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Reducing RANS Model Error Using Random Forest JIAN-XUN WANG, JIN-LONG WU, HENG XIAO, Virginia Tech , JULIA LING, Sandia National Labs — Reynolds-Averaged Navier-Stokes (RANS) models are still the workhorse tools in the turbulence modeling of industrial flows. However, the model discrepancy due to the inadequacy of modeled Reynolds stresses largely diminishes the reliability of simulation results. In this work we use a physics-informed machine learning approach to improve the RANS modeled Reynolds stresses and propagate them to obtain the mean velocity field. Specifically, the functional forms of Reynolds stress discrepancies with respect to mean flow features are trained based on an offline database of flows with similar characteristics. The random forest model is used to predict Reynolds stress discrepancies in new flows. Then the improved Reynolds stresses are propagated to the velocity field via RANS equations. The effects of expanding the feature space through the use of a complete basis of Galilean tensor invariants are also studied. The flow in a square duct, which is challenging for standard RANS models, is investigated to demonstrate the merit of the proposed approach. The results show that both the Reynolds stresses and the propagated velocity field are improved over the baseline RANS predictions. SAND Number: SAND2016-7437 A

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