EEC 215 HW#4

1. For the system in Problem #1a of HW#3 (copy attached).

a) add an offset of 0.2 to the output of the channel. What happens to the MSE in steady state? Show a plot of MSE.

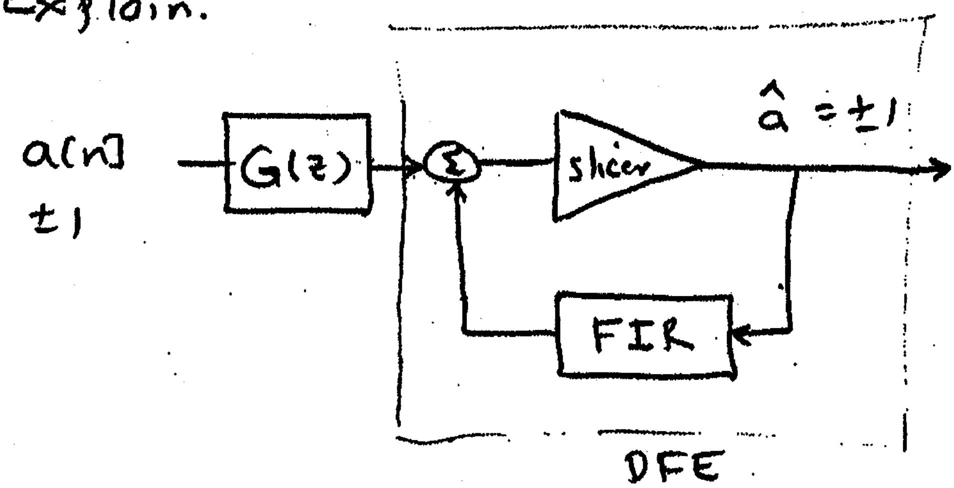
b) now add a DC-offset-cancellation tap to the equalizer. Plot MSE vs time. Plot the DC coeff value vs time.

c) for the system in (b), let's assume we're using analog d-t integrators in the adaptive loops, and that each integrator has an input-referred offset:

i.e.: $C_i[n+1] = C_i[n] + \mu\left(e[n]\,x[n-i] + \text{offset}_i\right)$.

Assume all the offset_i's are equal, and simulate with $\text{offset}_i = 0.01, 0.1$ and 0.2.

What happens to the MSE and the coeffs as the offset increases? Explain.

2. 

a) Let $G(z) = 1 - 0.3z^{-1} - 0.1z^{-2}$. Use an adaptive 2-tap DFE. Plot the coeffs and MSE vs time.

b) try a 3-tap DFE. What happens?

3. Derive the LMS update equation for the DFE coeffs:

$$d_i[n+1] = d_i[n] + \beta\,\epsilon[n]\,\hat{a}[n-i]$$

as we did in class for the FIR equalizer coeffs.

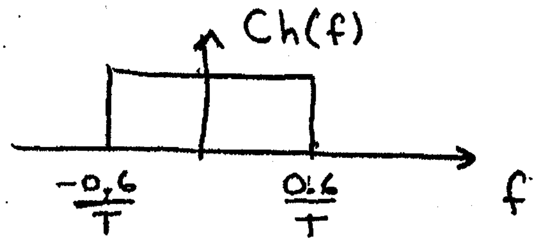
4. A channel has been equalized so that the total response is

$$G(z) \cdot E_q(z) = \left(1 - z^{-1}\right)\left(1 + z^{-1} + z^{-2}\right).$$

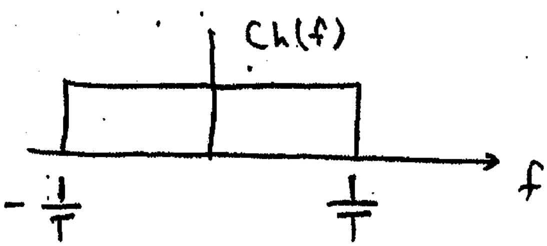
If the binary data transmitted is $\pm 1 = a[n]$, what levels will appear at the output of the equalizer?

