CSE 4214 :: Lab 3

Issued January 5, 2009; Due TBA

This lab introduces you to CDMA transmission and detection.

Although you are allowed (and encouraged) to consult with other students in performing this lab, your work must be submitted individually. Group submissions are not allowed.

Section 1. Feedback shift registers and chip sequences.

For a feedback shift register (FSR) with 5 flip-flops, consider the following pair of feedback taps:

[5, 4, 3, 2], [5, 4, 2, 1]

For each FSR, do the following:

1. Sketch the connections in the FSR.
2. Show that both FSRs produce maximum-length sequences, and give those sequences where the initial state of the shift register is: [1, 1, 1, 1, 1].
3. If a chip of 0 is transmitted as +1 for one time unit, and a chip of 1 is transmitted as -1 for one time unit, plot the sequences from part 2 with respect to time.
4. In the absence of interference, find the value of N_0 such that the probability of bit error is 0.25, and the value of N_0 such that the probability of error is 0.01. Show that these values must be the same for both sequences.

Section 2. Simulating the CDMA system.

In this part you will implement the system you designed in part 1. Use the same simulation method you used in Lab 1, with sampling frequency of 20 samples per time unit.

In this case, you have two users that are sharing the channel using CDMA: you will assign the [5, 4, 3, 2] chip sequence to one user, and the [5, 4, 2, 1] sequence to the other user.

The received signal will consist of the sum of the two users' signals, plus Gaussian noise with the appropriate variance. In the receiver, you will have two matched filters: one matched to the [5, 4, 3, 2] chip sequence, and the other matched to the [5, 4, 2, 1] chip sequence. As mentioned in class, apply each user's matched filters to the received signal to extract that user's transmitted symbol.

Simulate the CDMA system as you did in lab 2, using 2000 bits of binary data per user (a total of 4000 bits). Using MATLAB's plotting features, plot the simulated error rate versus N_0 on a log-log scale. In this case, your results should be somewhat worse than the values you found in part 4 above, because that analysis neglected interference.

Deliverables

Your deliverables for this lab are:

- Answers for the four parts in section 1;
- Your MATLAB code for section 2; and
- Plots from section 2.