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RESEARCH ON CTDRS TLES IN GEOSYNCHRONOUS ORBIT AND THE METHOD TO IMPROVE THE ACCURACY.

Abstract

TLE (Two-line Element) sets and the consistent SGPx/SDPx propagator have been used in many missions, such as collision avoidance, space debris protection and thermosphere neutral density model calibration. Although SGPx/SDPx model was released, the precision has not been indicated. By comparing with the CTDRS accurate ephemeris calculated by measured data in geosynchronous orbit, the characteristics of 260 CTDRS TLEs(covering one year) and their prediction results by the SDPx model are analyzed. (1)At epoch of CTDRS TLEs, The error that is mainly distributed in the tangential and normal direction in the orbit plane is generally in the kilometer level. The number of TLEs which position error is lower than 10 kilometers accounters for 80% of the total sets. (2)CTDRS ephemerides are predicted by SDPx in the forward and backward direction of the TLEs epoch, and then are compared with the accurate ephemerides. The long-period and short-period components coexist in the position error and the maximum error is about 10 kilometers one day prior or posterior to the epoch. The radial and normal direction error components fluctuate symmetrically around zero, however the tangential direction component has an obvious deviation, which has greatest impact on the error. (3)According to CTDRS orbit maneuver time, the total 260 TLEs are divided into 12 arcs. Three prediction methods are used to splice TLEs included in each arc and the corresponding error is calculated. The second method is better than the others, in which the current TLE set is predicted from epoch to the previous TLE set epoch. (4) CTDRS ephemerides generated by the second prediction method are fitted by high precision orbit determination software as another kind of measured data. The RMS of the position error in each arc is less than 10 kilometers, and the MAX is less than 25 kilometers. Comparatively, the accuracy of TLEs and the ephemerides is significantly improved through the fitting process. The research can be used for CTDRS orbit determination in the emergency case and collision avoidance, which is also useful for other geosynchronous orbit satellites.