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Physics-informed deep neural networks applied to scalar subgrid flux modeling in a mixed DNS/LES framework GAVIN PORTWOOD, Los Alamos National Laboratory, MISHA CHERTKOV, University of Arizona, BALASUBRAMANYA NADIGA, JUAN SAENZ, DANIEL LIVESCU, Los Alamos National Laboratory — The application of artificial neural networks (ANNs) to turbulence closure has been an emergent and active area of research in recent years due to the success of such data-driven methods in fields of computer vision, natural language processing, and other industrial and scientific disciplines. In this research, we apply ANNs to spacio-temporal dynamic modeling of the subgrid passive scalar flux as it relates to large-eddy simulations (LESs). By training on direct numerical simulations (DNSs) of homogeneous isotropic turbulence coupled to a passive scalar, we optimize ANNs to predict the subgrid scalar flux as a function of resolved-scale features. Trained models are then implemented in simulation and evaluated with *a-posteriori* analysis. In these simulations, filtered scalar advection is coupled to explicitly filtered and statistically-stationary turbulence such that scalar dynamics have no dependence on potentially inaccurate subgrid stress models. By analysis with single- and multi-point statistics, we demonstrate that the data-driven models compete, and often out-perform, properly optimized canonical models. We suggest that this simulation framework may serve as a simplified closure testbed for the investigation and evaluation of data-driven turbulence closures.

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