Design and validation of an adaptive CubeSat transmitter system

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Abstract

CubeSat in low earth orbit (LEO) primarily uses an amateur radio-band transmitter with a fixed specification. Nevertheless, the LEO satellite does not have an orbital velocity that equates to one sidereal day. Therefore, the ground station antenna views the satellite at different elevation angles which result in varied propagation path lengths. In this paper, an adaptive transmitter is designed to optimise the LEO satellite communication link and overcome the variability of the propagation path length issue due to different ground station elevation angles. A satellite communication link and operation analyses are performed to identify the relationship between the variation of the elevation angle so as to determine the optimum signal-to-noise ratio (SNR), improve data rate and increase the power efficiency of an adaptive link. Based on the results, a model is developed to control the adaptive configuration. The SNR and power consumption performance of the developed transmitter is compared with commercial transmitters. The results indicate that the transmitter output power is adjustable from 0.5 W to 1 W, and the data rate is selectable between 9600 bps and 19,200 bps. Compared to other CubeSat transmitters, the developed adaptive transmitter demonstrates more than 20% improvement in terms of SNR optimisation, additional throughput and power reduction. (C) 2019 Elsevier GmbH. All rights reserved.

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