EuroHPC Summit Week 2022
#PRACEdays

Fan/OGV broadband noise predictions using LES

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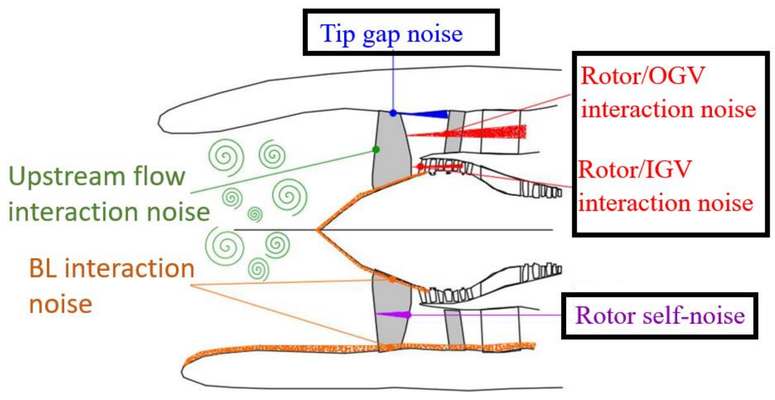
1. Introduction

- The fan stage of an aero-engine is a major contributor to the overall engine noise.
- At approach conditions, the broadband noise becomes a major contributor to the fan noise.

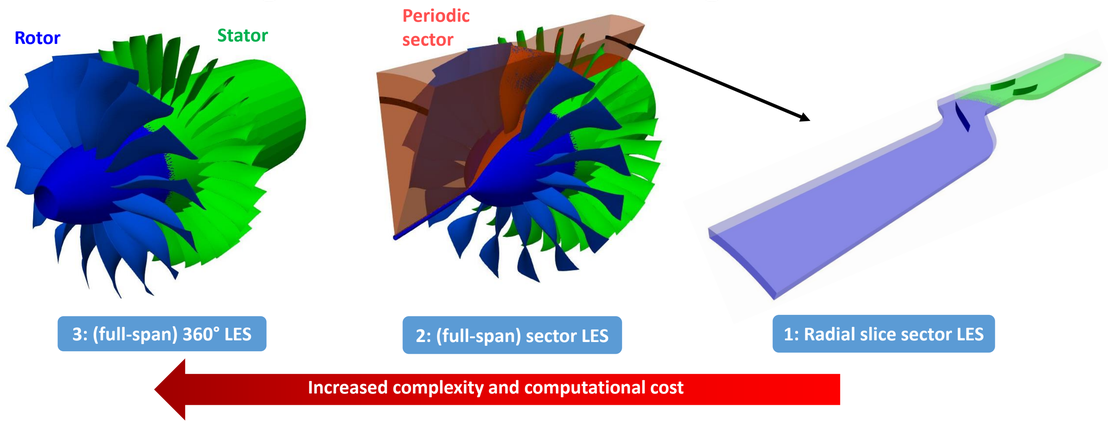


Objective

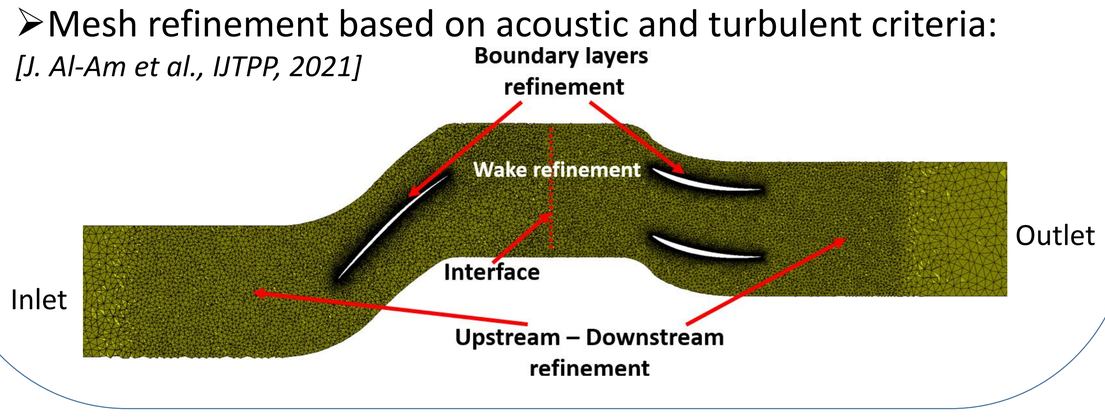
- Direct prediction of fan broadband noise using Large Eddy Simulations (LES).

