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Nonlinear Principal Component Analysis for Combustion Large-Eddy Simulation HESSAM MIRGOLBABAEI, North Carolina State University, TAREK ECHEKKI, Department of Mechanical and Aerspace Engineering, North Carolina State University — Moment-based methods have been widely used in turbulent combustion modeling, by transporting a set of moments and reconstructing thermo-chemical scalars' statistics. Instead of ad hoc strategies to select these moments, more optimal moments have been proposed recently using principal component analysis (PCA). However, it is not evident that the linear PCA alone can represent the non-linear nature of the space representing thermo-chemical scalars' statistics effectively. As a nonlinear alternative to the classical PCA in which the linear transformation of the original space is constructed, kernel PCA(KPCA) is adapted in the present work, in that the original space is mapped into a Feature space where the intrinsic dimensionality can be linearly extracted. Re parameterization is performed based on one-dimensional turbulence (ODT) for the implementation of KPCA, for implementation in a novel large-eddy simulation (LES) approach, as well. This involves the solution of LES on a coarse-grid and fine-grained ODT solutions embedded in the LES domain. Parameters from the KPCA analysis can be used to evaluate key terms in the transport equation for the moments. These terms are tabulated using artificial neural networks (ANN).

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