IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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

Dr. Cristian-Emil Constantinescu
Romania

THEORETICAL AND EXPERIMENTAL SOLUTIONS FOR MULTISTAGE QUASI-GUIDED ROCKET

Abstract

The purpose of the the paper consist in presentation of theoretical and experimental results for multistage quasi-guided rocket developed in Romanian under national research programs. The national programs focused on the development in successive projects of a technical solutions for microlauncher's subsystems, simultaneous with an adequate theoretical approach. The idea was to obtain a multistage rocket with the unguided function during first stage and the guided flight during upper stage by controlling the vehicle attitude. During the first stage, beside the native stability due the fins, in order to eliminate the asymmetry, we force a roll rotation by fins shape. The roll movement during the first stage induce a difficulty to evaluate the attitude of upper stage, after separation, at the beginning of his evolution. To solve this inconvenient, we develop Kalman filter which use information from the magnetometer. Using this algorithm, we can obtain initial attitude of the upper stage. Further, to solve control of upper stage we use un guidance system based on proportional-integrative-derivative low with Triger Schmidt nonlinear element. The command is realized by two blocks, each one having three nozzles with cool gases, with intermittent operation, similarly to VEGA launcher. In order to improve guidance system, we use rotation angles which are a combination between Hamilton quaternion and Euler angles. As working methodology, we combine the theoretical model developed with the laboratory experiments and the flight tests. We will present the testing plans for flight qualification of guidance system explained before, and the restrictions due to safety zone of firing range in Romania. Area of discussions is focused on possibilities to transpose the results obtained to a suborbital microlauncher. The novelty of the paper consists in original concept regarding quasi-guidance system of the multistage rocket, the Kalman filter used during unguided phase to obtain initial condition for guided phase and the rotation angles used for attitude control during guided phase.