Multipath Fading Demonstration Platform using Software Defined Radio

Students

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Introduction: Nowadays, smartphones, internet of things (IoT) and many other wireless devices are omnipresent and have to work in environments that are very far from ideal from a technical perspective. Wireless channels have many complex problems that need to be solved to guarantee a reliable communication link. Among the multitude of problems, a common issue is the so called "multipath fading effect". Multipath refers to the fact that electromagnetic waves radiated from a transmitter antenna may take different paths and be reflected on multiple surfaces before reaching the receiver (see figure 1). Because electromagnetic waves travel at a constant speed, and some paths are longer than others, the receiver sees multiple superimposed copies of the sent signal, each with a different phase shift. However, in practice only one path is desirable, thus the other delayed copies cause a degradation of the received signal (fading and intersymbol interference).

Definition of Task: The goal of the project is to develop a platform to illustrate the impact of different fading effects on the received signal. The platform is thus built for educational purposes and ought to show the various parts of the signal processing chain of a receiver.

Approach: Two USRP B210 software defined radio (SDR) devices from Ettus Research, together with the open source software libraries GNU Radio and Dear PyGUI were used to create a graphical user interface to display waveforms from either a simulated or real wireless link affected by multipath fading. The platform transmits data either using QPSK or 16-ary QAM over a 2.4 GHz carrier and computes the empirical bit error rate of the link.

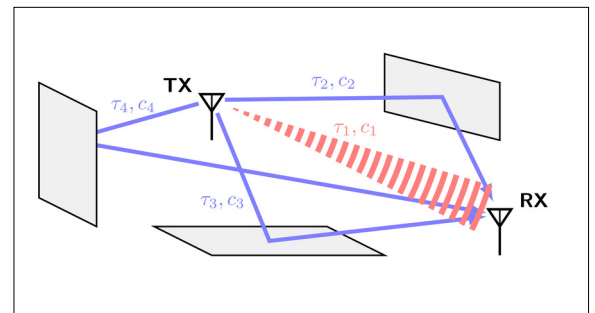**Figure 1: Sketch of a channel with multipath fading**
Own presentment

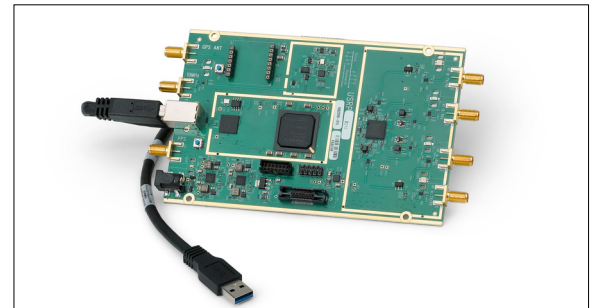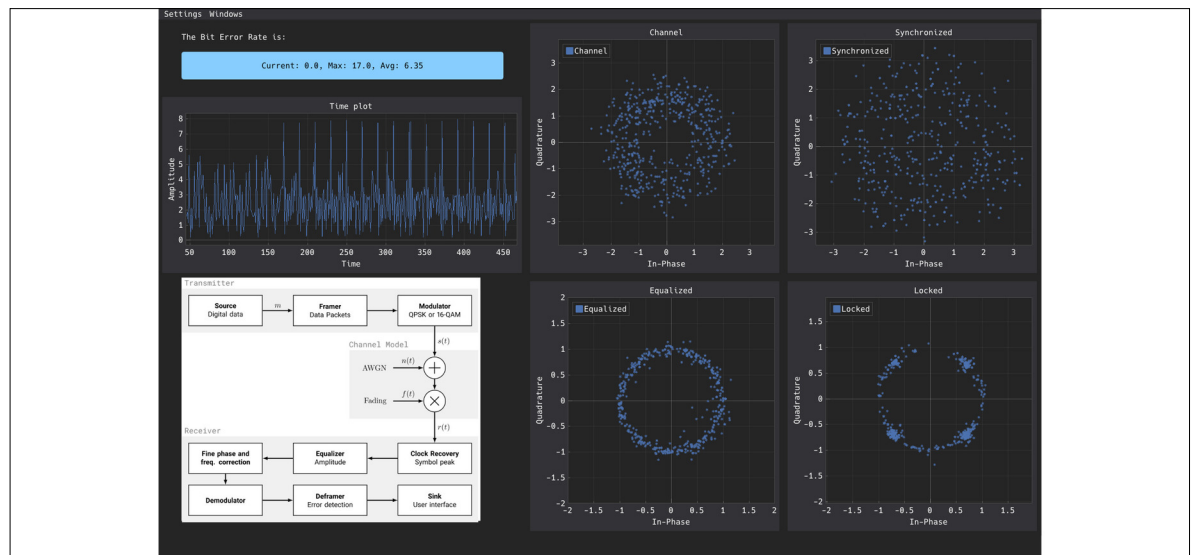**Figure 2: USRP B210 SDR Kit - Dual Channel Transceiver**
Ettus Research

Figure 3: Graphical user interface
Own presentment