SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Prof. Teodor-Viorel Chelaru
University POLITEHNICA of Bucharest - Research Center for Aeronautics and Space, Romania, teodor.chelaru@upb.ro

Prof. Dr. Virgil Stanciu
Politechnic University of Bucharest, Romania, vvirgilstanciu@yahoo.com
Mr. Florin Mingireanu
Romanian Space Agency (ROSA), Romania, florin.mingireanu@rosa.ro
Mr. Adrian Chelaru
Romania, adrian.chelaru1988@gmail.com

# MATHEMATICAL MODEL FOR JET COMMAND SYSTEM USING CONTINUOUS HYBRID MICRO-THRUSTERS

**Abstract**

In this paper we intend to develop a calculus model for an innovative Jet Command System (JCS) using hybrid rocket engine technology. Our JCS uses several hybrid micro-thrusters with their thrust modulated by a separate control system. For JCS, each of the thrusters will be able to burn few minutes and its thrust will be modulated within certain limits by controlling the oxidizer flow. In order to reduce size and weight of the JCS we will use a single oxidizer tank which will have at the output a flow distributor. The basic idea is to have continuous burn for all the JCS micro-thrusters. However their thrust is reduced when their control action is not needed through a reduction of the oxidizer flow. This approach avoided the inconvenience of repeated stopping and starting the engine, which can create reliability problems the entire JCS. By creating thrust imbalance between various hybrid micro thrusters, one can create torques with which the attitude or the trajectory of the vehicle can be adjusted. The hybrid micro-thrusters plastic based fuels and has thrusts varying from the order of Newtons to order of tens of Newtons. Their burn time is of the order of 60-90 seconds. The computation model developed starts from our previous theoretical and experimental studies, which aimed to build a computational model for a hybrid rocket engine focusing on the scalability, stability and its controllability. These studies were presented in conferences IAC 2009 and IAC 2011 and are based on our own experiments performed at Electromecanica Ploiesti - Romania. Furthermore, starting from bifurcation theory, our computation models aims to outline the existence of two solutions for the basic parameters of the engine, leading to two modes of operation: one high thrust mode and one low thrust mode, keeping the unchanged geometric characteristics of the engine. At the same time, we demonstrate that the two solutions are stable and by oxidant flow control one can easily switch between them. Based on this concept we achieve a computation model of the performance of the JCS and an evaluation of their size depending on the mission that needs to be achieved. Conclusions will be focused on technological possibilities for achieving the system and possible areas of application of the JCS.