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DNS of high speed boundary layers over ablating surfaces KALEN BRAMAN, VENKAT RAMAN, Department of Aerospace Engineering and Engineering Mechanics, The University of Texas at Austin, ROCHAN UPADHYAY, PECOS Center, The University of Texas at Austin, OFODIKE EZEKOYE, Department of Mechanical Engineering, The University of Texas at Austin — Ablation of thermal protection shields is an important design problem in developing reentry vehicles. Development of predictive computational models for this problem will enable optimization of the size and hence weight of the protective layer. In this work, direct numerical simulation (DNS) of a compressible ablating boundary layer is used to understand the modeling issues in the context of Reynolds-averaged Navier Stokes (RANS) equations. The DNS is performed at conditions obtained from a detailed RANS study of a reentry vehicle. The free stream conditions of the two simulations are Mach 0.6, temperature 5940 K, and Re_θ 1000; and Mach 1.2, temperature 5580 K, and Re_θ 2000. The surface ablation of a graphite ablator is modeled using a locally 1-D, quasi-steady state formulation with control volume mass and energy balances over the interior of the ablator. A 10-species gas phase chemistry mechanism is used. A priori studies are used to evaluate scalar flux models and the reaction source term closure in RANS.

Kalen Braman
Department of Aerospace Engineering and Engineering Mechanics,
The University of Texas at Austin

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