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NEW TECHNOLOGY FOR THE OPTIMIZATION OF SATELLITE MANEUVERS BETWEEN NEAR-CIRCULAR ORBITS FOR THE PURPOSES OF VARIOUS SPACE MISSIONS

Abstract

There are currently two principal approaches to creation of technologies for solving practical problems of the satellite maneuvers calculation. The first one is based on simple and intelligible solutions, though not an optimal one. Another approach includes implementation cumbersome numerical methods in order to obtain an optimal solution. In the present paper a new technology for solving the basic practical problems of satellite maneuvers optimization for the purposes of various space missions is presented. This technology is principally different from the aforementioned ones and is based on developing special analytic methods for optimization the satellite maneuvers. The implementation of the technology based on these methods leads to the optimal (or nearly optimal) solutions, like in the case of the second traditional approach, but at the same time, like in the first case, allows vivid interpretation of the results. The technology includes software with extended user interface and incorporates the use of geometric elements in searching for solution. The technology can be used for optimization of coplanar and non-coplanar orbital transfer maneuvers (with flight time not being fixed), short and medium duration rendezvous, long duration rendezvous with target orbit having a significant deviation in the longitude of ascending node (this problem is faced during build-up and replenishment of the satellite constellations, especially perspective multi-tiered constellations basing on the orbits with different altitudes and inclinations, space debris disposal etc.) as well as station keeping of the satellite constellation configuration. The technology presented is applicable for near-impulse maneuvers, as well as for continued maneuvers performed with low-thrust engines. Another advantage of the technology in review is high speed of computer operations and, as a consequence, possibility of its implementation using on-board satellite computer. The technology is currently implemented as a universal software package for the optimization of the satellite maneuvers between the Low-Earth orbits with eccentricities up to 0.1 corresponding to wide range of different space missions. Its implementation can be extended to the cases of MEO and geostationary orbits as well as highly eccentric.