Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Supersonic turbulent boundary layer on a surface with distributed roughness OLAF MARXEN, JOSHUA GIEGEL, GIANLUCA IACCARINO, Stanford University — Knowledge of heat load on the surface of vehicles (re-)entering a planetary atmosphere is important for heat-shield design. However, due to the heat-shield material itself or as a result of ablation during flight, the surface of a heat shield is often not smooth. The surface roughness may strongly influence the heat flux, but the details of this influence are presently not well understood. We carry out numerical simulations of a flat-plate boundary layer with small distributed roughness at a supersonic Mach number. Time-accurate solutions to the compressible Navier-Stokes equations are obtained by an overall fourth-order finite-difference method with explicit time stepping for a calorically perfect gas. In the computation, the rough wall is modelled by an immersed boundary method. The boundary-layer is tripped to turbulence upstream of the rough surface. Its downstream evolution will be compared between a smooth flat-plate and the rough-wall case. This approach shall allow to identify physical mechanisms that lead to a possible enhancement in heat load caused by distributed roughness.

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Date submitted: 04 Aug 2008 Electronic form version 1.4