

EE685: VLSI Broadband Communication Circuits; HW4

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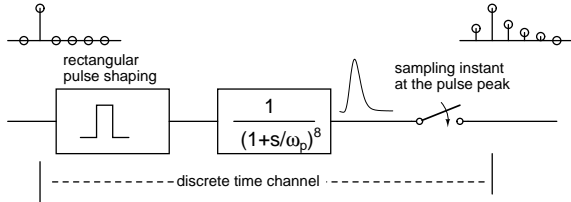


Figure 1: Channel model

Channel model: For this assignment use the channel model above. Determine the sampling phase by driving the channel with a unit pulse and finding the peak at the channel output. Do all simulations for $\omega_p/2\pi = 1$ GHz and $\omega_p/2\pi = 0.5$ GHz. Input binary data has ± 1 values and the slicer output levels are ± 1 .

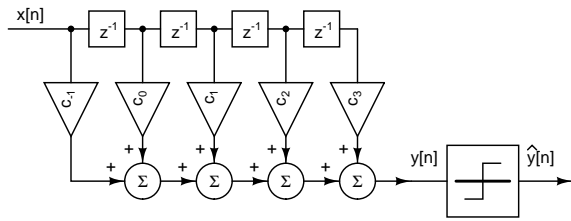


Figure 2: Feedforward equalizer

Adaptive feedforward equalizer: $x[n]$ is the discrete-time output of Fig. 1 for a PRBS 7 sequence. The FIR filter in Fig. 2 has the following coefficient ranges:

- $-3 \leq c_{-1,1} \leq 3$
- $0.5 \leq c_0 \leq 5$
- $-1 \leq c_{2,3} \leq 1$

At startup, all coefficients except c_0 are zero and $c_0 = 1$. Simulate the equalizer with adaptation for the following cases

- LMS algorithm, $\mu = 1/64, 1/16$.
- Sign-sign LMS algorithm, $\mu = 1/64, 1/16$.
- Sign-sign LMS algorithm, $\mu = 1/64$, coefficient updated by μ after $\text{sgn}(e)\text{sgn}(de/dc_k)$ accumulates to ± 32 . The accumulator is reset after each update.

Simulate the system until the coefficients are settled. Compare the coefficients to what you get by directly minimizing the mean squared error in the channel+equalizer impulse response (as you did in the first assignment). Show plots of the coefficients and the squared error versus time.

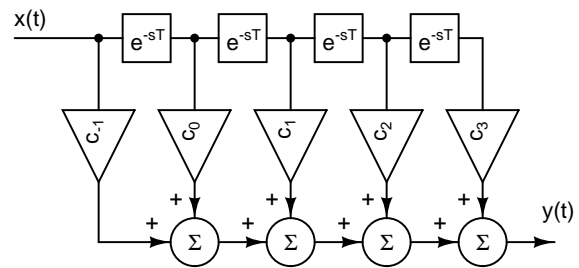


Figure 3: Continuous time feedforward equalizer

Continuous time waveforms: Simulate the equalizer in continuous time using the settled values of the coefficients and plot the eye diagram of $y(t)$. Determine the horizontal and the vertical eye opening. Do this for all cases above.

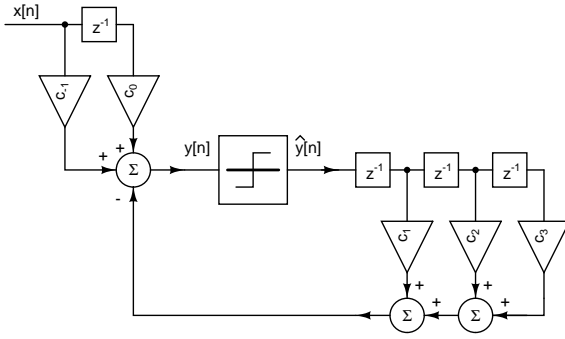


Figure 4: Decision Feedback equalizer

Adaptive feedforward and decision feedback equalizer: $x[n]$ is the discrete-time output of Fig. 1 for a PRBS 7 sequence. The FIR filter in Fig. 4 has the following coefficient ranges:

- $-3 \leq c_{-1,1} \leq 3$
- $0.5 \leq c_0 \leq 5$
- $-1 \leq c_{2,3} \leq 1$

At startup, all coefficients except c_0 are zero and $c_0 = 1$. Simulate the equalizer with adaptation for the following cases

1. LMS algorithm, $\mu = 1/64, 1/16$.
2. Sign-sign LMS algorithm, $\mu = 1/64, 1/16$.
3. Sign-sign LMS algorithm, $\mu = 1/64, 1/16$, coefficient updated by μ after $\text{sgn}(e)\text{sgn}(de/dc_k)$ accumulates to ± 32 . The accumulator is reset after each update.

Simulate the system until the coefficients are settled. Compare the coefficients to what you get by directly minimizing the mean squared error in the channel+equalizer response (as you did in the first assignment) Plot the squared error versus time. Plot the magnitude response of the feedforward part (c_{-1}, c_0) of the equalizer and compare it to that of Fig. 2.

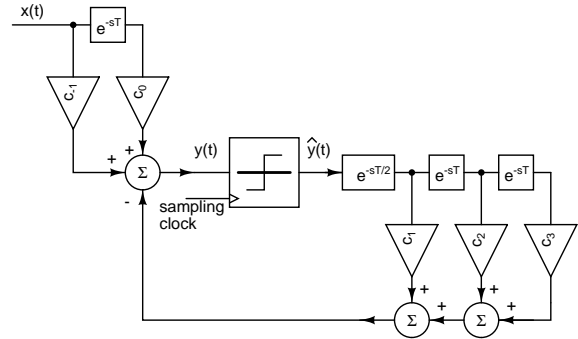


Figure 5: Continuous time decision feedback equalizer

Continuous time waveforms: Simulate the equalizer in continuous time using the settled values of the coefficients and plot the eye diagram of $y(t)$. Do this for all cases above. Determine the horizontal and the vertical eye opening. The sampling phase for the decision slicer is the same as what you determined for Fig. 1. Note that the first delay after the slicer is half the sampling period (why?).

Time taken to do the assignment: How many hours did you spend on this assignment? Of those, how many were spent in writing up the report?