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Developing an automatic calibration tool for turbulence closure models using machine learning techniques[1] ISMAEL BOUREIMA, VITALIY GYRYA, JUAN SAENZ, SUSAN KURIEN, Los Alamos National Laboratory — We present a new data-driven methodology, using Machine-Learning techniques, to develop, test and optimize turbulence closure models. The proposed methodology is validated by automatically tuning and calibrating the system of parameter coefficients in the BHR 3.1 turbulence closure model against reference statistics from direct numerical simulation (DNS) of homogeneous variable-density turbulence and Rayleigh-Taylor instability canonical turbulence flows. Two approaches are considered: a static approach which considers (and minimizes) the instantaneous rate of deviation of the model from the DNS data, and a dynamic approach which considers the deviation over a finite (vs. infinitesimal) time interval. Both approaches were found to work with high degree of accuracy in the ideal case where the ground truth data was generated by the model. However, on actual DNS data, the static method was found to well approximate only short(instantaneous) times limit of the dynamics. We will contrast results obtained using the different approaches, and discuss their merits, together with their limitations and suggest possible remedies. We will also discuss various challenges and decisions that were made along the way.

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