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Direct Numerical Simulation of a supersonic reacting jet with thermochemical nonequilibirum ROMAIN FIÉVET, University of Michigan, STEPHEN VOELKEL, The University of Texas at Austin, HEESEOK KOO, University of Michigan, PHILIP VARGHESE, The University of Texas at Austin, VENKAT RAMAN, University of Michigan — In flows that exhibit nonequilibrium of internal energies, the ignition and stabilization of flames can exhibit complex dependencies. Common to shock-containing flows, the lack of equilibrium between vibrational and translational motion of the molecules can significantly alter the initiation of the fuel oxidation process. In this study, direct numerical simulation is used to understand the impact of nonequilibrium on flame stabilization. An important aspect of this work is the determination of chemical reaction rates consistent with such nonequilibrium. For this purpose, quasi-classical trajectory analysis based two-temperature reaction rates have been formulated. The nonequilibrium multi-species mixture is described using species-specific temperature, leading to an enhanced set of momentum, species, and energy equations. A jet-in-crossflow configuration is used to understand the onset of chemical reactions under such nonequilibrium conditions.

Romain Fiévet
University of Michigan

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