ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics - Part 1 (5)

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ANALYSIS ON THE ATTITUDE INFLUENCE OF MOTIONS OF FLEXIBLE ANTENNAS AND ATTITUDE CONTROL FOR CHINESE TDRS

Abstract

Tracking and Data Relay Satellite (TDRS) can cost-effectively provide nearly world-wide coverage to manned and unmanned LEO/MEO spacecrafts. It is a large spacecraft with complicated structures that move in a wide range. This paper focuses on Chinese Tracking and Data Relay Satellite, in which a dynamical model for the flexible multi-body system is established first followed by study of antenna track and scan-back maneuver impact on the attitude of satellites. And at last, feed-forward attitude control law for TDRS with mobile antennas is proposed.

To track or point the target spacecraft with median/low orbit, the large mobile antennas of TDRS have to move in a wide range. The movement of such mobile antenna disturbs the satellite attitude consequently. First, the analytical model of the satellite is established based on the theory of multi-body dynamics. The satellite is considered as a rigid body with secondary accessories and described by using Newton-Euler equation to represent the kinematics relationship between bodies. The system dynamic equation can be deduced by using the Lagrange equation with the style of quasi coordinate. Influence of flexible antennas and accessories motions on the attitude of satellite is calculated by the model. The results showed that the influence is significant for designing the laws of control of satellite attitude with relevant analyses. Second, the main body of the satellite and the mobile antennas are controlled independently. The proposed controller first estimates the angular momentum which is produced by the mobile antennas based on the momentum conservation equation. Then it computes the desired velocity of reaction wheels to compensate the disturbance due to the antenna motion. In the following, it adds the error of the wheels' velocity between a desired one and a current value as a feed-forward signal to the control system. Third, the proposed controller is demonstrated through a mathematical simulation, and these results are concordant with the analytical results.