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Author: Mr. Yanbo Gong
Beijing Aerospace Propulsion Institute, China

MODELING AND SIMULATION OF STEADY-STATE CHARACTERISTICS OF CRYOGENIC ROCKET ENGINE

Abstract

In the classical design process of the rocket engine, the test accounts for a large proportion. However, engine testing is a costly and dangerous activity. With the rapid development of computer and numerical simulation technology, digital modeling and numerical simulation of engine system have gradually become an important means of engine static characteristic analysis. In order to improve the accuracy of simulation of existing models, and emancipate designers from complicated coding and debugging process to focus on the research of rocket engine theory and digital models. In this paper, related researches are carried out and eleven categories are modularized such as medium, pump, turbine, pipeline, orifice, valve, gas generator, thrust chamber, regulator, cooling jacket and boundary using engineering modeling language Modelica, which considering the cryogenic propellant temperature and density changes in the pump, and improved cooling jacket heat transfer model is adopted to effectively improve the accuracy and universality of the model. Furthermore, a modular general simulation platform, which can be applied in the field of cryogenic rocket engine static characteristic simulation, is developed – Steady-State Simulation for Cryogenic Propulsion System (SSCPS). The platform has the characteristics of friendly interface, simple operation, strong flexibility and high accuracy of simulation. By simulating the static characteristics of existing engines and comparing them with the real test data, the adaptability and credibility of the platform are verified. Based on this, the static fault simulation of YF-77 cryogenic rocket engine is carried out. The trend and specific value of the main parameters of YF-77 cryogenic rocket engine under typical failure mode are obtained, which provides a theoretical reference for engine fault diagnosis.