

GEO/LEO satellites joint orbit determination based on satellite-to-satellite tracking

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TDRSS and Double Satellite Positioning System (DSPS) usually consist of two or three operational geosynchronous (GEO) satellites and a few customers' LEO satellites. The satellite-to-satellite tracking data provided by these systems put forward the requirement for multi-satellite joint orbit determination (OD). This paper will introduce the difference between OD with known GEO ephemerides and OD with unknown GEO ephemerides, describe the measure model for sum of range observable and the difficulties on multi-satellite joint OD, and examine the OD accuracy for the whole system. The system including 2 GEOs, 1 LEO and 3 ground stations (tracking GEO) is regarded as the standard mode for TDRSS or DSPS. OD using the imitation observations on this mode indicates that GEO/LEO satellites joint OD can achieve better positioning accuracy than LEO single satellite OD under the same measurement and force model error. On the extreme mode(1 GEO, 1 LEO, 3 ground stations or 2 GEOs, 1 LEO and 1 ground station), the error on GEO satellite solar radiation force modeling is found to be decisive to the OD accuracy for the whole system. On the constellation mode (2 GEOs, N LEOs (e.g. N=3), 3 ground stations), the accuracy of 5-satellite joint OD can get further improved compared with the standard 3-satellite OD mode.