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Author: Mr. August Lear
UTIAS Space Flight Laboratory, Canada

Dr. Robert Zee
Space Flight Laboratory (SFL), Canada
Mr. Nathan Cole
UTIAS Space Flight Laboratory, Canada
Dr. Erica Peterson
UTIAS Space Flight Laboratory, Canada
Mr. Nicolaas Handojo
Space Flight Laboratory (SFL), Canada

TESTING, VALIDATION, AND CHARACTERIZATION OF THE RADIO FREQUENCY RECEIVING PAYLOAD AND DATA PROCESSING CHAINS FOR A SMALL SPACECRAFT MISSION

Abstract

As small spacecraft technology improves, more complex payloads are produced with more complex testing requirements. Wideband Radio Frequency (RF) sensing is one of these types of payloads seeing increasing demand. As the variety of signals being monitored increases, so too does the complexity of validating these systems to ensure mission success. Validation that these payloads are performing nominally before launch is critical to quick time to first data and reducing time-consuming on-orbit debugging. Current methods available for validating the RF payloads on-board these missions, such as on-orbit payload validation using a pathfinder mission, are expensive, time consuming, and difficult. This paper presents the process of validating and characterizing a general software-defined radio RF payload and data processing chain using synthetically generated RF spectrum. The process presented in this paper describes both end-to-end and unit-level testing of components within an RF and data processing chain. Testing on RF components is performed by connecting a software defined radio transmitter to the component input and transmitting representative RF signals through the component. Synthetic spectrum which represents the RF environment anywhere between the antenna input and the receiver can be generated by modelling filters and amplifiers within the payload receive chain. Many modern small spacecraft RF payloads use software-defined radios as their receivers, and this paper describes validation and characterization of software processes and data pipelines using simulated software-defined radio data.