Analysis of Mars 2020 Entry with Coupled Material Response and CFD

John M. Thornton[a,*], Dinesh K. Prabhu[a], Brett A. Cruden[a], Jeremie B.E. Meurisse[a], Arnaud Borner[a]

[a]*Analytical Mechanics Associates, Inc. at NASA Ames Research Center, Moffett Field, CA 94035, USA*

Abstract

When computing the response of an ablating thermal protection system during entry, the aerothermal environment and material response are traditionally computed independently, with the introduction of a blowing correction term in the material response model to account for the outgassing of char and pyrolysis gases. This study presents an approach, where the pyrolysis blowing gases, calculated within the PATO material response code [1], are integrated into the DPLR hypersonic CFD code [2] via a blowing boundary condition. This methodology employs an iterative process, whereby the blown pyrolysis gas products from PATO are incorporated into DPLR, refining surface heating predictions. The NEQAIR code is used to compute radiative heating [3]. The method is applied in computing 3D material response of the Mars 2020 entry. When compared with uncoupled material response, the coupled simulations show a lower surface heat flux initially and a higher heat flux at peak heating as shown in Fig. 1. This is in agreement with previous work using a sphere case with environments from MSL [4].

Keywords: Heat Transfer, Mass Transfer, Material Response, Ablation, CFD

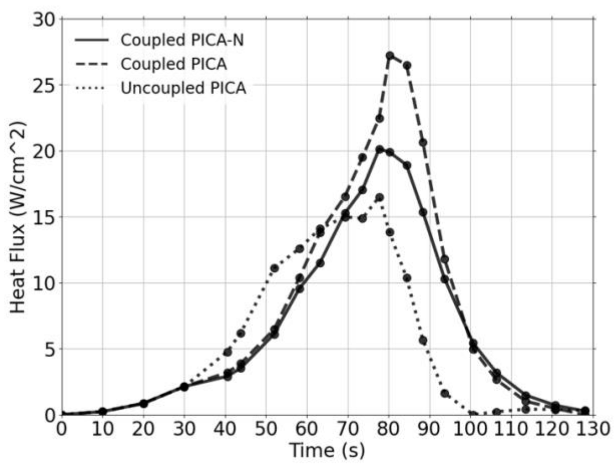

Figure 1: Heat flux from convection, diffusion, and advection of blowing gases at MTH1.

References

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*Corresponding author.
Email address: `john.m.thornton@nasa.gov` (John M. Thornton)