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

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DYNAMIC CALCULATION MODEL FOR AN ATTITUDE CONTROL SYSTEM THAT USES TILTING NOZZLES

Abstract

In this paper we intend to develop a calculus model for an innovative Reaction Control System (RCS) using hybrid rocket engine technology and a tilting nozzle. In order to study the effectiveness of this system, a gazo-dynamic model has been constructed, in addition to the dynamic model that describes the movement of the rocket. In terms of the calculation model developed, we started from our theoretical and experimental studies, which aimed to build a computational model for hybrid rocket engine, highlighting his controllability. These studies are based on our own experiments performed in Electromechanics Ploiesti. Based on this concept we achieved a calculation of the performances of the RCS and an evaluation of its size. The system 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 rocket is assured. The required jet is assured thru a hybrid micro-engine. One of the novelty of this paper consists in the design solutions that were adopted in order to manufacture the RCS system. The RCS system assures the following functions: angular control of the vehicle on three axes, and it's stability on a preset trajectory. Also, thru the tilting of the nozzles between extremes angles that are equal in modulus, one being positive and the other one negative, the attitude control is assured, as well ass the traction. The command is modulated in time, which leads to a robust system that does not require the control of certain intermediary angles for the nozzle, but only the switching moment between points. The modelling of this kind of control system is also one of the novelty elements of the paper. Conclusions and any discussion will be focused on technological possibilities for manufacturing the system and possible areas of application for the RCS.