Problems Week 4

Due Thursday, October 20, 2016

1. **Prepare two data sets and produce spectra.** For this problem set, please generate a 100,000-element data set with Gaussian white noise. Use your white noise to generate a second data set using an autoregressive (AR1) process. In Matlab you can do this as follows:

```
a=randn(100000,1);
b(1)=b(1)=a(1);
for i=2:length(a)
  b(i)=.5*b(i-1)+a(i);
end
```

   Now compute spectra for the white noise and autoregressive data sets by breaking the data up into segments. What are the differences between the spectra?

2. **Convolve your data with a filter.** To do this, try 2 filters (or "windows") applied to your 2 "data" sets: (a) a 50-point boxcar window, normalized so that the coefficients sum to 1 (e.g. boxcar(50)/50), and (b) a 50-point Hanning window (e.g. hanning(50)/sum(hanning(50))). Now compute and plot the spectra of the data convolved with the filters. What is the difference between the 2 filtered results?

3. **Compute spectra for the filters.** To do this use the 50-point filters suggested here, but pad them with zeros to make a 1000-point record. (You'll only need to do one segment, since there's no noise in your filters.) What is the structure of the spectra of the filters?

4. **Interpret the results.** Based on what we discussed in class, what relationship would you have expected between the spectra of the data, the spectra of the filter, and the spectra of their convolutions? Are the results consistent with this expectation? What do these results tell you about possible implications of choosing a boxcar filter vs a Hanning window? Why do the two filters lead to different results?