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PERFORMANCE OPTIMIZATION OF 1U SATELLITE ANTENNA

Abstract

Swayam is a pico-satellite being developed by the students of College of Engineering, Pune. It is a passively stabilized 1U communication satellite operating a half-duplex link. The half duplex link was envisaged as a solution for lack of space for using two different frequency band antennae. The length of the antenna cannot be longer than the satellite itself for better stabilization. Being operated in the HAM band, there are two choices of frequency bands available in India. The higher frequency band is used as it requires a smaller antenna. The antenna system of a 1U satellite cannot be in deployed state during launch due to launcher constraints. This requires that the antenna be contained within or along the satellite body during launch and deployed after separation from the launch vehicle. Hence the antenna must be small and feasible for deployment. These two constraints narrow down the design of the antenna to a whip antenna. The whip antenna, to be mounted at the center of the surface of the satellite, has an insufficient ground plane. Hence, the satellite body forms a part of the antenna structure thereby the antenna behaving as an irregular dipole. Geometry of the payload antenna is optimized for beam-width of the radiation pattern and standing wave ratio. Being a passively stabilized satellite, beam width of the antenna has to be wide enough to offer maximum possible pass time. Circular curvature of whip and inverted triangular shape at the base are the geometric features of antenna which are optimized. The results of optimization computed using numerical electromagnetic code. Radius of curvature is limited by the property of antenna material to regain the intended shape upon deployment. The inverted triangular base dimensions are restricted by fabrication feasibility and mechanical strength requirements from the antenna. This paper describes the trade-off between the optimization of physical geometry and the performance of the antenna. The results of this trade-off yield the optimum antenna design for a 1U satellite employing a whip antenna for low power communications.