Enabling large eddy simulations of realistic turbulent flows

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ABSTRACT

The large eddy simulation (LES) technique for turbulent flows has become a standard tool of academic research but has yet to truly make an impact on the engineering design and analysis process in more applied situations. The talk will identify a range of reasons for this situation, and will describe recent work towards solving two of the main obstacles: the need for robust and accurate wall-models in LES, and the need for a solution-driven approach to grid-adaptation in LES.

The proposed approach to wall-modeling is based on the multi-scale nature of turbulent boundary layers and on the need for showing grid-convergence in numerical simulations. These considerations naturally lead to a number of criteria on wall-modeled LES, and a simple method that satisfies these criteria is presented. This is then shown to lead to excellent accuracy on a number of test cases, including of separated flows [1].

Given the importance of the grid in determining the accuracy of wall-modeled LES (and LES in general), the talk will then discuss recent work on grid-adaptation for LES of wall-bounded flows. A directional error indicator is introduced, which measures the level of kinetic energy at scales near the grid-spacing in a directional manner; this then enables the grid to be adapted to resolve the turbulence in a more balanced way. The method is tested on turbulent channels and the flow over a backward-facing step with very reasonable results [2].

REFERENCES

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[2] S. Toosi, J. Larsson, “Anisotropic grid-adaptation in large eddy simulations”, *Comput. Fluids* 156, (2017).