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Modeling Gas-Dynamic Effects in Shock-Tubes for Reaction-Kinetic Measurements KEVIN GROGAN, QING WANG, MATTHIAS IHME, Stanford University — Accurate chemical kinetic models are pivotal for characterizing the effects of new fuel compositions on existing propulsion systems and for developing future combustion technologies. Shock-tube facilities remain invaluable for providing detailed information about ignition delay times, extinction limits, and species time histories for the development and validation of reaction mechanisms. However, viscous and heat transfer effects along the shock-tube wall introduce variations of the thermodynamic state behind the reflected shock wave, thereby affecting the reaction kinetics being measured. These effects have been countered experimentally by the use of driver inserts, extended shock-tube diameters, and the dilution of the test gas. To assist with the design of driver inserts and the selection of operating conditions, a low-order one-dimensional model is developed and compared to two-dimensional Unsteady-Favre-Averaged-Navier-Stokes (UFANS) models as well as experimental data. This model is shown to give accurate predictions of the gas-dynamics in shock-tubes at a computationally efficient cost.

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