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Towards Model Inadequacy Representations for Flamelet-Based RANS Combustion Simulations TODD OLIVER, M.K. LEE, DAVID SONDAK, CHRIS SIMMONS, ROBERT MOSER, Univ of Texas, Austin — Flamelet-based RANS simulations are commonly used in combustion engineering. In such simulations, chemical reactions are represented by a "flamelet-library" of laminar diffusion flame solutions generated with some chemical mechanism, and turbulence is represented using typical eddy-viscosity-based RANS closures. Modeling errors are introduced through both of these models as well as their interaction. In this work, we formulate and apply physics-based stochastic model inadequacy representations to capture the effects of possible modeling errors, allowing their impact on quantities of interest to be estimated. Specifically, the uncertainty introduced by inadequacy of the chemical mechanism is represented using a recently developed stochastic operator approach, which is extended to the diffusion flame here, leading to a stochastic diffusion flame library. A Karhunen-Loeve decomposition applied to these random fields enables low-dimensional representation of this uncertainty. A stochastic extension of typical eddy-viscosity-based RANS models is developed to represent inadequacy in the turbulence closures. The full stochastic model is demonstrated on simulations of a planar jet flame.

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