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ADVANCED MODELS FOR LARGE-EDDY SIMULATION OF WALL-BOUNDED TURBULENT FLOWS

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ABSTRACT

The Navier-Stokes (NS) equations are an excellent mathematical model for turbulent flows. However, direct simulations at high Reynolds numbers are not feasible yet because the non-linear convective term produces far too many scales of motion. Hence, in the foreseeable future, numerical simulations of turbulent flows will have to resort to models of the small scales. In this regard, large-eddy simulation (LES) equations result from filtering the NS equations in space. The effect of the under-resolved scales is then given by the subgrid stress (SGS) tensor that depends on both the filtered and the unfiltered velocity. Then, the famous closure problem in LES basically consists on approximating the SGS tensor with a tensor in terms of the (resolved) filtered velocity. Doing so, the dynamical complexity of the NS equations is significantly reduced resulting into a new set of PDE that are more amenable to be numerically solved on a coarse mesh.

Most of the difficulties in LES are associated with the presence of walls where SGS activity tends to vanish. Hence, apart from many other relevant properties, LES models should properly capture this feature [1,2]. Numerically, this implies an accurate resolution of the near-wall region which results on a high computational cost at high Reynolds numbers. Nowadays, this represents the main limitation of (wall-resolved) LES. Attempts to overcome this inherent problem of LES rely on wall modelling techniques [3,4]. Furthermore, the presence of highly skewed control volumes in the near-wall regions represents an additional challenge for LES. In this context, the objective of this Minisymposium is to bring together people working on advanced, cutting-edge methods for LES of turbulent flows with special emphasis to wall-bounded problems at high Reynolds numbers.

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