SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (1) (3)

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COMPARATIVE ANALYSIS REGARDING USAGE OF DIFFERENT REACTION CONTROL SYSTEM ON MICROLAUNCHER ATTITUDE CONTROL

Abstract

In this paper we intend to make a comparative analyse regarding the usage for micro launcher attitude control a different Reaction Control Systems (RCS), in order to choose the best solution. First two RCS analysed are innovative systems using hybrid rocket engine technology and third are a regular one using cold gas. For RCS with hybrid rocket engine we use two technical solutions, a static one, based on six micro thrusters oriented in different directions and a dynamic one based on tilting nozzles. For RCS with cold gas we consider regular solution, similarly on VEGA and Ariane 5, but based on nitrogen. The static system uses several hybrid micro-thrusters with their thrust modulated by a separate control system. For RCS, each of the thrusters will be able to burn a few minutes and its thrust will be modulated within certain limits by controlling the oxidizer flow. The basic idea is not to stop any of the engines during system's operation but to minimize their thrust reducing the oxidizer flow. The dynamic system based on tilting nozzles is composed out of an oxidizer tank that is linked thru o a system of pipes to the burning chamber. In this burning chamber we find the solid fuel that under the effect of the oxidizer ignites. The hot gases are then transported thru a convergent – divergent nozzle to the evacuation chamber, where 4 divergent moving nozzles eject the gas outside the engine. Thru these 4 moving nozzles, the attitude command of the vehicle is assured. The required jet is assured thru a hybrid micro-engine. For calculus model of each RCS we start from own experiments performed in Electromecanica Ploiesti - Romania. Based on these calculus models the performances of the RCS were evaluated and their size was established. In order to study the effectiveness of RCS, the model of each one will be added to the dynamic model of the microlauncher, and the performances of the microlauncher for different RCS will be evaluated. The main results of the paper consist of microlauncher performance evaluations regarding his attitude in roll and pitch for different RCS. The novelty of this paper consists in the design solutions that were adopted in order to manufacture the RCS based on hybrid rocket engine technology. Conclusions and any discussion will be focused on technological possibilities for manufacturing the system and possible areas of application for the RCS.