AD/AG-54: RaLESin – RANS-LES Interfacing for Hybrid RANS-LES and Embedded LES Approaches

AG 54: Hybrid RANS-LES Methods

Duration: 2014 – 2018/2019

Members: Airbus-F, CIRA, DLR, EADS-IW (withdraw), **FOI**, INTA, NLR, ONERA, Saab, TU-Munich, Uni-Man, ZUAS

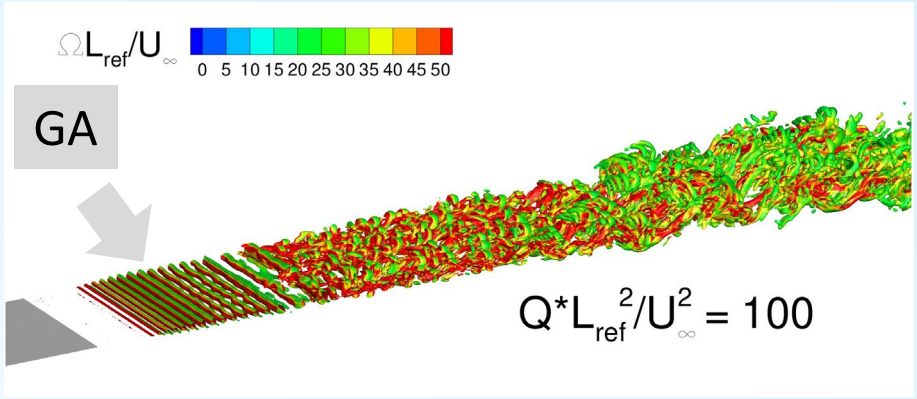
- 8 Countries
- 3 Universities, 6 Research Organizations, 2 Industries

AG chairman: Shia-Hui Peng (FOI)

AG vice-chair: Sebastien Deck (ONERA)

AG 54: Main Objectives

- To improve hybrid RANS-LES modelling in terms of the mitigation of “grey-area” problem stemmed from RANS-LES interaction



- To develop new RANS-LES coupling approaches for non-zonal, zonal and embedded LES methods
- To assess the methods developed in terms of the predictive capabilities
- To improve CFD methods and tools for unsteady aerodynamic applications, and serving robust analysis of aircraft aerodynamic performance, loads and noise, as well as their control.

AG 54: Overview of the Project

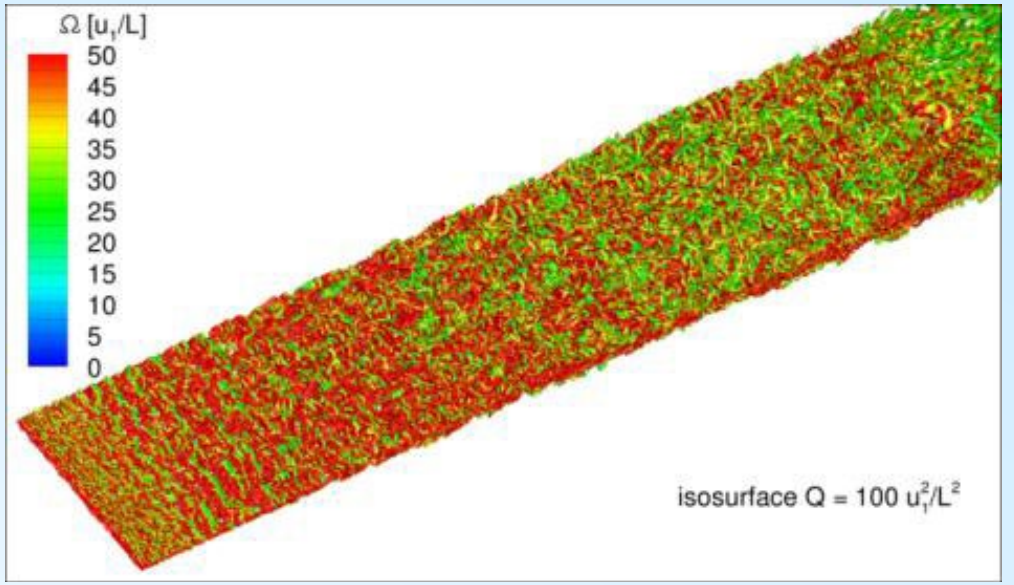
- Technical tasks
  1. RANS-LES coupling for non-zonal modelling approaches
  2. RANS-LES coupling for zonal and embedded LES approaches
  3. Verification and assessment of methods

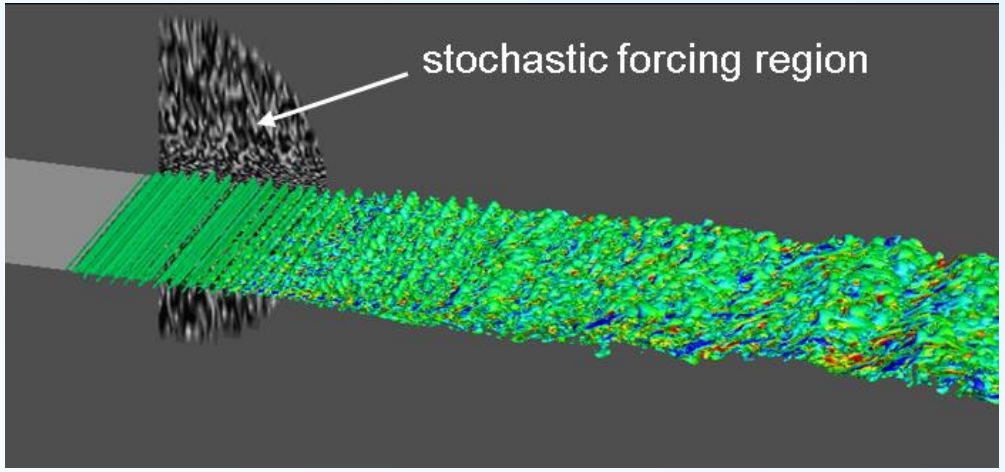
- In each task, one mandatory fundamental test case is defined for modelling validation
- In Task 3, the test case is more challenging and complicated than the fundamental test cases with combined flow features
- All the test cases have available experimental/DNS data for comparison

TC M1	TC M2	TC M3	TC O1	TC O2
Shear layer	Spatially developing B.L.	Wake/B.L. co-flow	Backward step flow	NASA hump flow

AG 54: Modelling Improvements for GAM

- Non-zonal methods
  - Stochastic backscatter+high-pass filter (HPF) SGS model;
  - Vorticity-based LES length scale
  - Leonard energy-backscatter LES mode
  - Commutation terms adopted in RANS-LES interface
- Zonal methods
  - Improved synthetic turbulence (divergence free)





AG 54: CONCLUSIONS

- Collaborative effort for exploring and improving hybrid RANS-LES methods
- Focus on “grey-area” issue for both non-zonal and zonal methods
- GAM methods developed and assessed on selected test cases
  - Typical and significant flow phenomena in aeronautical applications
  - DNS and experimental data available
- Low-dispersion, low-dissipation numerical schemes

- Significant Mitigation of “grey-area”
- Significant improvement of in-house developed CFD solvers

- Efforts required for
  - 3D, time-dependent RANS flow at LES interface
- New EG/AG for Embedded and WMLES and (EG78 → AG61)