2. LES setup

- Several configurations of the ECL fan stage at 55%Nn:

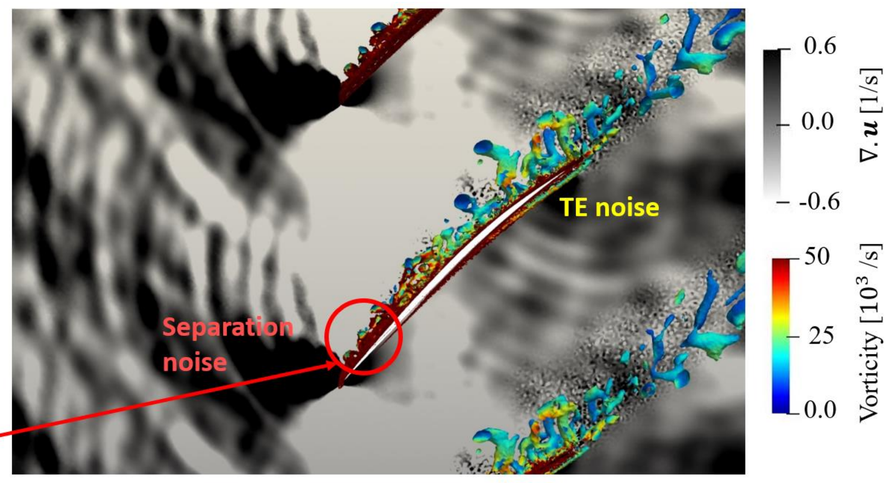


- Solver **AVBP**, numerical scheme: TTGC (3rd order).
- Mesh refinement based on acoustic and turbulent criteria:
[J. Al-Am et al., IJTPP, 2021]



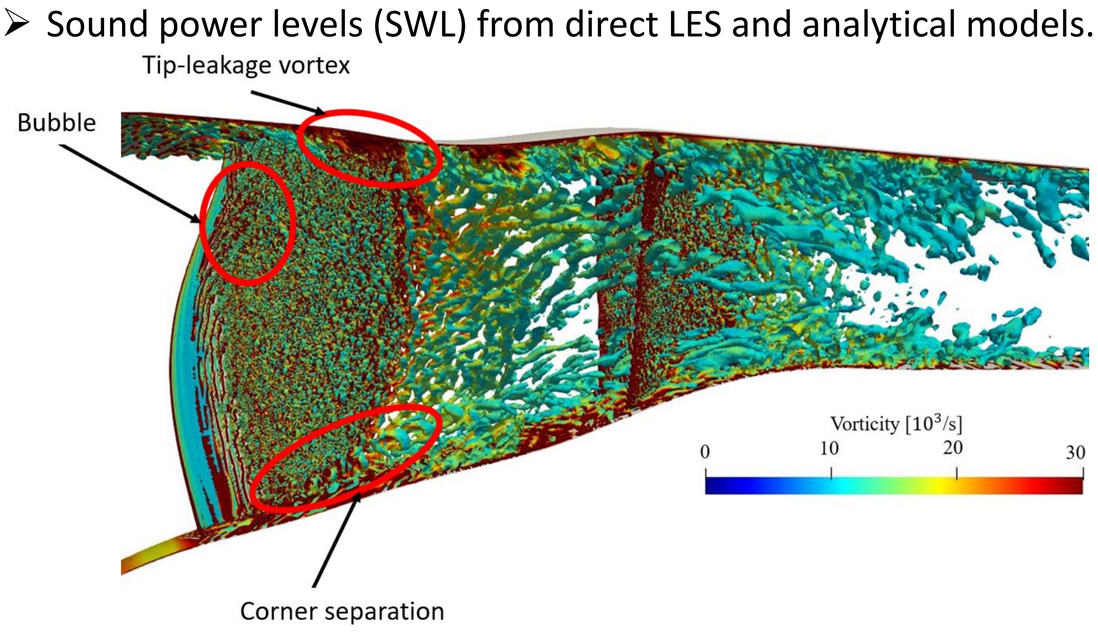
3. ECL5 - radial slice sector LES

- Two main noise sources: separation noise and trailing edge noise.
- High frequency tones related to fluctuations in the bubble region.

