Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Deep learning based sub-grid scale closure for LES of Kraichnan turbulence[1] SURAJ PAWAR, OMER SAN, School of Mechanical & Aerospace Engineering, Oklahoma State University, Stillwater, Oklahoma - 74078, USA., ADIL RASHEED, Department of Engineering Cybernetics, Norwegian University of Science and Technology, N-7465, Trondheim, Norway. — Performing high-fidelity simulations of large scale multiscale flow problems that resolves fine spatiotemporal features is computationally intractable. Large eddy simulation (LES) tech- niques aim at reducing the computational resources by resolving large scales of the flow and the effect of small scales is modeled. In the present work, we put forth data-driven sub-grid scale closure models for LES of two-dimensional Kraichnan turbulence in the a priori settings. We use the resolved flow field on the coarser grid to estimate the eddy viscosity and subgrid-stresses. Our data-driven closure models are based on convolutional neural network (CNN) fed by snapshot data from the whole domain, and multilayer feedforward deep neural network (DNN) that utilizes localized stencil data. We analyze these two different neural networks in terms of the amount of training data, training and deployment computational time, selection of input and output features, and their characteristics in modeling accuracy and numerical stability.

[1]This material is based upon work supported by the U.S. Department of Energy, Office of Sci- ence, Office of Advanced Scientific Computing Research under Award Number DE-SC0019290.

Suraj Pawar
Oklahoma State University

Date submitted: 01 Aug 2019 Electronic form version 1.4