

Fundamental Studies on Performance Improvement of Scramjet Engine

Xinyu Chang, Lihong Chen, Lianjie Yue, Xilong Yu and Hongbin Gu

Institute of Mechanics, Chinese Academy of sciences

No. 15 Beisihuan Xilu, Beijing 100190, China

changxy@imech.ac.cn

Keywords: Scramjet, Inlet, Combustor, Thrust Nozzle, Thermal Protection

The experimental and numerical investigations have been conducted to improve the performance of a scramjet engine. The studies were focusing on the interaction between components, such as inlet, combustor and thrust nozzle, as well as thermal protection and engine thrust performance.

An optimized axisymmetric flow based on a NURBS curve was investigated to create a better base flow than truncated Busemann flow. 3D streamline-traced inlet was then generated based on the optimized base flow. Furthermore, boundary layer correction was realized. CFD Results show the reliability of the correction method and the good performance of the inlet.

Several techniques, such as high-frequency excitation and strut, have been attempted to improve the mixing performance of the gaseous fuel and supersonic incoming flow in the combustor.

A method for designing three-dimensional scramjet nozzles was developed. Streamline tracing technique was employed to generate 3D nozzle surface based on the flowfield of axisymmetric nozzle with optimum thrust. According to a typical hypersonic flight condition, an inviscid nozzle was constructed and then the boundary layer correction is performed. Inviscid and viscous flowfields are computed on design point to get thrust and lift of the nozzle.

Related to the thermal protection of the scramjet engine, the regenerative cooling consideration has been taken. The kerosene fuel supplied to the engine was heated and pressurized to its supercritical conditions to simulate the fuel active cooling process. The engine thrust was much better in supercritical case than that in normal case.

In order to acquire more data beside the normal measurements such as pressure and temperature, a TDLAS (Tunable Diode Laser Absorption Spectroscopy) system has been developed. The temperature, concentration, species and velocity could be obtained by using this system.