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The Use of the Reynolds Stress Transport Equation to Constrain Eigenvectors Perturbations on Model Form UQ of RANS Simulations LUIZ SAMPAIO, Stanford Univ, RONEY THOMPSON, Universidade Federal do Rio de Janeiro, WOUTER EDELING, AASHWIN MISHRA, GIANLUCA IACCARINO, Stanford Univ — Despite the recent developments in LES and DNS approaches for turbulent flow simulations, RANS modeling is still vastly used by industry, due to its inherent low cost. Since accuracy is a concern in RANS modeling, model-form UQ is an essential tool for assessing the impacts of this uncertainty on quantities of interest. Bounding values for the eigenvalues of the dimensionless deviatoric part of the Reynolds Stress tensor (RST) can be obtained from realizability constraints, and therefore can be used as a first step towards a general perturbation approach. In this connection, decoupling the perturbation into an intensity (kinetic energy), a shape (eigenvalues), and an orientation (eigenvectors) parts constitutes a natural methodology to evaluate the model form UQ associated to the RST modeling. In this work, we show that ignoring eigenvectors perturbations can lead to significant impacts on the results from the UQ analysis. Besides that, we use the RST Equation as a constraint to impose some consistency between eigenvectors and eigenvalues perturbations, where the latter can be obtained from a more standard technique. We applied this methodology on the convex channel flow, and show the benefits of including the eigenvectors perturbations predicted by this methodology.

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