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An S-frame Discrepancy Correction for Data-Driven Reynolds Stress Closure AVIRAL PRAKASH, University of Colorado, Boulder, ERIC PETERS, Ball Aerospace, RICCARDO BALIN, KENNETH JANSEN, ALIREZA DOOSTAN, JOHN EVANS, University of Colorado, Boulder — Scale-resolving simulations demand large computational resources. Therefore, industry often relies on solving the ensemble averaged mean flow equations. This averaging leads to an unclosed term known as the Reynolds stress tensor. This closure problem is often addressed using linear eddy viscosity (LEV) models which assume alignment of the anisotropic part of the Reynolds stress tensor and mean strain rate tensor. However, the two tensor do not align for many turbulent flows, including those exhibiting flow separation. In this work, we present a strategy for modeling the discrepancy between the Reynolds stress tensor predicted by an LEV model and the actual Reynolds stress tensor. The strategy relies on learning the discrepancy components in the mean strain rate eigenframe. By intelligently selecting model inputs, we arrive at a model that is both frame and Galilean invariant. We can also ensure energy stability using a simple constraint on the diagonal terms of the discrepancy. To learn a computable model, we employ high fidelity DNS data and neural networks. Numerical results illustrate the effectiveness of our discrepancy modeling strategy. We finally discuss how to use model derived turbulence variables rather than DNS data in the learning process.

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