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Towards a transport model for epistemic UQ in RANS closures WOUTER EDELING, GIANLUCA IACCARINO, Stanford Univ — Due to their computational efficiency, Reynold-Averaged Navier-Stokes (RANS) turbulence models remain a vital tool for modeling turbulent flows. However, it is well known that RANS predictions are locally corrupted by epistemic model-form uncertainty. Whereas some Uncertainty Quantification (UQ) approaches attempt to quantify this uncertainty by considering the model coefficients as random variables, we directly perturb the Reynold-stress tensor at locations in the flow domain where the modeling assumptions are likely to be invalid. Inferring the perturbations on a point-by-point basis would lead to a high-dimensional problem. To reduce the dimensionality, we propose separate model equations based on the transport of linear invariants of the anisotropy tensor. This provides us with a low-dimensional UQ framework where the invariant transport model decides on the magnitude and direction of the perturbations. Where the perturbations are small, the RANS result is recovered. Using traditional turbulence modeling practices we derive weak realizability constraints, and we will rely on Bayesian inference to calibrate the model on high-fidelity data. We will demonstrate our framework on a number of canonical flow problems where RANS models are prone to failure.

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