HW5 - Viterbi Equalization
due December 11, Tuesday

In this problem set, consider a received signal model

$$y_k = \sum_{l=0}^{L} f_\ell x_{k-\ell} + n_k$$

where f is the *causal* ISI channel impulse response, x_k is the binary data symbol at time k ($x_k \in \{-1, 1\}$), and n_k is the AWGN noise sample ($n_k \sim N(0, \frac{N_0}{2})$).

Consider three ISI channel scenarios

1. $f_\ell|_{\ell=0}^{4} = \begin{bmatrix} 0.74 & -0.514 & 0.37 & 0.216 & 0.062 \end{bmatrix}$
2. $f_\ell|_{\ell=0}^{1} = \begin{bmatrix} 0.893 & 0.449 \end{bmatrix}$
3. $f_\ell|_{\ell=0}^{2} = \begin{bmatrix} 0.802 & 0.536 & 0.265 \end{bmatrix}$.

Note that all channels are normalized ($\sum f_\ell^2 = 1$).

For each given channel, implement a Viterbi equalizer (note that the trellis size of the equalizer will change with each channel) and a 15-tap MMSE equalizer. Run Monte Carlo simulations to measure performances of both equalizers for each channel.

Before generating the figures and preparing your report, go through the next page.

Instructions on Figures, Report and Submission:

You are expected to implement the equalizers on your own, therefore do not use the equalization toolbox. Your code has to be understandable (commenting, meaningful variable names etc).

For each channel, create one semi-logarithmic BER vs E_b/N_0 figure by following the instructions below.

- Each figure will have 2 curves in total: Viterbi, MMSE.
- Name each curve, show the legend and make sure the legend does not block the curves. (*semilogy(...,'DisplayName',CurveName)*).
- Curves for Viterbi equalizers will be red with the marker 'x'.
- Curves for MMSE equalizers will be blue with the marker 'o'.
- All curves will be straight lines (no dashed or else.)
- Axes have to be squared (*axis square*).
- Background have to be gridded (*grid on*).
- Set the font size of the figure to 14 (*set(gcf,'FontSize',14)*).
- Label both axes. No need for a title, instead caption the figures in your report.
- Make sure your curves go down to at least 10^{-4} BER level.
- Limit the axes appropriately (no blank spaces).
- You will end up with 3 different figures (one for each channel).

In your report, comment on the change in performance when the equalizer is switched for the same channel.

Your report does not need to exceed two pages. Zip the three m-files with your report pdf and upload it on the moodle. Late submission is penalized with 10% per day.