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IMPROVED DEEP SPACE COMMUNICATION FOR INTERPLANETARY MISSIONS USING SATELLITE NETWORKS IN SUN-SYNCHRONOUS POLAR ORBIT.

Abstract

During the interplanetary journey of deep space spacecraft like orbiters or explorers, it is essential to get data on the spacecraft's health and the payload. Spacecraft navigation is also an essential part of interplanetary missions. Sometimes there is a need to perform Trajectory Correction Maneuvers (TCM) at the right time to get into the destination planet's orbit. So for both satellite communications and navigation, real-time data transmission is necessary and must be very efficient as it cannot waste a fraction of dB of performance. Nevertheless, for a deep space mission, communications performance is inversely proportional to distance squared. It takes minutes to many hours for signals to travel between a deep-space spacecraft and ground stations. With the earth's rotation, uplink and downlink telemetry with the ground stations breaks, which further delays the data transmission process. In this paper, we have proposed an approach to avoid the communication blackout caused by earth rotation and poor connectivity caused by the earth's ionosphere using a relay satellite (RESAT) placed in Sun-Synchronous Polar Orbit (SSPO). The satellite in SSPO can always keep its pace with the interplanetary spacecraft without any blackouts avoiding eclipses and repeats the same ground tracks each day at the same local time. The main advantage of SSPO is that the RESAT could get continuous telemetry from the spacecraft without any communication blackout and relay that data to the ground station with higher transmission rates. We developed an orbital model in which the RESAT placed in SSPO could get a continuous feed from the spacecraft cruising toward its destination.