

## Commutator-Errors in Large-Eddy Simulation of Turbulent Flow

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Commutator-errors in large-eddy simulation of incompressible turbulent flow arise from the application of non-uniform filters to the continuity – and Navier–Stokes equations. For non-uniform, high-order filters the order of magnitude of the commutator-errors is shown to be the same as that of the turbulent stress fluxes. Consequently, one can not reduce the size of the commutator-errors independently of the turbulent stress terms by some judicious construction of the filter operator. For situations in which the dynamical consequences of the commutator-errors are significant, e.g., near solid boundaries, explicit similarity modeling for the commutator-errors is proposed, including the application of Leray regularization. The performance of this commutator-error parameterization is illustrated for the one-dimensional Burgers equation. The Leray approach captures the filtered flow with higher accuracy than conventional similarity modeling, especially for large filter-width variations.

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