Chapter 1

Lab 1

1.1 Lab 1: Synchronization

Goal: Implement a basic digital communications link using the Universal Software Defined Radio Peripheral (USRP) with the following specifications.

- Distance of at least 2 feet
- Data rate of at least 32 kbps
- Error rate of less than 10^{-3}
- Implement Quadrature Amplitude Modulation (QAM)

Recommendation: Start with the following steps:

1. Install the UHD driver. Instructions are given in **?? ?? ??**.
2. Transmit data at a low-rate data (1-2 bps, meaning large symbol period). Visualize effects of carrier frequency offsets. Research methods for timing synchronization.
3. Implement a low data rate communications system.
4. Optimize the communications system to improve data rate.

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 1.1: Lab 1 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; include a block diagram*	5 points	
Explanation of the Timing Synchronization Algorithm *Explanation of the mathematics and implementation of the timing synchronization algorithm you used*	15 points	
Explanation of QAM *Explanation of how QAM works and a comparison between BPSK and QAM*	15 points	
Implementation Section *Discussion of your particular implementation that highlights any design decisions*	15 points	
Code Explanation *Explanation of your code that is not too granular; include a flow diagram and label functions and scripts*	15 points	
Results Section *An overview of the results of your implementation; Include all plots that illustrate your implementation and a block diagram of your physical system* *Include:* *- Constellation diagrams of transmitted and received signals* *- Time plots of transmitted and received signals (before and after timing synchronization)* *- Achieved error rate with calculations explained* *- Achieved data rate with calculations explained*	15 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	