A Novel Principal Component Analysis-Based Acceleration Scheme for LES-ODT: An A Priori Study TAREK ECHEKKI, HESSAN MIRGOLBABAEI, North Carolina State University — A parameterization of the composition space based on principal component analysis (PCA) is proposed to represent the transport equations with the one-dimensional turbulence (ODT) solutions of a hybrid large-eddy simulation (LES) and ODT scheme. An a priori validation of the proposed approach is implemented based on stand-alone ODT solutions of the Sandia Flame F flame, which is characterized by different regimes of combustion starting with pilot stabilization, to extinction and reignition and self-stabilized combustion. The PCA analysis is carried out with a full set of the thermo-chemical scalars' vector as well as a subset of this vector. The subset is made up primarily of major species and temperature. The results show that the different regimes are reproduced using only three principal components for the thermo-chemical scalars based on the full and a subset of the thermo-chemical scalars' vector. Reproduction of the source term of the principal component represents a greater challenge. It is found that using the subset of the thermo-chemical scalars' vector both minor species and the first three principal components source terms are reasonably well predicted.

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