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Structure-Preserving Variational Multiscale Modeling of Turbulent Incompressible Flow with Subgrid Vortices JOHN EVANS, CHRISTOPHER COLEY, RYAN ARONSON, COREY NELSON, University of Colorado Boulder — In this talk, a large eddy simulation methodology for turbulent incompressible flow will be presented which combines the best features of divergence-conforming discretizations and the residual-based variational multiscale approach to large eddy simulation. In this method, the resolved motion is represented using a divergence-conforming discretization, that is, a discretization that preserves the incompressibility constraint in a pointwise manner, and the unresolved fluid motion is explicitly modeled by subgrid vortices that lie within individual grid cells. The evolution of the subgrid vortices is governed by dynamical model equations driven by the residual of the resolved motion. Consequently, the subgrid vortices appropriately vanish for laminar flow and fully resolved turbulent flow. As the resolved velocity field and subgrid vortices are both divergence-free, the methodology conserves mass in a pointwise sense and admits discrete balance laws for energy, enstrophy, and helicity. Numerical results demonstrate the methodology yields improved results versus state-of-the-art eddy viscosity models in the context of transitional, wall-bounded, and rotational flow when a divergence-conforming B-spline discretization is utilized to represent the resolved motion.

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