Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Tensor Basis Neural Networks for Turbulent Scalar Flux Modeling[1] PEDRO M. MILANI, Stanford University, JULIA LING, Citrine Informatics, JOHN K. EATON, Stanford University — The Tensor Basis Neural Network (TBNN) model developed by Ling et al. (2016) has shown great promise to improve the momentum equations in Reynolds-averaged Navier Stokes (RANS) solvers. It uses physical insight together with machine learning paradigms to embed rotational invariance into a deep neural network, and then predicts a turbulence anisotropy tensor that obeys this property. The original formulation allows only the prediction of a symmetric, traceless tensor (which is the case for the turbulence anisotropy). In the scenario where a turbulent flow carries a scalar, such as heat or a contaminant, the turbulent scalar flux (a vector) needs to be modeled concurrently in the RANS framework. In this talk, we will present how to use the TBNN construction to model the turbulent scalar flux in a way that can be readily applied to a RANS solver. Manipulation of the appropriate invariant vector basis leads to a form with a general, tensorial turbulent diffusivity which is predicted by the deep neural network at test time. We apply this model to an inclined jet in crossflow and obtain significant improvement in the mean scalar concentration prediction.

[1]supported by Honeywell Aerospace

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Date submitted: 26 Jul 2019 Electronic form version 1.4