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Large Eddy Simulation of Supersonic Combustion[1] AMIRREZA SAGHAFIAN, VINCENT TERRAPON, FRANK HAM, HEINZ PITSCH — Large eddy simulation of supersonic combustion is performed based on a flamelet/progress variable combustion model. This model was originally formulated for low Mach number, where temperature and species mass fractions are looked up from a pre-computed flamelet library. In the compressible formulation presented here, the equation for the total energy is solved to find temperature. Because total energy is a non-linear function of temperature, an iterative method like Newton-Raphson is inevitable. However, a new formulation is introduced to eliminate this expensive iterative step. Large eddy simulation of under-expanded hydrogen jet in supersonic cross-flow is performed and results are compared with experiments. For sufficiently high jet to cross-flow momentum ratio, burning of the fuel is observed in the upstream region of the jet exit and the length of this burning region is in good agreement with experimental data. In addition, reaction is also observed in a large portion of the boundary layer downstream of the jet consistent with experimental observations.

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