Hybrid reduced order models for turbulent flows

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ABSTRACT

In this talk we discuss recent advances on reduced order models which are specifically designed to deal with turbulent flows.

The idea of this approach is to obtain a reduced order model which is still based on conservation principles for what concerns momentum and continuity equation and that it is merely data-driven for what concerns turbulence modeling. The objective is also to develop a general methodology which does not depend on the specific set of equations used to approximate the eddy viscosity contribution at the full order level.

The ROMs that we present to address the above requirements are based on the idea of merging/combining projection-based techniques and data-driven approaches. Specifically, we discuss reduced order models starting from full order models with an eddy viscosity turbulence approximation \[1, 2\]. At the reduced order level, momentum and continuity equation are treated using a standard POD-Galerkin approach while the set of PDEs modeling the eddy viscosity evolution are approximated by means of data-driven approximations.

Different techniques to approximate the turbulence model are discussed such as the proper orthogonal decomposition with interpolation approach and artificial neural networks. The methods are demonstrated on different computational fluid dynamics problems of increasing complexity.

REFERENCES
