Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Simulations of shock-induced combustion using adaptive mesh refinement algorithm on mapped meshes[1] HAN PENG, CHAY W. C. ATKINS, RALF DEITERDING, University of Southampton — Shock-induced combustion (SIC) has gained interest as a promising combustion mode for hypersonic airbreathing propulsion devices. We use adaptive mesh refinement (AMR) on mapped meshes to resolve the complex interaction between the bow shock and reaction wave of SIC, where the body-fitted meshes are refined dynamically. This technique is applied to simulate Lehr's experiments, in which projectiles at a Mach number from 4.18 to 5.11 travel through hydrogen/air. The 2-D axisymmetric Euler equations with detailed chemical kinetics are solved within the AMROC finite volume framework. A second-order accurate MUSCL-Hancock scheme with Minmod limiter is used for the reconstruction. The inviscid flux on mapped meshes is evaluated by a rotating advection upstream splitting method (AUSM). Godunov splitting is adopted for the reactive source term and the Jachimowski hydrogen/air reaction mechanism is employed. The results show that the computed oscillation frequencies, observed in the stagnation point pressure, are in good agreement with the frequencies from Lehr's experiments when the inflow is subdetonative. The simulations predict an irregular and unstable oscillation when the inflow is superdetonative and a detonation occurs at the front of the bow shock occasionally.

[1]The first author gratelfully acknowledges financial support from China Scholarship Council

Han Peng
University of Southampton

Date submitted: 28 Jul 2020 Electronic form version 1.4