SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Technologies (6)

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ERROR-CORRECTING CODES FOR RELIABLE COMMUNICATIONS IN MICROGRAVITY PLATFORMS

Abstract

Rocket launched microgravity platforms are employed to expose scientific experiments to a close-to-zero gravity environment. Experiments carried aboard these platforms may transmit telemetry data to ground stations as a measure against the very real risk of being unable to recover the vehicle after landing at sea, especially for the Brazilian launch sites. In this case, telemetry data is the only way to recover scientific data collected during flight; hence corruption of this data could put the experiment in jeopardy.

In the Brazilian Cumã II mission, launched from the Alcântara Launching Center (CLA) in 2007, we experienced such an instance of data corruption in the transmission of telemetry data from our experiment, named Platform for Acquisition of Acceleration Data (PAANDA). This instrument was conceived to assess the residual acceleration environment during the microgravity period of a microgravity platform. Theoretically it is capable of measuring accelerations with magnitudes of 1 μg. The instrument can also measure and store acceleration data of all flight phases of the vehicle, from launch through recovery.

PAANDA's telemetry data was received (with errors) by the CLA ground station, as well as the Barreira do Inferno Launching Center (CLBI) ground station, and due to these errors, part of the data was lost, including all of the telemetry data sent during the reentry period. For the second version of PAANDA, we sought to prevent such data corruption from happening.

Using this telemetry data, we observed that the communication channel for this application has peculiar characteristics, producing short and long periods of burst data loss. Traditionally, in specifying an error-correcting code for this channel, one might be compelled to specify a block code with very large block size to protect against long data loss periods. Instead, we propose the use of digital fountain codes along with traditional Reed-Solomon codes to protect against long and short burst error periods, respectively. We propose a model for the communication channel based on the information extracted from the telemetry data of the Cumã II mission, and simulate the transmission of data encoded with our proposed error-correcting code under this channel model. Simulation results show that, for reasonable coding rates, all but the last few blocks of data can be recovered, including data lost during the reentry period.