

49th STUDENT CONFERENCE (E2)
Educational Pico and Nano Satellites (4)

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EFFECT OF SOLAR SAIL ON ANTENNA PARAMETERS AND LINK TIME OF NANOSATELLITE

Abstract

As solar sailing continues to gain popularity as a non-exhaustive method of propulsion and orbit steering, a compendious analysis of its effect on the parameters of communication is vital. This paper puts forth the study, done through simulations, of the impact of a massive reflecting sail on the operation of a system of antennas and changes in link time associated with the COEPSAT-2 mission. COEPSAT-2 is a student initiated nanosatellite research project aimed at demonstrating orbit raising through solar sailing with a scientific objective of measuring energy of the charged particles in space. The solar sail under consideration is a large 40 square meter reflective film made of a polymer substrate, providing a reflectivity of around 90 per cent, which causes changes in the antenna radiation pattern, gain, polarization, beam width and bandwidth. The system of antennas to be employed in COEPSAT-2 comprises a pair of dipole antennas for data uplink and downlink and a rectangular microstrip patch antenna for GPS signal reception. Due to the reflecting nature of the solar sail, the omnidirectional radiation patterns of the dipole antennas obtain directional properties. Besides, the orientations of the satellite are so chosen as to assist solar sailing and are not typically favorable for communication. Consequently, the radiation cone offers less coverage area on the surface of the earth owing to which it reduces the link time available for effective communication with the ground station. The communication feasibility has been inferred from the simulations performed for different TLEs (two-line element set) of the satellite over one year for nadir pointing and orbit raising orientations. A comparative analysis of the antenna parameters before and after the deployment of sail and its subsequent effect on the link time is presented and the results are

corroborated by extensive simulations.