Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

SGS Model Based on Removal of Small-Scale Energy Production through Nonlinear Interactions[1] JULIAN DOMARADZKI, GUANGRUI SUN, University of Southern California — Nonlinear dispersive SGS models are not sufficiently dissipative in actual LES. In this work a new nonlinear model is proposed to remove the unphysical energy accumulation near the LES cutoff. The model is derived based on the analysis of the nonlinear energy transfer among scales of different size and can be regarded as a direct removal of the energy production in targeted regions. We compare the present model with other nonlinear models and regularization techniques both theoretically and numerically. We show that through the removal of energy production in a targeted region of scales in the vicinity of the LES cutoff the new model is able to provide sufficient SGS dissipation in actual LES. The scale separation is facilitated by a smooth low-pass filter, which becomes increasingly more active for smaller resolved scales. Since the filter already takes grid size into account, the model is found to consistently produce accurate results in a posteriori tests in LES of turbulent channel flow at various grid resolutions and Reynolds numbers. Our results demonstrate that the energy pileup at small resolved scales in insufficiently dissipative LES can be removed by a simple modification of the nonlinear term without a need for extra dissipative terms such as an eddy-viscosity model.

[1]Supported by NSF

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Date submitted: 25 Jul 2019 Electronic form version 1.4