IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

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LES OF AXIS SYMMETRIC AFT WALL ANGLE CAVITY IN SCRAMJETS

Abstract

The development of the scramjet engines poses considerable challenges and it demands multidisciplinary design, analysis, modeling, simulation and system optimization. The hardware realization and testing becomes equally complex and multidisciplinary. Supersonic combustion, which plays a key role in the scramjet technology, was first demonstrated in the laboratory in the 1960s. Subsequently NASA developed considerable expertise in airframe integration and combustion testing facility in the 1970s and 1980s. The critical component of the scramjet engine is combustor which presents the most formidable problems. The complex phenomenon of supersonic combustion involves turbulent mixing, shock interaction, holding of flame and heat release in supersonic flow. At a hypersonic flight speed, the flow entering the combustor should be maintained supersonic to avoid the excessive heating and dissociation of air. The residence time of the air in a hypersonic engine is on the order of 1 micro second for typical flight conditions. The fuel must be injected, mixed with air, and burned completely within such a short time span. The flow field within the combustor of scramjet engine is very complex and poses a considerable challenge in design and development of a supersonic combustor with an optimized geometry. Such combustor shall promote sufficient mixing of the fuel-air and flame stabilization. During the design of combustor, the things that a designer keep in mind are (i) Good and rapid fuel air mixing, (ii) minimization of total pressure loss, (iii) high combustion efficiency. The use of Cavities has been proposed and investigated in this work as it is a special perspective as flame holder and fuel injector. In particular, axisymmetric cavity with varying aft wall angle have been numerically analyzed. In the present work, all the simulations have been carried out by using ANSYS 2019R2 CFX tool. Simultaneously, the validation of the present work is completed by comparing its result with available experimental data which is available in the literature. It is observed that the computational results are in good qualitative agreement with the experimental data.