Universal Software Radio Peripheral (USRP) Instruction Guide

The USRP is an open source hardware platform for Software Defined Radio (SDR). SDRs are radio devices whose functionality is defined primarily in software which results in flexible systems that can perform very different functions.

The USRP system uses a host PC to perform the bulk of the signal processing. On the transmit side, the USRP essentially acts as a Digital-to-Analog converter (converting digital samples from the PC to analog waveforms), a modulator (which converts base-band signals to high frequency signals) and a Radio-Frequency (RF) amplifier (which transmits the high frequency RF signals with sufficient power to propagate through the air). On the receive side, the USRP acts as an RF amplifier (amplifying wireless RF signals to appreciable levels), followed by a demodulator (which converts a high frequency RF signal to base-band) and an analog to digital conversion (which converts the analog base-band waveform to digital samples for processing in the PC). The USRP interfaces with the host PC via a USB connection.

The USRP has been used in many different academic institutions primarily for research but also for teaching and as such there are several different software tools that could be used to interface with the USRP, the most popular of which is GNURadio.

The simplest method to use the USRPs is by reading from and writing to raw data files. The UHD driver (which is the hardware driver for the USRP provided by Ettus Research) has utilities to transmit raw data samples from files, using two utilities. tx_samples_from_file and rx_samples_to_file

These utilities use binary data formats which can be specified by the user. The real and imaginary data are alternating in these files.

Two MATLAB functions are provided with your assignment to read and write files in the float32 format.

To get the command line parameters required, you can type ./tx_samples_from_file –help if you have included /usr/lib/uhd/examples in your path.

For example:

tx_samples_from_file --file tx.dat --type float --freq 2.4312e9 --rate 1e5 --gain 0 --bw 1e5

This transmits the samples stored in file tx.dat which is stored in 32-bit floating point, at a carrier frequency of 2.4312 GHz and a sample rate of 100k samples/second, with a gain of 0dB (i.e. 1).

To receive signals:

rx_samples_to_file --file rx.dat --type float --freq 2.4312e9 --rate 1e5 --gain 0 --bw 1e5

This receives samples and stores them into the file rx.dat in 32-bit floating point format. The remaining parameters are the same as in the transmitter. This function terminates after the user hits CTRL-C on the keyboard.

Usage Tips

Start receiving before you transmit. This way, you can be sure to not miss any transmissions

The receivers often have a large glitch at the beginning, so be prepared to discard about 1000 initial samples.

Be cautious of how large your files get. They could be cumbersome to manipulate if you save large amounts of receive data in single files.