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THEORETICAL ANALYSES OF PERFORMANCE OF THE INTEGRATED ROCKET-RAMJET ENGINE

Abstract

The possibility of applying integrated rocket–ramjet propulsion system for the air-breading booster of rocket launcher is theoretically analyzed in the paper. For this proposes the model of the integrated engine was developed and the performance was calculated for different flight conditions. Developed model is base on two-dimensional calculations performed by FLUENT numerical code. Calculation was directed to evaluate the influence of rocket section on ramjet mode. The influences of the variation of the O/F ratio in rocket mode on ejector performance were calculated. Additionally afterburning of the rich combustion products from the rocket section of the engine during mixing with incoming air from diffuser in ramjet section were analyzed. For the takeoff and initial acceleration the model contained a pure rocket with ejector, but for increasing Mach number of the flight afterburning was included in the ramjet section of the model. Inlet parameters, for ramjet section was initially calculated analytically, but later were also verified by FLUENT code. The calculation provided allows obtaining thrust and specific impulse of the integrated rocket-ramjet engine under different flight conditions (Mach number and altitude). The analyses of engine performance were made for methane fuel, oxygen and air. For low Mach number the engine operate basically on the rocket mode, while for higher Mach numbers rocket is basically used as the generator of fuel rich products, which are afterburning with air in combustion chamber of the ramjet section of the integrated propulsion system. The results of numerical simulation has shown that in the rocket ejector augmented system's specific impulse and the thrust is increased and significant increase of specific impulse is obtained for integrated rocket-ramjet mode of operation, especially for Mach number between 2 and 3.