Paper ID: 39661
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24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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IMPROVED DATA SELECTION AND TRANSMISSION SCHEMES FOR APPLICATIONS WITH UNDEFINED TRANSMISSION DURATIONS

Abstract

Small low-cost atmospheric entry missions, without recovery, are required to transmit scientific data collected during descent, before communication is permanently severed. In case of scientific data collection during the hot phase of a re-entry, which usually corresponds to a communication blackout, data needs to be stored and transmitted after the plasma shroud subsides. Modelling atmospheric disturbances and accurately predicting the available time of transmission is very challenging. Here, two methods are presented that alleviate this problem, by ensuring that for an arbitrary transmission duration a maximum amount of useful collected data is transmitted. The classic scheme for the transmission of scientific data is done on a first in first out (FIFO) basis. Data points will be transmitted in the chronological order of collection. If the communication link terminates most recent data that was stored but not yet transmitted is lost. One presented method to circumvent this issue is called "bisection". The order of data point transmission begins with the oldest data point and is succeeded by the most recent. Third is the data point closest to the center of the set. Fourth and fifth data points are selected to be closest to the centers of the two intervals defined by the first three data points. Successive points are always centered between the already transmitted data points. Such a method will always converge to the data plot of a FIFO scheme, while directly producing a global data overview, which increases in resolution over time. Such a method is deterministic as the order of data points can be hardcoded. It also allows for effortless upscaling an arbitrary number of separate sensor data sets. The second presented method is called "gradient selective". Collected data is analyzed on-board and selected accordingly. First and second data points are selected as before. Transmission order here is to choosen by identifying absolute gradients between two successive data points. Strong maxima and minima are prioritized for transmission. It is shown that this method reproduces meaningful data sets quicker than the bisection method, which is indifferent to the data at hand. Each data set needs individual analysis, thus increasing the strain on available computing units. This method converges to the FIFO set, if full transmission was achieved. Both methods can be modified easily to function with dynamically appended data sets. Both methods are tested and validated on hardware planned for the nanosatellite MIRKA2.