SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Technologies for Space Communications and Navigation (7)

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MAXIMIZING CUBESAT TELEMETRY THROUGHPUT BY ADAPTIVE CHANNEL CODING

Abstract

Cubesat missions operating in LEO can gather large amounts of data, but have only a small time window every day when downlinking this data to a dedicated ground station. This window is usually extended by utilizing passes at lower elevation angles by transmitting at a higher power or reducing data rate and bandwidth to enable communication. This paper proposes an adaptive channel coding method that can be used to vary the telemetry throughput during a cubesat communication window. This adaptive method instructs the satellite the forward error correction scheme to use for each downlink packet based on real time calculations performed at the ground station. The essence of these calculations involves finding the error pattern in previously received packets — which is readily available at the output of a channel decoder at the ground station — and using the characteristics of the error pattern such as number and spacing between corrupted symbols and length of burst errors to select the appropriate channel coding scheme for the next packet from a predefined set. A predicted link margin and the actual received signal strength at the ground station also influence these calculations. This paper compares the achievable throughput of the adaptive method with the traditional approach based on observed error characteristics and practically verified link budgets. Other constraints that apply to cubesats, such as transmission power, required onboard computational power and time to run the channel coding algorithms are also compared. This paper seeks to reveal valuable insights in favour of developing a data link layer with an adaptive channel coding method suitable for future cubesat missions that maximizes the amount of data that can be downlinked and thus the utility of the mission. This proposal is based on the analysis of the error patterns and corrected output from a Reed-Solomon decoder on the received raw data from Swayam, a 1U picosatellite developed by undergraduate students of College of Engineering, Pune, and launched by ISRO, operating in LEO and communicating in the UHF amateur radio band.