Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

On the Conditioning of Machine-Learning-Assisted Turbulence Modeling JINLONG WU, RUI SUN, Virginia Tech, QIQI WANG, Massachusetts Institute of Technology, HENG XIAO, Virginia Tech — Recently, several researchers have demonstrated that machine learning techniques can be used to improve the RANS modeled Reynolds stress by training on available database of high fidelity simulations. However, obtaining improved mean velocity field remains an unsolved challenge, restricting the predictive capability of current machine-learning-assisted turbulence modeling approaches. In this work we define a condition number to evaluate the model conditioning of data-driven turbulence modeling approaches, and propose a stability-oriented machine learning framework to model Reynolds stress. Two canonical flows, the flow in a square duct and the flow over periodic hills, are investigated to demonstrate the predictive capability of the proposed framework. The satisfactory prediction performance of mean velocity field for both flows demonstrates the predictive capability of the proposed framework for machine-learning-assisted turbulence modeling. With showing the capability of improving the prediction of mean flow field, the proposed stability-oriented machine learning framework bridges the gap between the existing machine-learning-assisted turbulence modeling approaches and the demand of predictive capability of turbulence models in real applications.

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Date submitted: 30 Jul 2017 Electronic form version 1.4