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Uncertainty quantification for RANS simulations of variable density flows AASHWIN MISHRA, ZHU HUANG, JAN HEYSE, GIANLUCA IACCARINO, Center for Turbulence Research, Stanford University, TIMOTHY CLARKE WALLSTROM, DAVID SHARP, Los Alamos National Laboratory — Variable density turbulent flows are widely encountered in a variety of natural phenomena and industrial applications, from the Jovian atmosphere and its Giant Red Spot to nuclear applications such as Inertial Confinement Fusion. RANS models and specifically eddy viscosity closures are widely used for investigations into variable density turbulence. However, RANS models have shortcomings in accounting for the effects of anisotropy, rotation, streamline curvature. This is further exacerbated by the forced alignment of the heat flux with the temperature gradient and the relationship between eddy diffusivity and viscosity. These assumptions lead to significant errors and uncertainties in turbulent model predictions for such flows. In this investigation, we outline the application and extension of tensor perturbations to estimate the uncertainties in variable density turbulent flows, deriving uncertainty estimates for the Besnard-Harlow-Rauenzahn (BHR) model. This is carried out for a variety of flows including tilted rocket rigs, variable density turbulent jets, etc. The selected cases show that extensionsof tensor perturbation can be utilized for uncertaintyestimationfor predictions ofvariable density turbulent flows.

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