 Paper ID: 39641
student

24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

Author: Mr. Manfred Ehresmann
Institute of Space Systems, University of Stuttgart, Germany

Mr. Florian Grabi
KSat e.V., Germany
Prof.Dr. Georg Herdrich
Institute of Space Systems, Germany
Dr. Rene Laufer
Baylor University / University of Cape Town, United States

EFFECTIVE CONTINUOUS TRANSMISSION SCHEME FOR BANDWIDTH LIMITED SATELLITE APPLICATIONS

Abstract

In this paper a transmission scheme is presented, which allows increasing the scientific output of any satellite mission with limited transmission bandwidth. This scheme is likely to be most interesting for the application on small satellites, as by scaling down the size of a satellite a transceiver, power supply and antenna are similarly scaled down. Hence, the available bandwidth is limited especially with regards to the possible data stream generated by any on-board sensors. Typically, the overall sensor sampling rate is reduced to accommodate the available bandwidth, which is, most likely, not the most effective way to transmit the measured data. The presented scheme allows for sensor sampling rates near the maximum processing rate the on-board computer (OBC) can handle. From one or two initial measurement samples a corridor of follow-up measurements is predicted. If a follow-up datum falls within the predicted corridor it is omitted from the transmission. Thus, its required data volume within the next transmission message is freed up to be used by data of other sensors, which does not fall within the predicted corridor. This makes dynamic payload packaging a requirement for OBC and ground station. The predicted corridor can be readjusted after transmission of a respective data package. Modelling the prediction corridor can be as simple as using a constant function by allowing a limiting deviation percentage from a reference datum, using a linear function by linear regression from multiple reference values, or using more complex functions depending on the type of sensor and measurement, as well as the required computational and memory overhead. The proposed scheme functions similar to lossy compression schemes , where data with high similarity is often excluded or replaced in the compressed output. The difference to usual compression schemes is that the full data set is not yet available but measurements are processed on the fly. As the ground station software has knowledge about the modelling implemented on the OBC implicit knowledge of skipped data is available. A naïve implementation of the proposed scheme could lead to the transmission of an error enriched data set. As measurement errors will, most likely, fall besides the predicted corridors. For the exclusion of erroneous data points, usage of calibration data and sensor error flags as well as in-sensor oversampling is advisable.