Communication Basics
Lap Report 1
Transmitter Simulink Study

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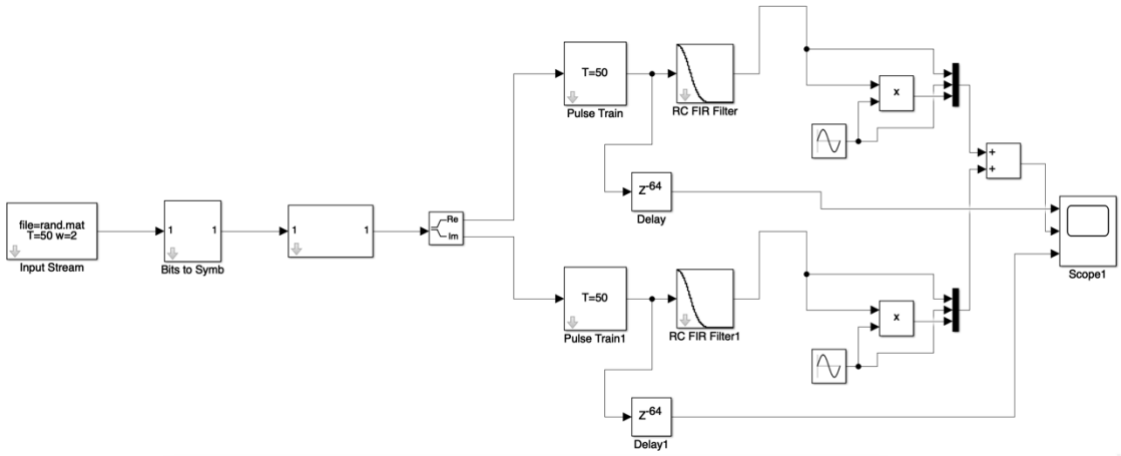
Lab Write Up:

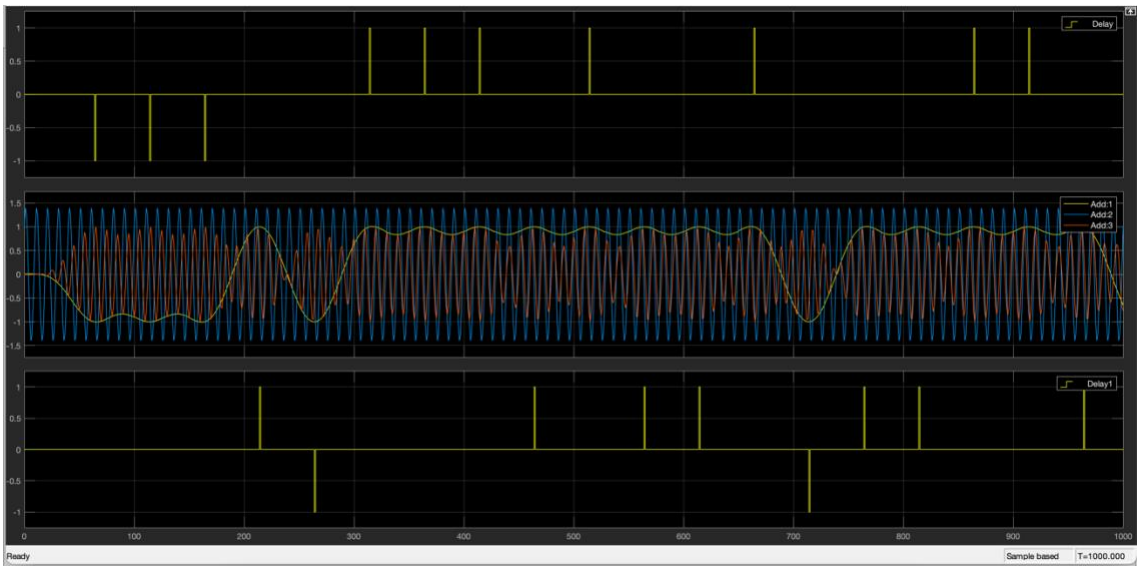
- *Explain in one or two paragraphs what you learned about communications systems that you didn't know before.*

One of the new things I learned in this lab is the reason for pulse-shaping. Since having a large bandwidth in frequency domain is very expensive, and rectangular shape has sync shape in frequency domain whose bandwidth is infinity, we can describe rectangular shaped signal with sync shaped signal in the time domain, whose transform in frequency domain would be rectangular shaped.

- *Show a picture of your final QPSK transmitter. Explain briefly what the different blocks are for. Explain how you checked that it was working correctly. A plot of the output showing important signals would be very helpful.*

The final design of the QPSK transmitter is shown below. Here, the very first block reads the input file names "rand.mat". Then, the input is mapped to symbols with indexes from 0 to 3 and the lookup block maps these symbols to [1 j -1 -j]. Thus, these blocks encode 00 to 1, 01 to j, 10 to -1, and 11 to -j. After, we split the signal into the real and imaginary parts. The pulse train block samples its input, RC filter avoids ISI and puts the signal to baseband giving delay of 64 samples. Then, sine wave function is multiplied for the up conversion of the signal. The real part is multiplied by a cos function, while the imaginary part is multiplied by a sin function. The results are combined and displayed in the scope. Also, the real and imaginary parts are displayed in the scope with delay of 64 samples to compensate the delay from RC filter.





- *Explain why we do pulse-shaping in communications systems, rather than just sending rectangular pulses.*

When we transmit a digital signal between two points, it is important to note that the bandwidth of any digital signal is infinite. However, all physical communication channels have finite bandwidth. A pulse shaping filter's job is to turn a discrete time sequence of digital data into a continuous analog signal. Furthermore, they reduce the bandwidth of the analog signal so that it doesn't exceed the channel's bandwidth.

- *Tell why synchronization (e.g. sampling the received signal at the right place) is critical in a communications system that uses pulse shaping)*

The receiver must figure out when to sample the channel in order to recover the symbols correctly. The delay from the transmitter to the receiver is an unknown amount of time. Therefore, the receiver must be able to synchronize itself based on information found only in the signal. In other words, the synchronization is the process by which a receiver node determines the correct instants of time at which to sample the incoming signal.

- Describe any difficulties you experienced in getting your design to work and how you fixed these problems.

I didn't have any problems, everything was clear!