SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (3)

Author: Dr. yibai wang
Beijing University of Aeronautics and Astronautics (BUAA), China

NUMERICAL AND EXPERIMENTAL ANALYSIS OF A TILE-SHAPED AEROSPIKE NOZZLE WITH CHARACTERISTIC CONTOUR

Abstract

The representational aerospike nozzles include the linear-type tested in the X-33 program in America, annular-type investigated in Europe and Japan, tile-shaped nozzle in China. In order to gain high performance and validate the altitude compensation characteristic comparing with bell-type nozzles, a six-cell tile-shaped test aerospike nozzle with characteristic plug contour was designed, and numerical analysis and experimental studies were carried out for such a model. The numerical simulation was based on MUSCL scheme to solve three-dimensional Reynolds-averaged Navier-Stokes equations, and the cold flow tests using high pressure air evaluated the nozzle performance. The aero ratio of internal nozzle of thrust cell is 4 and the total aero ratio of the aerospike model is 40, whose designed optimum altitude is at the pressure ratio about 1047. Design parameters and structure photographs of the experimental engine and the test apparatus were introduced. The Mach number distributions of flow field, the plug pressure profiles, and the nozzle thrust coefficient efficiency were computed, and the plug surface pressure profiles for the three planes at different NPR were gained. Chamber pressure, thrust and ambient pressure were acquired and data analyses were also provided. The model has high nozzle performance with the maximum thrust coefficient efficiency of 0.995, and has good altitude compensation characteristic comparing with the bell nozzle that the efficiency is in the range of 0.93 0.995 with the pressure ratio changing from 55 to 1200. The six-cell model has higher nozzle performance through optimized designing the plug contour, which can adequately show altitude compensation characteristic plug nozzles and can be a promising candidate for the future engineering application.