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A data-driven approach to modeling turbulent flows in an engine environment[1] PEETAK MITRA, University of Massachusetts Amherst, MATEUS DIAS RIBEIRO, German Research Center for Artificial Intelligence, DAVID SCHMIDT, University of Massachusetts Amherst — In Internal Combustion Engines, turbulence plays a key role in the fuel/air mixing, improving overall efficiency and reducing emissions. Modeling these environments involve dealing with turbulence, multiphase flow, combustion, and moving boundaries. Because of the wide variations in length and time scales, the high fidelity models such as Large Eddy Simulations impose strict resolution requirements making the computations both expensive and doomed to omit critical information that cannot be resolved in a pragmatic design cycle. Here we propose using a data driven method for learning optimized approximations to these unresolved features trained on in-house generated high fidelity dataset. In this hybrid PDE-ML framework developed in OpenFOAM the large scale, resolvable features are to be obtained by solving the governing flow/energy equations (PDE) and the machine learning is to be only applied to the small, unresolved scales. A key aspect in developing this framework is that the machine learning model respects the rotational as well as Galilean invariance of the Reynolds stress models and use local quantities to construct the feature set for the data-driven model thereby improving model performance on a low resolution grid, and thus providing a pathway to coarse-graining methods

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