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AN APPROACH FOR CLASSIFICATION OF RF SPECTRUM DATA ON-BOARD THE NANOSATELLITE SALSAT

Abstract

The number of small satellites launches has increased continuously in the past years. The resulting intensification of radio communication and number of users inherits an increasing probability of interferences. This can compromise reliable satellite operation in the utilized frequency bands. Therefore, the nanosatellite mission SALSAT (Spectrum AnaLysis SATellite) of Technische Universität Berlin (TU Berlin) aims to investigate the global RF spectrum use in VHF and UHF amateur radio bands and in S band scientific bands. The SALSAT satellite is be equipped with the spectrum analyzer payload SALSA which is based on a Software Defined Radio (SDR). A preparatory study using the COTS device LimeSDR has been successfully performed during the MarconISSta experiment aboard the ISS. The experiment revealed first insights of the global spectrum usage for regions overflown by the International Space Station (ISS). The SALSAT mission shall achieve a global coverage.

It is expected that a large quantity of mission data will be collected during mission lifetime. However, the mission's capabilities are limited by operational and technological constraints. A limited up- and downlink capacity of the satellite and a comparatively small number of available ground stations are only a few examples. Nevertheless, the scientific value of a spectrum analysis mission is measured by the quality and quantity of the collected samples. This necessitates a payload design which maximizes the number of recorded samples and contained spectrum information over time. The amount of data generated on-board the satellite increases greatly and contrasts the abovementioned operational constraints.

This paper will introduce a new on-board data compression and classification approach to solve this contradiction. The SALSAT mission and constraints of nanosatellite missions for in-orbit spectrum analysis will be evaluated. The architecture and functioning of an artificial signal classification approach will be introduced. Test results of the classification algorithm will be presented and evaluated. Lessons learned during the development and testing process will be shared. The portrayed approach for on-orbit spectrum analysis and automated on-board RF data classification shall contribute in enabling future small satellite missions to collect and evaluate a great multitude of spectrum data. It aims to increase the effectiveness of the satellite downlink utilization and mission performance parameter, respectively. Following the principles of the Design-to-Cost philosophy the scientific outcome of the mission can be increased while the amount of human resources for data evaluation is decreased.