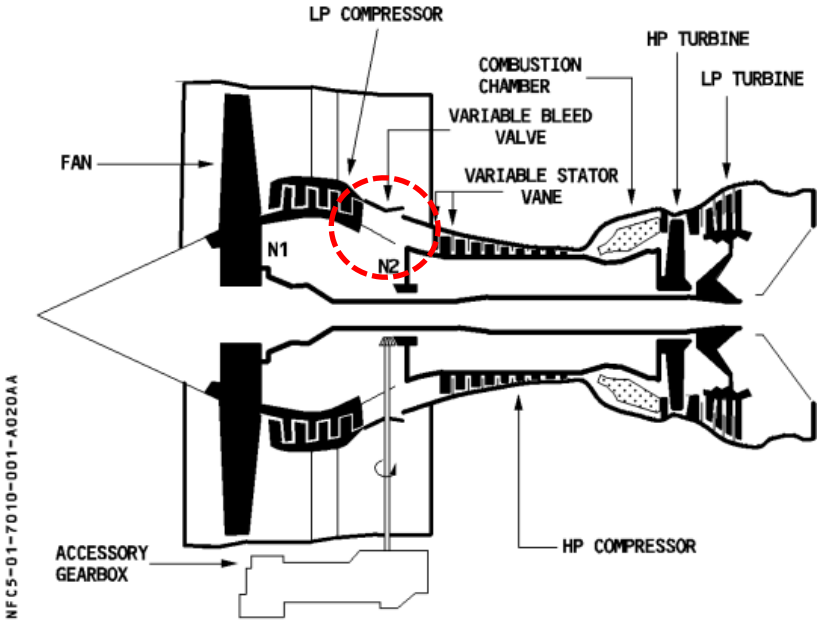


Overview

- Aero-engine bleed
- Aim - Why are we looking into this topic?
- Methodology
- Experimental setup
- Current results
- Outcome

Aero-engine bleed

- Usage of bleed air:
  - pressure for the cabin
  - Cooling of engine parts
  - De-icing of critical parts

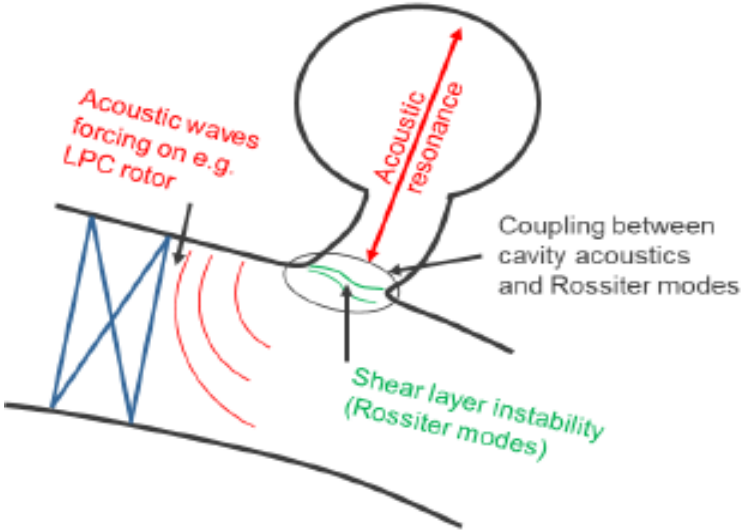


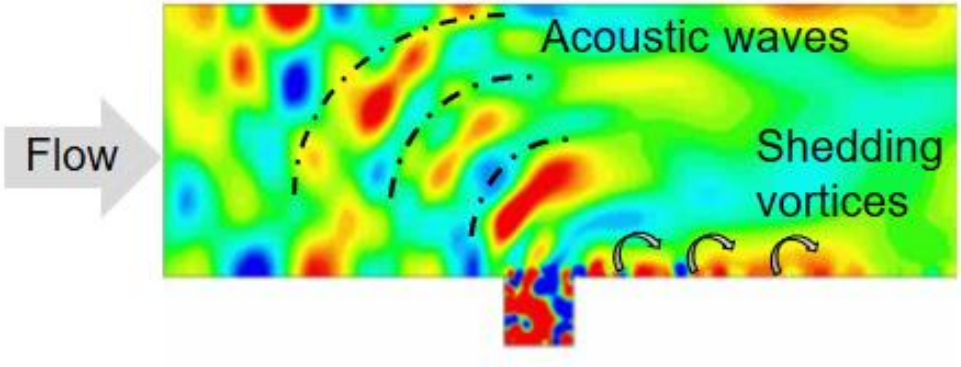
Schematic CFM56-5B

Ref.: Airbus Training - A320 Simulator Flight Crew Operating Manual

Aim

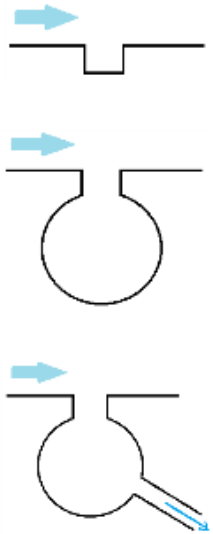
- Experimentally quantify the coupled resonance due to interaction between vortex oscillations from the shear layer flow and the cavity acoustics
- Validation data for analysis methods at industry





