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PRECISE POINT POSITIONING OF MEGHA-TROPIQUES USING ROSA DATA

Abstract

Megha-Tropiques mission is an Indo-French collaborative project intended for studying water cycle and energy exchanges in tropics using a satellite platform. The spacecraft orbit is near earth at an altitude of 865.5 km and inclination of 20 degree so as to cover the tropical regions. It carries a 10 channel SPS and a payload ROSA which is an instrument consists of a 16 channel GPS receiver for space borne applications. It is specifically used for atmospheric sounding by radio occultation and also to determine position, velocity and time using GPS signals. The ROSA, besides providing real-time navigation data, is able to accurately measure pseudo ranges and integrated carrier phase. ROSA works in two main modes -Navigation, in which the normal navigation functions of a space GPS receiver are carried out, and Observation, in which the occultation measurements are carried out. The ROSA processes the received GPS signals in both L1 and L2 frequency bands allowing compensation of ionospheric delays. The POD antenna measurements (pseudo range and carrier phase) of ROSA instrument can be used for precise point positioning of the spacecraft. This paper describes the orbit determination system and achievable accuracy using ROSA data for Megha-Tropiques. The orbit determination system using ROSA data consists of accessing ROSA pocket data, pre-processing and orbit determination. Measurements were corrected for atmospheric and clock errors. Orbit determinations were carried out using dual frequency L1 L2 pseudo-range, Doppler and carrier phase data. Carrier phase measurements were processed and cycle slips were removed. Single difference method was used to remove the ambiguity. The dynamic model used for orbit determination consists of all the dominant perturbing forces including asphericity of earth, aerodynamic drag, Luni-Solar gravitation attraction, solar radiation pressure. Weighted least square method is used to estimate the orbit. The estimated orbit solutions were propagated and compared with onboard (NKF) orbit solutions and the results are presented. The orbit determination system performance is analysed by its quickness, reliability and consistency of determined orbit solutions and its achieved accuracy. Achieved OD accuracy was analysed in detail by theoretical definition based on 'difference in position' approach and by comparing OD results obtained from other sources viz. SPS/GPS based and ODTK results. It is observed that the achieved orbit determination accuracy of Megha-Tropiques with ROSA data is about 5 meters in position.