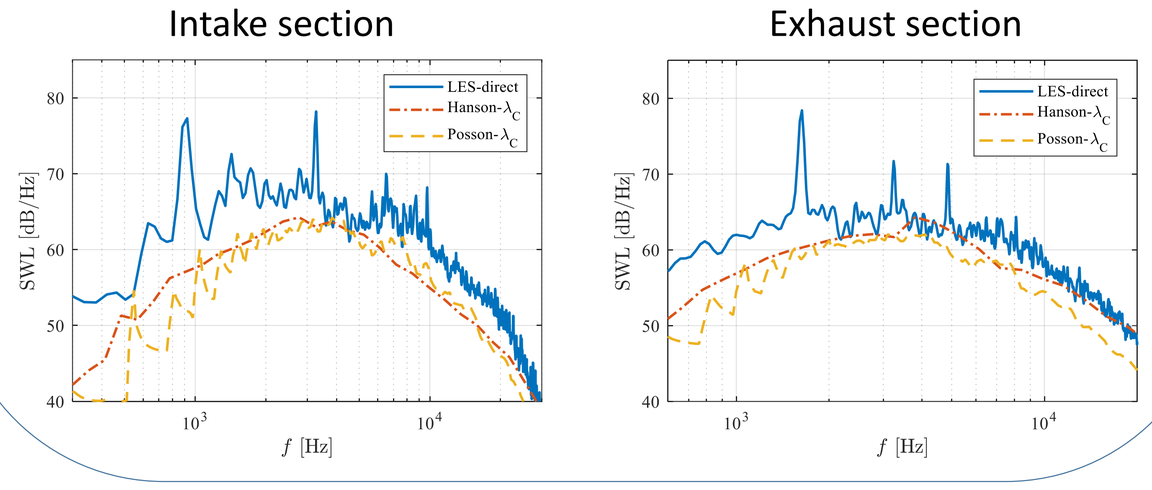


4. ECL5 – (full span) sector LES

- Turbulent structures and noise mechanisms.
- Sound power levels (SWL) from direct LES and analytical models.



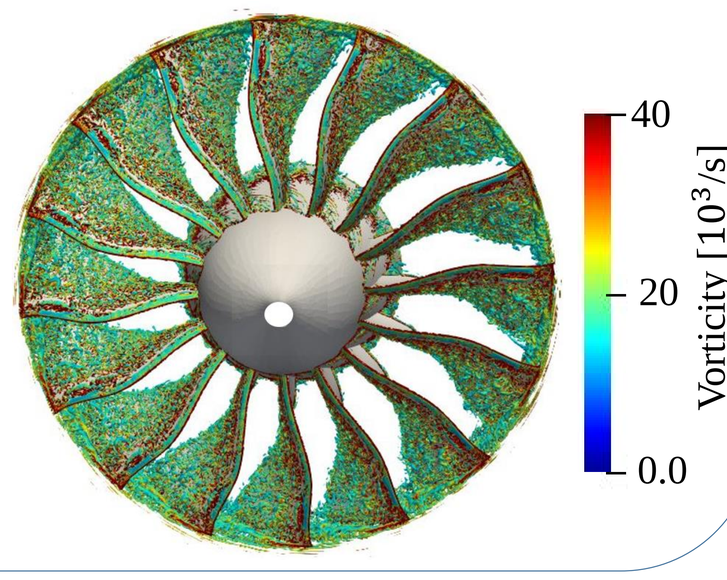
Turbulence interaction noise



5. ECL5 – (full span) 360° LES

- A full 360° configuration allows us to:
  - Predict all the cut-on propagating modes.
  - Describe properly the correlation of the blade-to-blade unsteady loads.

Nb. cells	1.5×10^9
Procs	15360
CPUh (PRACE)	30×10^6



6. Conclusions and perspectives

- ✓ Fan stage noise predictions using LES and analytical models.
- ✓ Analysis of the different noise mechanisms.
- Convergence of the (full span) 360° LES.
- Comparison between the different LES configurations.

7. Acknowledgements

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