Paper ID: 42546
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IP)

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ORBIT DETERMINATION OF CE-4'S RELAY SATELLITE IN EARTH-MOON L2 LIBRATION POINT ORBIT

Abstract

The lunar far-side is a virgin land and a unique scientific platform on which no humans or robots have ever landed. In order to support the far-side mission, a relay satellite is necessary and the Earth-Moon L2 libration point is an ideal location for relay. The Earth-Moon L2 libration point is unstable equilibrium point, once the Halo orbit was achieved, the ground team had to perform frequent small station-keeping maneuvers to keep the relay satellite orbiting around Earth-Moon L2 libration points. In this chaotic environment, errors in initial conditions and dynamic models used for propagation can have a significant effect on the resulting orbit solution. Thus, any improvement in orbit determination accuracy and dynamic modeling directly translates to mission capabilities in the form of reduced station-keeping maneuver and operations requirements.

Satellites in the region of consideration are perturbed predominantly by the solar radiation pressure except the gravity of the earth, the moon and the sun, the orbit determination accuracy is closely related with the solar radiation model. This paper proposes an optimized canon-ball solar radiation model, to improve the orbit determination accuracy of measured data.

The mission of the CE-4's Relay Satellite and the research status of solar radiation model in deep space exploration are introduced.

The numerical analysis is used to evaluate the perturbed dynamics of the relay satellite orbiting around Earth-Moon L2 libration points. At the same time, the effect of perturbation on orbit determination is evaluated.

The canon-ball solar radiation model is an empirical model for estimat-ing surface solar radiation, widely applied to the deep space exploration, the model is the function of fixed area-to-mass ratio.

An optimized canon-ball solar radiation model is proposed.According to the satellite structure and real-time satellite attitude to solve the real-time solar pressure equivalent area, it optimizes the area parameters in the canon-ball model.

We perform the CE-4's Relay Satellite orbit determination through BACC Orbit Determination and Analysis System(BODAS). BODAS uses a batch-weighted least-squares method and the optimized canon-ball model to estimate the orbit form received tracking data. At the same time, the contribution of the model on orbit determination accuracy is evaluated.

Combined with the results of orbit determination accuracy analysis, the advantages of the optimized canon-ball model are analyzed, and the idea of area modeling is proposed. The analysis and methods used for CE-4's Relay Satellite orbit estimation can be carried over to similar missions in the future.