Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

A Flow-Based Coordinate Frame Representation for Invariant Data-Driven Subgrid Stress Closure AVIRAL PRAKASH, KENNETH JANSEN, JOHN EVANS, University of Colorado, Boulder — Large-Eddy Simulations are often used to get accurate statistics of turbulent flows. These simulations rely on an accurate model for Sub-Grid Scale Stress (SGS) tensor to close the system of filtered Navier-Stokes equations. We propose a data-driven approach to model SGS tensor. The model form is designed to ensure Galilean, time, frame, and dimensional invariance, thereby ensuring physical consistency with the filtered Navier-Stokes equations. The proposed model form further allows for a simplified low-cost neural network representation that is trained using a small amount of data obtained from an open-source turbulence database. We show that the data-driven model has superior performance than the classical SGS models for both a priori and a posteriori simulations. We demonstrate that the data-driven model seems to have a generalizable nature as it gives accurate results even for cases that are at a different Reynolds number or involve flow physics that is different than the training data.

Aviral Prakash
University of Colorado, Boulder

Date submitted: 09 Aug 2020 Electronic form version 1.4