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Timescale Analysis Procedure Applied to Premixed and Non-Premixed Turbulent Combustion[1] SALVADOR BADILLO-RIOS, University of California, Los Angeles, MATTHEW HARVAZINSKI, VENKATESWARAN SANKARAN, Air Force Research Laboratory, Rocket Propulsion Division, ANN KARAGOZIAN, University of California, Los Angeles — Full detailed kinetics in turbulent combustion simulations can be computationally prohibitive for propulsion systems. While reduced kinetic models are often selected to reduce cost, there needs to be a clear understanding of their impact on the phenomena being modeled. The present study examines the effects of alternative kinetic models and flow parameters on turbulent combustion processes associated with non-premixed combustion in a shear-coaxial rocket injection configuration, as a means of determining the conditions under which turbulent reaction phenomena may be altered via the kinetics. A combination of 2D axisymmetric parametric studies and selected 3D simulations for a single element shear coaxial rocket injector are performed, incorporating GRI-Mech 3.0 and several alternative reduced kinetic models representing the combustion of gaseous methane and oxygen. Systematic timescale analysis procedures, e.g., the Chemical Explosive Mode Analysis (CEMA) procedure based on the Jacobian matrix of the chemical source term, are applied to explain differences in observed flame behaviors. This approach can serve as a quantitative method for the systematic detection of critical flame features, species, and reactions.

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