ASTRODYNAMICS SYMPOSIUM (C1)
Guidance and Control (4)

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DEVELOPMENT AND LABORATORY VERIFICATION OF CONTROL ALGORITHMS FOR FORMATION FLYING CONFIGURATION WITH A SINGLE-INPUT IMPULSIVE CONTROL

Abstract

Once been orbited the technological nanosatellite TNS-0 is supposed to be used in one of the next missions for the demonstration of orbital maneuvering capability purposed to eliminate a secular drift in a relative motion of two satellites under disturbing effects like J2 harmonic of the Earth's gravitational field. It is assumed the longitudinal axis of the satellite is stabilized along an induction vector of the local geomagnetic field and a thruster engine is installed along this axis. It decouples an attitude control and orbital manuevering of the satellite. Continuous and pulse thruster control algorithms eliminating the secular relative drift have been developed. It allows us to use Hill's problem solutions which simply describe relative motion of close particles in a central gravitational field as a nominal motion.

For demonstration and laboratory testing of satellite motion identification and control algorithms a facility of the horizontal smooth table and mobile mock-ups which are able to glide over the surface of the table due to compressed air stored in on-board pressure tanks was designed and build. Compressed air provides a glide of the mock-ups and their translational and attitude motion control by a number of pulse thrusters. Also, a battery, set of sensors and on-board computer with controllers are installed on the mock-up board. A dynamical model for mock-up controlled motion over the table was developed. Algorithms for mock-up motion control, which allow us to simulate a relative motion of pair of TNS-0 nanosatellites and controllable motion of other orbiting satellite group in the orbital plane, are developed too.

TNS-0 nanosatellite and the laboratory facility descriptions are presended. Results of TNS-0 nanosatellite controlled orbital motion and corresponding relative motion of mock-ups simulation are compared and presented in the paper. The facility experiments, together with analytical and numerical simulation of nanosatellite group motion, successfully verified dynamical models and algorithms for the motion identification and control. Actually, the hardware-in-the-loop research tool for testing of the satellite relative motion control models and algorithms has been developed, build and verified.

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