

Investigation of the Technological Demonstrator 14x B in Different Angle of Attack in Hypersonic Velocity

Authors : Victor Alves Barros Galvão, Israel Da Silveira Rego, Antonio Carlos Oliveira, Paulo Gilberto De Paula Toro

Abstract : The Brazilian hypersonic aerospace vehicle 14-X B, VHA 14-X B, is a vehicle integrated with the hypersonic airbreathing propulsion system based on supersonic combustion (scramjet), developing in Aerothermodynamics and hypersonic Prof. Henry T. Nagamatsu Laboratory, to conduct demonstration in atmospheric flight at the speed corresponding to Mach number 7 at an altitude of 30km. In the experimental procedure the hypersonic shock tunnel T3 was used, installed in that laboratory. This device simulates the flow over a model is fixed in the test section and can also simulate different atmospheric conditions. The scramjet technology offers substantial advantages to improve aerospace vehicle performance which flies at a hypersonic speed through the Earth's atmosphere by reducing fuel consumption on board. Basically, the scramjet is an aspirated aircraft engine fully integrated that uses oblique/conic shock waves generated during hypersonic flight, to promote the deceleration and compression of atmospheric air in scramjet inlet. During the hypersonic flight, the vehicle VHA 14-X will suffer atmospheric influences, promoting changes in the vehicle's angles of attack (angle that the mean line of vehicle makes with respect to the direction of the flow). Based on this information, a study is conducted to analyze the influences of changes in the vehicle's angle of attack during the atmospheric flight. Analytical theoretical analysis, simulation computational fluid dynamics and experimental investigation are the methodologies used to design a technological demonstrator prior to the flight in the atmosphere. This paper considers analysis of the thermodynamic properties (pressure, temperature, density, sound velocity) in lower surface of the VHA 14-X B. Also, it considers air as an ideal gas and chemical equilibrium, with and without boundary layer, considering changes in the vehicle's angle of attack (positive and negative in relation to the flow) and bi-dimensional expansion wave theory at the expansion section (Theory of Prandtl-Meyer).

Keywords : angle of attack, experimental hypersonic, hypersonic airbreathing propulsion, Scramjet

Conference Title : ICAMAME 2017 : International Conference on Aerospace, Mechanical, Automotive and Materials Engineering

Conference Location : Prague, Czechia

Conference Dates : March 23-24, 2017