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Reduced Order Chemical Kinetic Modeling for a Hydrogen Fueled Radical Farming Scramjet

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Abstract **-** Computational modeling for scramjets and other high-speed reacting fluids often requires significant computing resources. The need to capture complex flow phenomena at high-speeds requires the use of large grids. This numerical demand is further compounded by the chemistry, which must be resolved across the entire domain. This work investigates the reduction of a detailed hydrogen mechanism, containing some 33 reactions and 10 species. The effectiveness of the mechanism reduction is examined by applying the results to a two-dimensional radical farming scramjet geometry. The results show that a 5-step reduced hydrogen mechanism with chemical kinetic rates optimized using laminar burning velocities can potentially replicate aspects of a detailed hydrogen mechanism. On current computing infrastructure, a speed up to 2.7 times has been achieved with the reduced models in comparison to the detailed model in the hydrogen combustion in a two-dimensional domain.

Keywords**:** Reduced-order, Hydrogen, Radical farming, Scramjet, Chemical kinetics