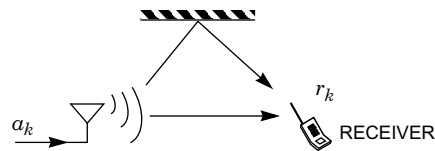


ECE 4601
ASSIGNMENT NO. 7

DATE ASSIGNED: Tuesday October 28, 2003
DATE DUE: Thursday November 6, 2003
READING: Chapters 9, 10

Consider the following scenario:



A wireless transmitter sends a sequence of 16-QAM symbols $\{a_k\}$ to a portable receiver. There is a line-of-sight path and also a reflection, which results in a delayed and attenuated version of the transmitted signal at the receiver. Specifically, the k -th symbol-rate sample at the receiver is given by:

$$r_k = a_k + g_k a_{k-1} + \text{NOISE},$$

where $g_k = 0.25 - 0.25\cos(\pi k/500)$. Observe that the reflected energy changes as a function of time.

In this assignment you will explore the performance of an adaptive linear equalizer with N taps using the LMS algorithm, based on the following MATLAB code:

```
alphabet=[-3-3i,-3-1i,-3+1i,-3+3i, ...
          -1-3i,-1-1i,-1+1i,-1+3i, ...
          1-3i, 1-1i, 1+1i, 1+3i, ...
          3-3i, 3-1i, 3+1i, 3+3i];
L = 2000;
echo = 0.25 + 0.25*sin(4*pi*(1:L)/L);
a = alphabet(ceil(length(alphabet)*rand(1,L)));
C = [1; zeros(N-1,1)];
r = a + [0,a(1:L-1)].*echo + 0.2 * randn(1,L) + 0.2i*randn(1,L);
R = zeros(N,1);

for k=2:L,
    R(2:N) = R(1:N-1);
    R(1) = r(k);
    z(k) = C.' * R;
    C = C - mu * (z(k) - a(k)) * conj(R);
end;
plot(z, 'o');
```

- (a) What is the disadvantage of having a step size that is too small?
- (b) What is the disadvantage of having a step size that is too large?
- (c) Can you predict analytically what the equalizer coefficients should be, roughly, at any given time k ?
- (d) For $N = 4$, find the step size μ_{opt} that minimizes the $\text{MSE} = \frac{1}{L-1} \sum_{k=2}^L |z_k - a_k|^2$.
- (e) Repeat part(d) for $N = 3, 5, 10$. Does μ_{opt} increase or decrease as N increases?