Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

Master 2020

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Realisation of a small satellite software define radio transmitter demonstrator.

ABSTRACT - Masterthesis

Nowadays, among the space industries an ongoing evolution of small satellites by means of CubeSats is becoming a way to perform scientific and technological missions are more economically. The constellation of CubeSats with respect to rising of satellite numbers has urge to the reconfigurable communication platforms. As a result, an increasing number of communication window for supporting multiple signals with higher data rates over reliable inter-satellite and ground links to Earth are become more critical. Due to dramatic increments of small satellite, shortages are formed for available band frequencies for reasonably good performance band with 70cm and 2m. The existing radio signal processing core with Intellectual Property (IP) is unable to solve all of these issues. This is where the Software Defined Radio (SDR) comes to play an important role for possible solutions of these issues. The SDR is a such platform which has capabilities to make radio communications feasible by realising of various software implementations without changing the hardware.

In this work, we propose the design, realisation and test of a such SDR based transmitter which can be implemented in a typical small satellite. The work will be started with generating I-Q baseband signals with controlled frequency band. Three modulation techniques will be implemented in order to generate I-Q signals. Those digital schemes are Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK) and Quadrature Amplitude Modulation (QAM-16). Digitally modulated signals (I-Q) will be realised through the hardware adapter. In this project we choose to use very useful Field Programmable Gate Array (FPGA) board so called Red Pitaya V1.1. Which will be performed the FPGA configurations with respect to CIC, FIR, Complex Multiplications and DACs. The quadrature modulator circuit (LTC5588IPF) from 'Linear Technology' will be used for modulating/translating complex baseband (I-Q) signals into RF signal. This modulator circuit has demand of two differential signalling channels. Thus, two differential amplifiers circuitry will be implemented. A evaluation board (ADF4351) will be used to generate 35 MHz to 4.4 GHz carrier signal. In order to make a flexible system, Serial Peripheral Interface (SPI) protocol will be implemented for ADF4351 with respect to Red Pitaya.

Transmitter realisation will be completed after installing required software and hardware parts in meaningful manner. The generated signals and implemented circuits will be tested. Characterisation will be measured by Eye and constellation diagram and required bandwidth with spectrum analysis.