ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (10)

Author: Prof. Vyacheslav V. Ivashkin
Keldysh Institute of Applied Mathematics, RAS, Russian Federation

SPACE TRAJECTORIES FOR SPACECRAFT RE-ENTRY FROM GEOSTATIONARY ORBIT TO EARTH USING LUNAR GRAVITY ASSIST

Abstract

Space trajectories for the flight between the Earth and the geostationary equatorial orbit (GEO) with the lunar gravity assist are studied in the paper. The "detour" scheme for this flight is often better essentially from the energy point of view than the "direct" one [1-5]. The main attention is paid to the problem of the spacecraft re-entry from the GEO to the Earth. An "exact" numerical method in frame of four-body problem (Earth-Moon-Sun-particle) and a qualitative method of the point Moon's sphere of influence are used for the analysis.

The sets of these trajectories are constructed with the osculating perigee radius of the final orbit at the entrance to the Earth atmosphere as a parameter that is varied from zero to about the Earth radius. They can be used for the spacecraft destruction at the Earth atmosphere and for its soft landing on the Earth surface.

The trajectories with the flyby of the Moon near both ascending and descending nodes of the lunar orbit relatively the Earth's equator plane are presented. There are analyzed the peculiarities which are caused by the fact that the geographic longitude of the spacecraft on the GEO is fixed. The trajectories are presented for the case of a given geographic longitude of the spacecraft at the initial time.

An analysis of permissible deviations in initial data because of the rocket errors is given for the re-entry trajectory with a normal nominal entrance to the Earth atmosphere. It is shown that the permissible errors are large enough, and these trajectories can be implemented without the orbital correction.

References

1.Ivashkin V.V., and Tupitsyn N.N. Use of the Moon's Gravitational Field to Inject a Space Vehicle into a Stationary Earth-Satellite Orbit. // Cosmic Research, Vol. 9, No. 2, 1971. P. 151-159.

2.Graziani F., Gastronuovo M.M., Teofilatto P. Geostationary orbits from mid-latitude launch sites via lunar gravity assist. // American Astronautical Society Publications, Advances in Astronautical Sciences. Vol. 84, 1993, AAS 93-289, pp. 561-572.

3.Riebe T., Schweitzer M., Space operations and support. // AEROSPACE AMERICA, Dec. 1998, p. 83.

4.Ivashkin V.V. On Trajectories of Spacecraft Re-entry from a Geostationary Orbit to Earth Using Lunar Gravity Assist. // Doklady Physics, 2006, Vol. 51, No. 8. Pp. 450-453.

5.Ivashkin V.V. Space Flight from Geostationary Orbit to the Earth Using Lunar Gravity Assist. // 57th International Astronautical Congress Valencia, Spain, 2-6 Oct. 2006. Proceedings, Papers. Paper IAC-06-C1.8.4, 9 p.