IAF SPACE PROPULSION SYMPOSIUM (C4)
Joint Session on Advanced and Nuclear Power and Propulsion Systems (10-C3.5)

Author: Mr. Ya Jun Wang
College of Astronautics, Northwestern Polytechnical University, China, nwpu802wyj@gmail.com

NUMERICAL RESEARCH ON THE COMBUSTION ORGANIZATION OF RBCC ENGINE

Abstract

The rocket-based combined cycle (RBCC) integrates a high thrust-to-weight ratio, a low specific impulse rocket engine, a high specific impulse, and a low thrust-to-weight ratio ramjet engine in the same flow path, using a rocket jet and ramjet flow path to form a new thermodynamic cycle. The RBCC engine has various operating modes at different Mach numbers and is characterized by a wide range of speed and multi-mode integration. The design of RBCC full flow-path operating in Ma2-7 was carried out, which adopting a 2-D inlet with the variable throat of two contraction ratio 3.8 and 7.6, two stage combustor with different expansion ratio of 2.1 and 2.7 and the nozzle with expansion ratio of 1.8. The different combustion organization of full flow-path was investigated through three-dimensional numerical simulation. The results showed that, for the operating condition of Ma5 and Ma6 where the total pressure of the incoming flow was relatively high, the better performance of large equivalence ratio can be achieved through adopting the more front of injection location with the recirculation region of rear-faced step at the entrance of combustor. For the operating condition of Ma3 where the total temperature of the incoming flow was relatively low, the rocket jet of high temperature shorten the interval of mixing and combustion and realized the stable and efficient combustion of fuel in the expanding flow-path with thermal throat. The performance of combined operation mode was better than pure ramjet mode.