

Abstract Submitted
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Progress in the Variational Multiscale Formulation of Large Eddy Simulation¹ ZHEN WANG, ASSAD OBERAI, Rensselaer Polytechnic Institute —

In the variational multiscale (VMS) formulation of large eddy simulation subgrid models are introduced in the variational (or weak) formulation of the Navier Stokes equations and a-priori scale separation is accomplished using projection operators to create coarse and fine scales. This separation also leads to two sets of evolution equations: one for the coarse scales and another for the fine scales. The coarse scale equations are solved numerically while the fine scale equations are solved analytically to obtain an expression for the fine scales in terms of the coarse scales and hence achieve closure. Till date, the VMS formulation has lead to accurate results in the simulation of canonical turbulent flow problems. It has been implemented using spectral, finite element and finite volume methods. In this talk, for the incompressible Navier Stokes equations, we will present some new ideas for modeling the fine scales within the context of the VMS formulation and discuss their impact on the coarse scale solution. We will present a simple residual-based approximation for the fine scales that accurately models the cross-stress term and demonstrate that when this term is append with an eddy viscosity model for the Reynolds stress, a new mixed-model is obtained. The application of these ideas will be illustrated through some simple numerical examples.

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