Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Generalized Non-Linear Eddy Viscosity Models for Data-Assisted Reynolds Stress Closure BASU PARMAR, University of Colorado Boulder, ERIC PETERS, Ball Aerospace, KENNETH JANSEN, ALIREZA DOOSTAN, JOHN EVANS, University of Colorado Boulder — The prediction of turbulent flow is critical for the design and analysis of engineering systems. Unfortunately, Linear (LEV) and Non-Linear Eddy Viscosity (NLEV) models lack predictive capability in practical flow scenarios involving severe flow separation, secondary flows, and adverse pressure gradients. In this talk, we propose Generalized Non-Linear Eddy Viscosity (GNLEV) models for modeling the Reynolds stress tensor. In these models, we assume the anisotropic part of the Reynolds stress tensor is a function of the mean strain rate tensor, the mean rotation rate tensor, and the mean pressure gradient: The Hilbert basis theorem can be used to generate a symmetric tensor integrity basis, and thus any GNLEV model can be written as a linear combination of these basis functions. The coefficients associated with this expansion themselves are scalar functions of the invariants. The exact form of these coefficients is unknown and hence models must be introduced to obtain complete Reynolds stress closure. In this talk, we use a tensor-based feed forward neural network as a surrogate model to predict these coefficients. Numerical results illustrate the effectiveness of the proposed Reynolds stress closure approach.

Basu Parmar
University of Colorado Boulder

Date submitted: 01 Aug 2019 Electronic form version 1.4