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INDIA'S FIRST LUNAR MISSION CHANDRAYAAN-I LAUNCH AND EARLY ORBIT PHASE ORBIT DETERMINATION

Abstract

India's first moon mission Chandrayaan-I carrying eleven scientific instruments for the purpose of expanding scientific knowledge about the moon was launched on 22nd October 2008 from Satish Dhawan Space Centre, Sriharikota, India by India's Polar Satellite Launch Vehicle PSLV-C11. Spacecraft was injected into transfer orbit of (257.928 X 22865.227) km with an inclination of 17.902deg at 2008-10-22-01-10-19-081 UT. The main objective of the mission is a simultaneous chemical, mineralogical and photo geologic mapping of the whole moon with high spatial resolution using high resolution state of the art sensors.

The spacecraft was put into moon's polar, circular orbit of about (100 X100) km on 13th November 2008 by carrying out sequence of five Earth bound maneuvers (EBNs), one trajectory correction (TCM) and four Lunar bound maneuvers (LBNs). The orbit of the satellite had to be determined continuously at a brisk pace to a good degree of accuracy to meet the requirements of the mission operations.Precise orbit determinations were carried out during each phase of the mission using tracking data collected from network of tracking stations configured for the mission. Tracking data was collected from NASA's DSN (Deep Space Network) as well as ISRO's DSN and non-DSN tracking stations. NASA's DSN stations namely Goldstone, Canberra, Madrid have supported the mission during initial phase of the mission. The purpose of this paper is to describe the methodology as well as the performance of Chandrayaan-1 orbit determination system using S-band range and accumulated Doppler measurements during initial phase of the mission.

ISRO's operational orbit determination software used for low earth missions was suitably updated and validated with simulated as well as live tracking data of Lunar Prospector mission before the launch of Chandrayaan-I mission. This paper describes about evolution and performance of OD software during pre-launch and post launch operations of Chandrayaan-I respectively. During initial phase of the mission, OD results from JPL/NASA were also obtained. This paper highlights on comparison of OD results with that of JPL obtained OD results during all phases of the mission. ISRO's OD results matched closely with that of JPL – OD results. At each phase of the mission, the orbit was determined using tracking data obtained over varying periods. The orbit solutions obtained from short arc OD's are compared with those obtained using the longest arc OD of each stage of the initial phase of the mission. This paper demonstrates the achieved OD results along with consistency and comparison with JPL-OD results during each phase of the mission. The maximum difference in position and velocity between ISRO's OD results and JPL/NASA OD results were with in 500 meters and 16 cm/sec respectively during initial

phase of the mission. Quick, accurate and consistent orbit determination solutions resulted in success of Chandrayaan-I mission.