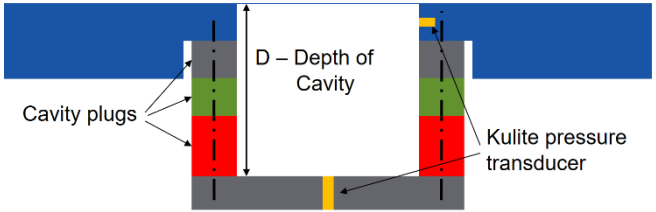
Methodology

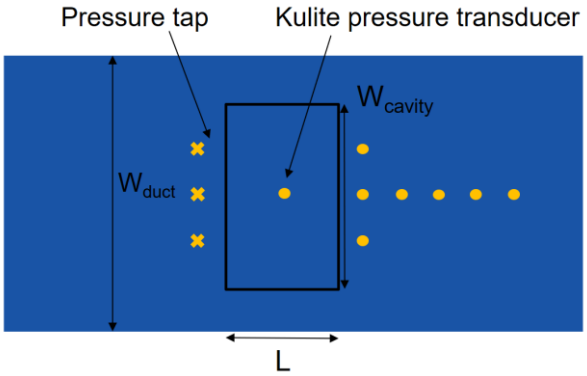
- Configuration 1
  - Identify Rossiter modes, open box
- Configuration 2
  - Identify resonance interactions, acoustic cavity
- Configuration 3
  - Test mitigation concepts, acoustic cavity

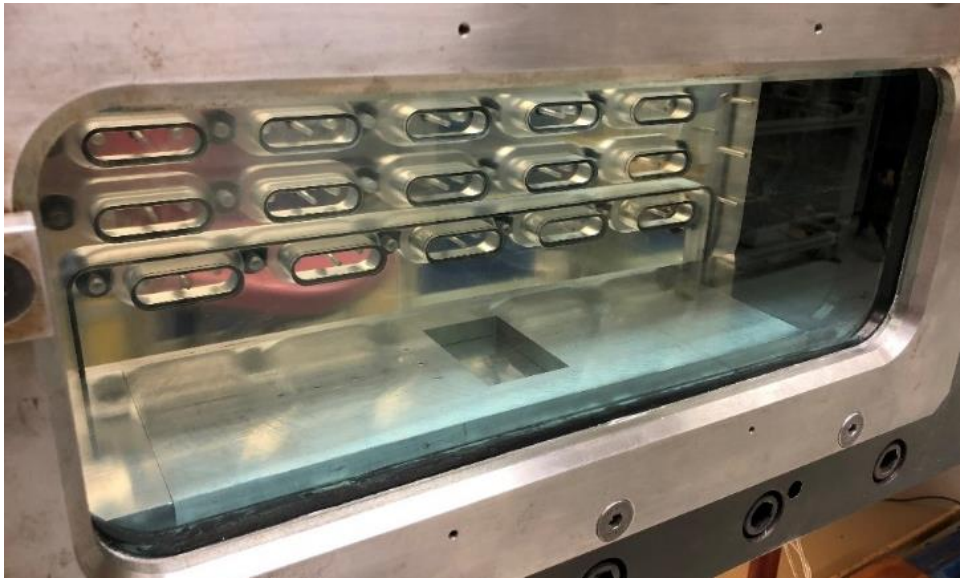


Experimental setup

- different length to depth ratios (L/D)





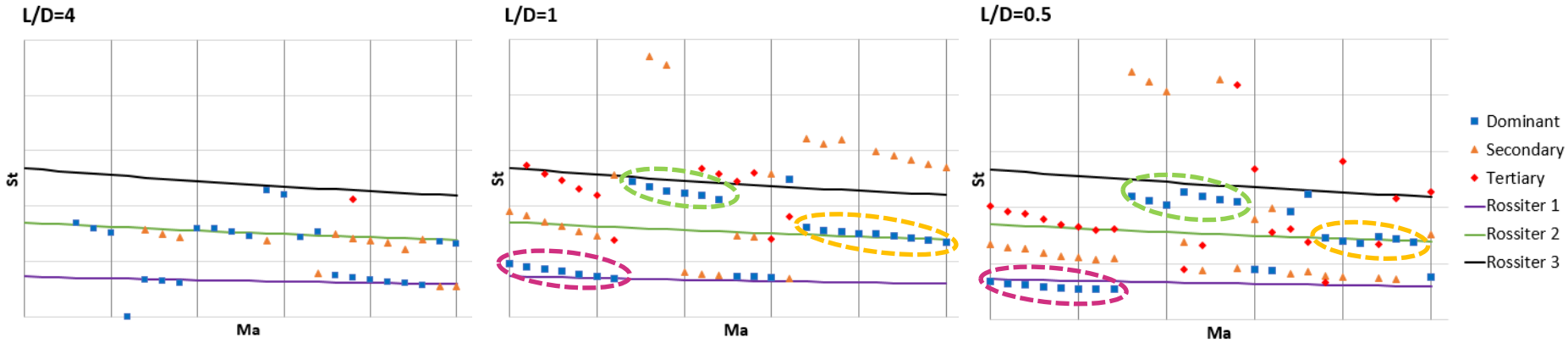


Current results

- All cavities show mode shifts
  - Cavities L/D=1, 0.5 show more similar shifting patterns than L/D=4
- Secondary and tertiary mode are more visible in deeper cavities
- Literature on mode shifting
  - Kunihiko, T., ”Biglobal instabilities of compressible open-cavity *flows*”, Journal of Fluid Mechanics 2017
  - Kegerise, M., *“*Mode-switching and nonlinear effects in compressible flow over a cavity”, Physics of Fluids 2004

$$f = \frac{U}{L}\frac{(m-\gamma)}{\left(\frac{1}{K}+M\right)}$$

$$\mathrm{St} = \frac{fL}{U}$$



Current results

- 3 cavity depths tested with at least 4 runs per cavity
  - Proven repeatability
- Results comparable to previously published papers
  - Rossiter modes
  - Mode shifting

- Abstract submitted to ASME TurboExpo 2021

Next steps and project outcome

Next steps

- 2 more configurations with increased geometric complexity
- Numerical studies

Project outcome

→ Clear understanding of acoustic behaviour in regards to geometry

→ Experimental database as validation data for numerical methods

Thank you!