5. Decide if the following c-t channels satisfy the Nyquist criterion for transmission at a rate $\frac{1}{T}$ w/o ISI.

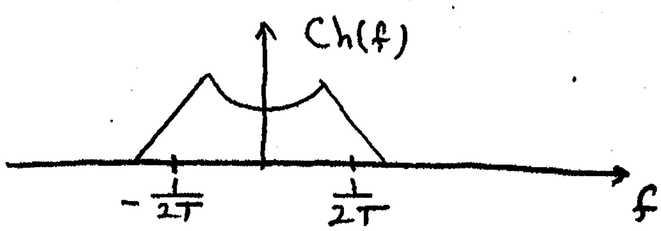
a)



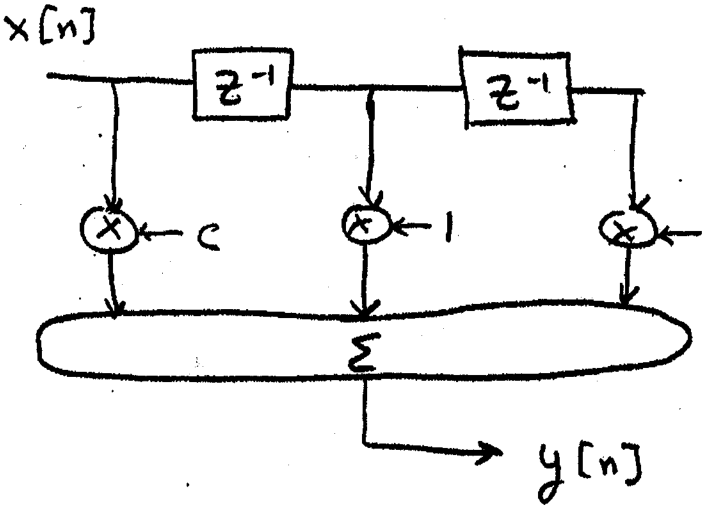
b)



c)



6.

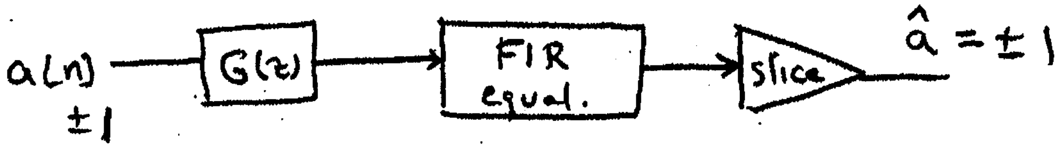


a) For the equalizer above (called a "cosine equalizer"), find $Eq(z) = \frac{Y(z)}{X(z)}$.

b) Let $z = e^{j\omega T}$ and show that the equalizer has linear phase and a magnitude response that is a fn of $\cos(\omega T)$.

c) If $x[n]$ = white noise w/ $\sigma_x^2 = E(x^2)$. What is the noise power in y? Is it bigger or smaller than σ_x^2?

7.



Let $G(z) = 1 - z^{-1}$. What FIR equalizer coeffs would be required to equalize this channel? How many taps?

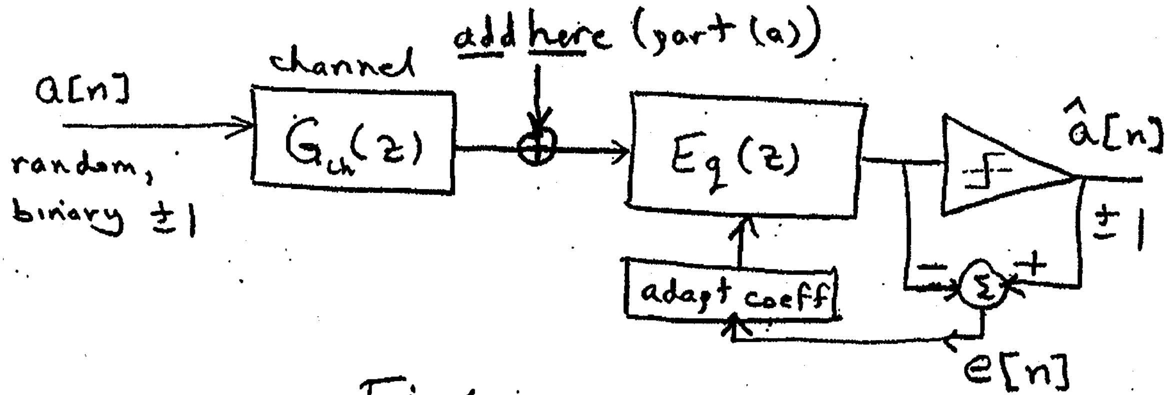


Fig. 1

$E_q(z)$ = adaptive FIR equalizer

1. a) In Fig. 1, let $G_{ch}(z) = \frac{K}{1 - 0.6z^{-1}}$, $K = 0.4$.

Use the LMS algorithm to adapt a 2-tap FIR equalizer. Use $\beta = 0.01$.

Preset the equalizer coeffs so $E_q(z) = 1 + 0z^{-1}$ initially. Plot the coeffs versus time.

Also plot $MSE[n] \approx \frac{1}{20} \sum_{i=0}^{19} e^2[n-i]$.

Show 2000 samples.

b) Repeat (a) using a 4-tap FIR equalizer. What do you notice?

c) Repeat (a) using $\mu = 0.001$. Compare (a) & (c).