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Leveraging In-Situ Adaptive Manifolds for computationally efficient simulations of turbulent combustion with multiple and/or inhomogeneous inlets CRISTIAN E LACEY, MICHAEL E MUELLER, Princeton University — Modeling turbulent combustion with reduced-order manifold approaches involves projecting the thermochemical state onto a lower-dimensional space comprising just a few manifold variables, substantially reducing computational cost compared to brute-force modeling. The thermochemical state is traditionally precomputed by solving manifold equations and pretabulated in a thermochemical database. Describing complex turbulent combustion processes featuring multiple and/or inhomogeneous inlet streams requires multiple mixture fractions (manifold variables) and a corresponding increase in the number of precomputed manifold solutions. The memory required to store these solutions, many of which are not even utilized in a CFD calculation, precludes the use of pretabulation for configurations requiring more than a couple of mixture fractions. In this work, a recently-developed approach termed In-Situ Adaptive Manifolds (ISAM) overcomes this limitation by computing manifold solutions 'on-the-fly' and reusing them with In-Situ Adaptive Tabulation (ISAT), enabling the utilization of manifold-based turbulent combustion models for complex inlet configurations. The performance of ISAM is evaluated via LES calculations of multi-stream turbulent flames.

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