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STUDY ON OPTIMIZATION STATION-KEEPING STRATEGIES FOR BIASED MOMENTUM SATELLITE

Abstract

Based on the experience in biased momentum geostationary satellite management for many years, this paper studies manifold optimization station-keeping strategies which can advance satellite management efficiency. These strategies have been used extensively, and good effect has been achieved in application. Firstly, the control mode of single gimbaled V-wheel attitude control system and long-term momentum management is analyzed. Secondly three optimization station-keeping strategies are studied detailedly, and mathematics model of every strategy is built. Lastly application effect is given to demonstrate the merit of these strategies.

- The first is optimization east-west station-keeping strategy in normal mode. The influence of engines caused by momentum management on mean longitude drift, eccentricity, and station-keeping cycle is existent. Aiming at the problem that the influence of momentum management on satellite orbit can't be analyzed accurately, the characteristic of V-wheel control system is used in this strategy. Based on the analysis about solar radiation torque and variation of momentum wheel rotation rate, the accurate calculation means of engines efficiency and orbit change is derived. Finally exact perturbation model about momentum management is built. This strategy can improve station-keeping precision availably, from 15 days to 2 days.

- The second is rapid evaluation algorithm of east-west station-keeping control results. Using routine orbit measure method, accurate orbit determination result will be given after about 20 minutes since station-keeping control end, which will debase the efficiency of control effect evaluation and on-orbit application. Based on the analysis about relation between orbit change and variation of momentum wheel rotation rate, an algorithm is presented that can realize rapid evaluation of station-keeping control results using satellite momentum variation. This algorithm can provide evaluation results about the change of semimajor, mean longitude drift, eccentricity accurately in 5 minutes since control end. And the precision of this algorithm is good as much as multi-stations orbit measure method.

- The third is optimization south-north station-keeping strategy using bias yaw. About 15km coupling semimajor change is brought because of engines fixing error after south-north station-keeping. So east-west station-keeping whose purpose is to hold the satellite in east-west windows must be performed as

soon as possible, which brings the complexity of operation. Based on the analysis about disturber torque, the accurate calculation model about bias yaw is presented. Through executing constant bias yaw during south-north station-keeping, this strategy can reduce coupling semimajor change to 500m, and prolong satellite on-orbit life at least half a year.