

## SGN-2206 Exercise Set 5

(Friday, November 16, 2007)

**Problem 1** Consider the channel equalization (Lecture 1) application.

Write a program for implementing the following steps:

1. Simulate the signals as in attached Figure *e2.pdf*, generating a training set and a validation set:

- Simulate some (useful) signal to be transmitted:

random bipolar (-1,1) sequence:  $a = (\text{randn}(5000, 1) > 0) * 2 - 1$

- Channel model:

$W = 2.9$

$h = [0, 0.5 * (1 + \cos(2 * \pi / W * (-1 : 1)))]$

$ah = \text{conv}(h, a)$

- Gaussian noise with variance 0.001:

$v = \text{sqrt}(0.001) * \text{randn}(5000, 1)$

$u = ah(1 : 5000) + v$

Note:

- First 500 samples are used to design the equalizer
  - Next 4500 samples are used to validate the performance of equalizer
2. Use LS method to estimate the parameters of the equalizer;
  3. Evaluate the equalizer performance using the validation data set;
  4. Experiment the effect of different data windows on the LS estimate;
  5. Write the LS estimation program for covariance method in 3 different ways and compare the results:

**Problem 2** Consider the same channel equalization application as in Problem 1. Simulate the signals as in Figure *e2.pdf*, generating a training set and a validation set. At time 250, change the parameters of the channel model, from  $W = 2.9$  to  $W = 3.1$ .

1. Use Recursive Least Squares (RLS) method to estimate the parameters of the equalizer;
2. Use LMS method to estimate the parameters of the equalizer;
3. Evaluate the equalizer performance using the validation data set;
4. Experiment the following:

- Differences in RLS estimate, depending on the parameters  $\delta$  and  $\lambda$ ;
  - Differences in LMS estimate, depending on the adaptation step  $\mu$ ;
5. Repeat the experiment for a different time variant scenario (e.g. slow drifting channel model parameter).