SC CONTROL IN HIGH ELLIPTICAL ORBIT BY "STAR"-CONFIGURED THRUSTERS

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Primary dynamic problem that should be solved by the spacecraft (SC) control system in the high elliptical orbit (HEO) is the maintenance of SC orbit design parameters and of the required orientation. Orientation tasks include the following: orientation related to the achievement of target aim; orientation of solar panels towards the Sun; orientation of the corrective thrust vector.

A propulsion system comprising "star"-configured pivoted thrusters may be used for the SC flight control in HEO [1-3]. With such configuration the thrusters are arranged regularly in the same plane, and the nominal thrust direction for each thruster crosses the SC axis of inertia that is orthogonal to this plane.

Conceptual peculiarities of the SC attitude control using the "Star" configuration are discussed in the paper, and an example of the SC attitude control system operation is considered as applied to the program of orbit parameter correction implemented according to the algorithm described in [4].

In this example, the solar panels have aircraft-type configuration, according to which the solar panel orientation to the Sun is provided by the SC rotation to a roll angle relative to the SC longitudinal axis and the solar panel rotation relative to its axis to the solar panel rotation angle.

An important peculiarity of such solar panel configuration is the presence of two possible orientation options that differ from each other by 180° in the roll angle, and by the sign of the solar panel rotation angle. Under certain circumstances, precise orientation of solar panels to the Sun requires very high values of angular velocities and accelerations of SC rotation in the roll angle and solar panel rotation angle.

Nominal dependencies of the roll angle and the ranges of acceptable roll angle values, at which accuracy of the solar panel orientation to the Sun is not worse than 15°, are analyzed. Representations of the roll angle dependencies during the orbit correction in view of the ranges of acceptable roll angle values are obtained. Possibility to reduce angular velocities of the roll angle variation due to the transition from one option of the solar panel orientation to the Sun to another one differing in the sign of the solar panel rotation angle is shown.

References

1. V.A. Obukhov, A.I. Pokryshkin, G.A. Popov, N.V. Yashina Spacecraft motion and attitude control in the high elliptic orbit. IEPC-2007-30. 30th International Electric Conference, Florence, Italy. September 17-20, 2007.

2. V.A. Obukhov, A.I. Pokryshkin, G.A. Popov, N.V. Yashina Spacecraft motion and attitude control in the high elliptic orbit. M:, Vestnik MAI, v.14, No. 4, p. 22-29, 2007 – in Russian.

3. V.A. Obukhov, A.I. Pokryshkin, N.V. Yashina Thrust vector direction control for an electric propulsion system with "star" configured thrusters. "Kosmonavtika i raketostroyeniye", 2008, iss. 3(52), p. 51-57 – in Russian.

4. M.S. Konstantinov, V.M. Murashko, V.A Obukhov, V.G. Petukhov, G.A Popov, G.G. Tchernobelsky "Application of stationary plasma thrusters for the multispacecraft constellation deployment and maintenance", 56th International Astronautical Congress, 2005, IAC-05-C4.4.03