Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Continuum approach for aerothermal flow through ablative porous material using discontinuous Galerkin discretization. PIERRE SCHROOYEN[1], PHILIPPE CHATELAIN, Universite catholique de Louvain, Institute of Mechanics, Materials and Civil Engineering, KOEN HILLEWAERT, Cenaero, THIERRY E. MAGIN[2], von Karman Institute for Fluid Dynamics, Aeronautics and Aerospace Department — The atmospheric entry of spacecraft presents several challenges in simulating the aerothermal flow around the heat shield. Predicting an accurate heat-flux is a complex task, especially regarding the interaction between the flow in the free stream and the erosion of the thermal protection material. To capture this interaction, a continuum approach is developed to go progressively from the region fully occupied by fluid to a receding porous medium. The volume averaged Navier-Stokes equations are used to model both phases in the same computational domain considering a single set of conservation laws. The porosity is itself a variable of the computation, allowing to take volumetric ablation into account through adequate source terms. This approach is implemented within a computational tool based on a high-order discontinuous Galerkin discretization. The multi-dimensional tool has already been validated and has proven its efficient parallel implementation. Within this platform, a fully implicit method was developed to simulate multi-phase reacting flows. Numerical results to verify and validate the methodology are considered within this work. Interactions between the flow and the ablated geometry are also presented.

[1]Supported by Fund for Research Training in Industry and Agriculture
[2]Supported by the European Research Council Starting Grant #259354

Pierre Schrooyen
Univ Catholique de Louvain

Date submitted: 29 Jul 2014 Electronic form version 1.4