CSE 4214 :: Lab 4

This lab will introduce you to M-ary data transmission.

In lab 2, you devised a method for simulating digital communication systems, and you simulated the performance of polar NRZ. In this lab, modify your code as follows to simulate the performance of an M-ary system.

Your modified code should have the same specifications as that for lab 2. However, instead of taking $s_0[k]$ and $s_1[k]$ as parameters, the code takes s[k] and α as parameters, where:

- s[k] represents the one-dimensional basis vector of the signal space;
- $\alpha = [\alpha_0, \alpha_1, \ldots, \alpha_{M-1}]$ is a 1-by-M vector containing the coefficients for each symbol (i.e., $s_0[k] = \alpha_0 s[k]$, $s_1 = \alpha_1 s[k]$, etc.).

Furthermore, the code returns three values. The first two are the theoretical symbol error probability and the simulated symbol error probability, as in Lab 2. The third returned value is x, where:

- If M is a power of 2, then x is the simulated bit error probability assuming the usual map from decimal to binary (e.g., for 4-ary, 0 = 00, 1 = 01, 2 = 10, 3 = 11); and
- If M is not a power of 2, then x is undefined, and you are free to return any value.

Let

$$s[k] = \begin{cases} \sqrt{n_b}, & 1 \le k \le n_b \\ 0 & otherwise \end{cases}.$$

Using this value of s[k], propose a method to compare the performance of binary, 4-ary, and 8-ary in terms of energy per bit. Using the method you propose, as well as the simulation program specified above, plot results on a log-log scale illustrating the bit and symbol error performance of these three schemes, with respect to energy per bit. Describe any conclusions arising from your scheme.

Deliverables

Your deliverables for this lab are as follows:

- All MATLAB code and plots; and
- A complete description of your simulation scheme, and any results obtained.

Deliverables are due at the end of the lab period on November 13, 2009.

Demonstration

In the lab, the TA will ask you to describe your work. You will demonstrate your simulations, and answer any of the TA's questions. The lab must be demonstrated before the end of the lab period on October 30, 2009; otherwise, the demonstration will be marked as "incomplete".

Evaluation

The following three components of this lab will be evaluated separately:

- Written work;
- MATLAB code and plots; and
- Lab demonstration.

Each component is weighted equally, and graded on the following five-point scale:

- 5: Outstanding work demonstrating original thinking
- 4: Satisfies the lab requirements
- 3: Minor issues in satisfying the lab requirements
- 2: Major problems in satisfying the lab requirements
- 1: Work is incomplete
- 0: Work is missing (or student is absent for the demonstration)

Note that the maximum grade for satisfying the basic lab requirements is an "A" (80%).