ASP: Homework 2

Adaptive Equalizer:
Suppose that the transmitter transmits a known (random) sequence $d(n)$ of length N through a channel with impulse response $h(n)$. The output of the channel, denoted by $u(n)$, is then fed into an equalizer whose output is denoted by $y(n)$. With the known $d(n)$ as the desired signal, we study the use of the LMS algorithm for training the coefficients of the equalizer, so that the trained equalizer can equalize the channel effect.

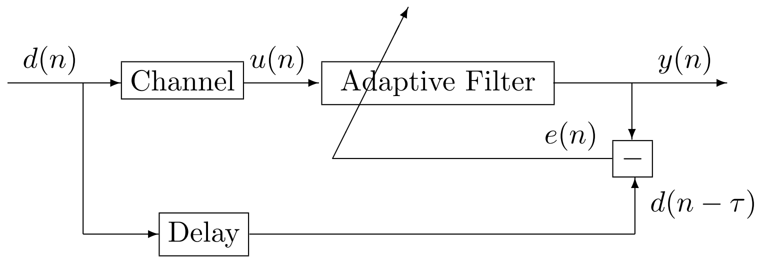

Figure 1: Application: Inverse Modeling.

The setup (Section 6.8 of the book by Simon Haykin, 5-th edition):

1. $d(n) = \pm 1$ is a Bernoulli sequence with length $N = 2000$.
2. $h(n)$ is a raised cosine with

$$h(n) = \begin{cases} \frac{1}{2}\left[1 + \cos\left(\frac{2\pi}{W}(n-2)\right)\right] & , \ n = 1, 2, 3 \\ 0 \ , & \text{otherwise} \end{cases}$$

   where W is a parameter controls the distortion of the channel.

3. The equalizer has $M = 11$ taps.
4. $\tau = 7$ models the delay.

Task: Use the LMS algorithm to train the equalizer and observe the behavior of the LMS algorithm. Specifically, you may do 200 independent runs, and plot the learning curve of "$e(n)^2$ versus n" obtained by averaging over the 200 independent runs. You may try

1. the effect of different W, say $W = 2.9, 3.1, 3, 3$, or 3.5
2. the effect of different delay τ.
3. the effect of different step size μ.
4. the effect of adding white noise $\nu(n)$ which corrupts $u(n)$.

You may refer to the book Adaptive Filter Theory, 5-th edition by Simon Haykin.