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Theoretically Based Optimal LES[1] NICHOLAS MALAYA, University of Texas, AMITABH BHATTACHARYA, University of Pittsburgh, ROBERT MOSER, University of Texas — A major obstacle to the practical application of optimal LES modeling has been the use of DNS statistical data for the multi-point velocity correlations that are needed in the formulation. Here we show that for high Reynolds number turbulence for which small-scale isotropy is valid, the Kolmogorov inertial range theory, the quasi-normal approximation and a model form for the three-point third-order velocity correlation are sufficient to define the optimal LES model. Only two flow-dependent constants remain, the velocity variance u^2 and the dissipation ϵ. These constants are determined via a dynamic procedure in which the statistics of the unfiltered turbulence are reconstructed from the LES statistics. These theoretical optimal models are applied to a finite-volume LES formulation of isotropic turbulence, and the resulting LES perform very well. In these finite-volume LES, an optimal model for the convective momentum flux through finite volume cell boundaries replaces the normal finite volume schemes. The model can thus be considered to be a finite volume LES operator. The spectral properties of the LES operators have been compared to those of standard finite volume schemes, and there are several surprising differences, which have important implications for the formulation of LES models.

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