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Constrained Dynamic Subgrid-scale Model for Large Eddy Simulation ZUOLI XIAO, Department of Mechanical Engineering, The Johns Hopkins University, Baltimore, MD 21218, USA, YIPENG SHI, College of Engineering, Peking University, Beijing 100871, P. R. China, SHIYI CHEN, Department of Mechanical Engineering, The Johns Hopkins University, Baltimore, MD 21218, USA — In traditional dynamic subgrid-scale (SGS) stress models of large eddy simulation (LES), the model coefficients are determined by a least square procedure which minimizes the error between the resolved stress and the model stress using the Germano identity. We propose to impose physical constraints in this dynamic procedure and to calculate the SGS model coefficients using a constrained variation. Based on the scale-invariance of the turbulence flow, we deduce a SGS energy dissipation constraint. Numerical simulations demonstrate that the constrained dynamic model predicts well the energy evolution and the SGS energy dissipation and the results are more accurate than those from the non-constrained models. The constrained SGS model also shows a strong correlation with the real stress and predicts well the energy backscatter, which is a desirable feature of combining the advantages of dynamics Smagorinsky and mixed models.

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