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PREDICTION OF VARIABLE-DENSITY TURBULENT FLOWS WITH SRS AND RANS METHODS

600

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ABSTRACT

Variable-density flows are of importance to various areas of engineering interest - *e.g.* inertial confinement fusion, astrophysical flows, oceanography, cooling systems, chemical engineering, and medicine. Such class of flow problems is characterized by its transient physics which entails buoyancy effects, hydro-dynamical instabilities and coherent structures, regions of low and high intensity turbulent flow, and evidently transition to turbulence. This set of complex phenomena turns the modelling and simulation of variable-density flows difficult. Whereas Direct Numerical Simulation (DNS) and Large-Eddy Simulation (LES) models are usually excessively demanding for practical applications, traditional Reynolds-Averaged Navier-Stokes (RANS) equations are often not able to predict the dynamics of such flows. Hybrid and bridging methods [1-3], on the other hand, have the potential to surpass many of the limitations of DNS, LES and RANS. By only resolving the flow phenomena that are not amenable to be modelled [4], these Scale-Resolving Simulation (SRS) models can achieve a good compromise between accuracy and computing cost. Yet, the development of such formulations for variable-density flow is rife with challenges.

The present mini-symposium aims to investigate the ability of SRS and RANS strategies to predict variable-density flows of canonical and practical interest. This is expected to contribute to the further development and establishment of such modelling strategies in engineering. Considering this objective, the participants are invited to estimate numerical and modelling errors with available verification and validation strategies. Submissions addressing the relevance of initial and boundary conditions to the computation's quality are also of interest.

[1] P. Sagaut, S. Deck, and M. Terracol. Multiscale and Multiresolution Approaches in Turbulence. Imperial College Press, London, United Kingdom, first edition, (2006);
[2] P.R. Spalart. Strategies for Turbulence Modelling and Simulations. *International Journal of Heat and Fluid Flow*, **21**(3), pp.252-263, (2000).
[3] J. Fröhlich and D. von Terzi. Hybrid LES/RANS Methods for the Simulation of Turbulent Flows. *Progress in Aerospace Sciences*, **44**(5), pp.349-377, (2008).
[4] F. S. Pereira, L. Eça, G. Vaz, S. S. Girimaji – Challenges in Scales-Resolving Simulations of Turbulent Wake Flows with Coherent Structures. *Journal of Computational Physics*, Vol. **363**, pp.98-115, (2018).