AIR/H_2 COMBUSTION PROCESSES IN A SCRAMJET ENGINE FOR AIRBREATING HYPERSONIC PROPULSION

D. E. Zeitoun[1], Y. Burtschell[1] and S. Seror[2]

[1]*University of Provence, E.P.U.M, Dept M.E, Hypersonic Research Group- Marseilles, France*
David.Zeitoun@polytech.unic-mrs.fr
[2] *Israel Aircraft Industries, Aerodynamic dept, CFD Group, Israel*

The aim of this work is to develop an axisymetric numerical code based on the FAVRE averaged Navier-Stokes equations coupled with a turbulence model and with a complex finite rate Air/Hydrogen combustion kinetic model to simulate the unsteady supersonic hydrogen-air mixing processes with application to the scramjet hypersonic air-breathing propulsion engine.

To achieve this goal, the Spalart-Allmaras turbulence model (SA) with correction terms to model the compressibility effects and a complete finite rate chemistry model of Jachimowsky involving 13 species and 127 reactions have been implemented in the home code CARBUR [1]. This code, based on a finite volume approach, is multi-block and parallel and has been developed for the re-entry flow studies. The paper focuses more on the verification and validation of the combustion modelling through a comparison with the experiments of Lehr [2] on the shock-induced combustion occurring in the flow around a spherical projectile shot into an explosive Air/H_2 mixture at the Mach number from 4 up to 6. After that, and as an application, a numerical study has been conducted to investigate the effect of shock waves on the supersonic Air/H_2 jet flame in a Mach 2.5 circular cross section scramjet. Turbulent and laminar simulations with and without combustion are addressed to assess the influence of the physics on the mixing layer processes. The computations are compared with other authors and with experimental results from the experiments carried by Huh and Driscoll [3].

References

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