Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Towards (Machine) Learning of Large Eddy Lagrangian Models (of Turbulence)[1] MICHAEL CHERTKOV, MIKHAIL STEPANOV, University of Arizona — Aimed at developing a physics-informed simulation approach compatible with modern Machine Learning, we focus here on designing, analyzing and experimenting with reduced Lagrangian, multi-particle models, which are capable of capturing fatefully turbulent dynamics within the resolved large-scale portion of the inertial range. We generalize over popular particle-based models, e.g. Molecular Dynamics (MD) and Smooth Particle Hydrodynamics (SPH), known to generate hydrodynamic behaviour at the scales (typically much) larger than the mean-particle distance. The generalization, reflected in introducing sufficient number of interpretable parameters, is inclusive: we allow variability in the choice of (a) MD pairwise potential, (b) SPH weighting function, and (c) thermodynamic relation between pressure and density. To mimic effects of the under-resolved scales, we include in the model additional regularizations, such as dependence of the potential and of the weighting function on the inter-particle velocity. In order to generate homogeneous, isotropic and weakly-compressible turbulence we force the Lagrangian system at large scales. To gain a qualitative understanding of what can be achieved at large scales we test the model in different regimes.

[1]This work is a part of Machine Learning for Turbulence project funded by LDRD office at LANL/DOE.

Michael Chertkov
University of Arizona

Date submitted: 01 Aug 2019 Electronic form version 1.4