

Scramjet Research at JAXA, Japan

Nobuo Chinzei

Invited Researcher at Combined Propulsion Research Group
Institute of Space Technology and Aeronautics
Japan Aerospace Exploration Agency
(JAXA)

ABSTRACT

Japan Aerospace Exploration Agency(JAXA) has been conducting research and development of the Scramjet engines and their derivative combined cycle engines as hypersonic propulsion system for space access. Its history will be introduced first, and its recent advances, focusing on the engine performance progress, will follow. Finally, future plans for a flight test of scramjet and ground test of combined cycle engine will be introduced.

Two types of test facilities for testing those hypersonic engines, namely, the "Ramjet Engine Test Facility (RJTF)" and the "High Enthalpy Shock Tunnel (HIEST)" were designed and fabricated during 1988 through 1996. These facilities can test engines under simulated flight Mach numbers up to 8 for the former, whereas beyond 8 for the latter, respectively.

Several types of hydrogen-fueled scramjet engines have been designed, fabricated and tested under flight conditions of Mach 4, 6 and 8 in the RJTF since 1996. Initial test results showed that the thrust was insufficient because of occurrence of flow separation caused by combustion in the engines. These difficulty was later eliminated by boundary-layer bleeding and staged fuel injection. Their results were compared with theory to quantify achieved engine performances. The performances with regards to combustion, net thrust are discussed. We have reached the stage where positive net thrust can be attained for all the test conditions. Results of these engine tests will be discussed.

We are also intensively attempting the improvement of thrust performance at high speed condition of Mach 8 to 15 in High Enthalpy Shock Tunnel (HIEST). Critical issues for this purpose may be air/fuel mixing enhancement, and temperature control of combustion gas to avoid thermal dissociation. To overcome these issues we developed the Hypermixer engine which applies stream-wise vortices for mixing enhancement, and the M12-engines which optimizes combustor entrance temperature.

Moreover, we are going to conduct the flight experiment of the Hypermixer engine by utilizing flight test infrastructure (HyShot) provided by the University of Queensland in fall of 2005 for comparison with the HIEST result. The plan of the flight experiment is also presented.