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Turbulence model form uncertainty quantification in OpenFOAM ZENGRONG HAO, Columbia Univ, STÉPHANIE ZEOLI, LAURENT BRICTEUX, Univ Mons, CATHERINE GORLÉ, Columbia Univ, CFD & UQ TEAM, FLUIDS-MACHINES TEAM — Reynolds-averaged Navier-Stokes (RANS) simulations with a two-equation linear eddy-viscosity turbulence model remain a commonly used computational technique for engineering design and analysis of turbulent flows. The accuracy of the results is however limited by the inability of the turbulence model to correctly predict the complex flow features relevant to engineering applications. To enable supporting critical design decisions based on these imperfect model results it is essential to quantify the uncertainty related to the turbulence model form and define confidence levels for the results. The objective of this study is the implementation and validation of a previously developed approach for quantifying the uncertainty in RANS predictions of a turbulent flow in the open source code OpenFOAM. The methodology is based on two steps: 1. calculate a marker to determine where in the flow the model is plausibly inaccurate, and 2. perturb the modeled Reynolds stresses in the momentum equations. The perturbations are defined in terms of the decomposed Reynolds stress tensor, i.e., the tensor magnitude and the eigenvalues and eigenvectors of the normalized anisotropy tensor. Results for a square duct and the flow over a wavy wall will be presented for validation of the implementation.

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