

## Lab #9 - Demodulation & BER Testing - ELEC 433 - Spring 2013

1. Modify your QPSK transmitter to implement differential encoding. This is a fairly simple extension, requiring only a few registers and XOR gates.
2. Implement a QPSK demodulator using the same differential mapping from #1.
3. Implement a BER tester in your receiver.
  - To align the demodulated bits with the known transmitted bits for comparison and BER measurement, correlate the known header with the received signal to find the beginning of the received frame. We recommend using a length-63 MLS as the header. On the website, we've included a matlab function for generating MLS sequences and have included a 64-tap FIR filter block. It is up to you to figure out how to use the filter to implement correlation.
  - Between the transmitter and receiver, add a simulink AWGN channel block. Vary the noise variance of the AWGN block, describe the BER you observe.
4. Split your transceiver into transmit and received parts, and interface each part to the WARP radio block, so that the transmit path is connected to a radio, and the receive path is connected to a radio. You will also want to connect the demodulated symbols to the DAC, so that you can view your demodulated constellations on a scope.
5. Export your transceiver as a pcore, and integrate your transceiver into the skeleton xps project we have provided on the website. Write C code for controlling your design (observe the API commands for radio control that are already a part of controller.c code in the project). The features of this controller should include:
  - Enabling/disabling CFO correction
  - Enabling/disabling/resetting collection of BER statistics
  - Configuring whether a given board is acting as transmitter or receiver
6. Download the bitstream and verify that you can transmit a signal of the air, and successfully demodulate at the receiver. Be sure to show your working design to Michael or Evan
7. As in part 3, measure BER as a function of SNR. You will not know the exact value of SNR, but you can control the *relative* SNR by varying the transmit power. Include a plot of BER vs. transmit power in your report, and discuss the results.