3.3 Lab 3C: OFDM System Through the USRP

To transmit an OFDM modulated signal through the USRP, you will build off of your simulated implementation from Lab 3A and 3B. In Lab 1, we utilized complex numbers to interweave data before sending across the USRP. You will do the same in this case. You should write your data to a file before sending it through the USRP. The USRP will return another file which you can then decode.

Since we are transitioning from simulation to hardware there are extra considerations. Sampling frequency offsets, or phase offsets, need to be accounted for. This can be done using pilot tones as described in **?? ??**. The low pass filters (LPF) in hardware are also not ideal. They will have some roll off, frequency zones with non-flat fading towards the edges of the LPF. In addition, there will be a DC component that needs to be accounted for. Solutions for these can be implemented as described in **?? ??**.

Goal: Transmit OFDM modulated data using the USRP with the following specifications:

- Bit-Error Rate: less than 0.001 (maximum)
- Data Rate: 1 MB/S (minimum)
- Using BPSK (or QPSK/QAM as a stretch goal)

802.11 WiFi uses BPSK at its lowest rate of 6 Mbps, i.e.when the channel conditions are just good enough to establish a minimal link. At the highest rates, it uses 64 QAM modulation.

Clipping occurs when the amplitude of the signal is too high for the analog to digital converters (ADC) or digital to analog converters (DAC). This effect can be seen if you transmit a cosine curve but the frequency domain plot of the received signal has peaks outside the expected frequency. In order to avoid this, make sure that the amplitude is less than 0.5. You may still notice clipping if your transmitter and receiver gains are high enough.

Deliverables: Please turn in all MATLAB code in your final implementation and corresponding report. Be sure to document and submit any files that will allow your code to run on another device without a USRP. Make sure to refer to the technical writing expectations for this course in the appendix as you write your report.

Table 3.3: Lab 3C Rubric

	Points	Self-Assessment
Introduction Section *Introduction of the goal of the lab and any contextual information*	5 points	
System Explanation *Explanation of the physical system; Diagrams are well suited to this*	5 points	
Explanation of Differences with Hardware *Explanation of the techniques used to send through hardware:* *- Phase Jitter* *- Handling Roll Off* *- Accounting for DC Offset*	20 points	
Implementation Section *Discussion of your particular implementation that highlights any design decisions*	20 points	
Code Explanation *Explanation of your code that isn't super granular; Include a flow diagram*	15 points	
Results Section *An overview of the results of your implementation; Include all plots that illustrate your implementation* *Include:* *- Constellation diagrams of relevant signals* *- One block of sent and received data* *- BER - Achieved data rate with calculations explained*	15 points	
Revised Lab 3B Section *Lab 3B technical report is included and edited where suggestions were made*	10 points	
Technical Writing *Refer to the technical writing guidelines*	10 points	
Self-Assessment *Fill out this rubric and include it in your submission.*	5 points	