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Turbulence Model Discovery with Data-Driven Learning and Optimization RYAN KING, PETER HAMLINGTON, University of Colorado, Boulder — Data-driven techniques have emerged as a useful tool for model development in applications where first-principles approaches are intractable. In this talk, data-driven multi-task learning techniques are used to discover flow-specific optimal turbulence closure models. We use the recently introduced autonomic closure technique to pose an online supervised learning problem created by test filtering turbulent flows in the self-similar inertial range. The autonomic closure is modified to solve the learning problem for all stress components simultaneously with multi-task learning techniques. The closure is further augmented with a feature extraction step that learns a set of orthogonal modes that are optimal at predicting the turbulent stresses. We demonstrate that these modes can be severely truncated to enable drastic reductions in computational costs without compromising the model accuracy. Furthermore, we discuss the potential universality of the extracted features and implications for reduced order modeling of other turbulent flows.

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