Handing in

Please hand in your m-files and a *short* PDF document summarizing your results. More figures are good. You will not be critiqued on your writing style, and point-form is OK. However, completeness and clarity is important so we can tell that you have understood the assignment.

To hand in, please `tar cfz` or `zip` your files (please don't use any other archive formats) into one directory with your lastname and the class id: i.e. `LastnameP515/`, and name your archive the same way (i.e. `LastnameP515.tar.gz`). Name your `pdf` file the same way, (i.e. `LastnameP515.pdf`). No need to uniquely identify your m-files so long as they are in a directory.

Email your archive to mailto:jklymak@uvic.ca.

PLEASE DO NOT INCLUDE THE DATA FILES (we have them already!).

If you used `tar` you should have an output like:

```
> tar tfzv LastnameP515.tar.gz
>   LastnameP515/LastnameP515.pdf
>   LastnameP515/mfile1.m
>   LastnameP515/mfile2.m
>   ...
```

Periodigrams and Spectral Coherence

- mailto:jklymak@uvic.ca
- http://web.uvic.ca/~jklymak/Phy580/

Obtain the data in http://hornby.seos.uvic.ca/~jklymak/Phy580/ShearData.mat. or as ASCII at http://hornby.seos.uvic.ca/~jklymak/Phy580/ShearData.txt.zip.

This data is from an oceanic towed turbulence instrument described at http://mixing.coas.oregonstate.edu/papers/Observations_of_boundary_mixing.pdf. No need to read this paper unless you are interested.

The data `dat.time` is the time in seconds. The data in `dat.s` is the first derivative of velocity dU/dx measured using a shear probe; units are s^{-1}. The data in `dat.ac` is data from an accelerometer, translated into equivalent shears via $dU_a/dx = a/U_o$, where U_o is the speed of the vehicle in the x direction. The accelerometer measures vibrations of the instrument that contaminate the shear signal.

For the following excercise be sure to label all axes and, if necessary, indicate different lines using the `legend` command. Please indicate units of the variables in your axes labels.

You will be graded on quality of data presentation. The choice of poor axes limits, or inappropriate axes scale (i.e. using a linear scale where a logarithmic would be more revealing) will cost grades. I am aware this is somewhat subjective, so it would be hard to do too badly at this part, but some care and thought into how you present your data is an important skill to learn.

1. Plot 20 seconds of the data and qualitatively compare the structures.

2. Compare the power spectra of the two signals, averaged for the whole data set (i.e. compute periodigrams). Use fft lengths of $nfft = 64, 256, 2560, 24000$. Deal with the fact that the number of data points is not necessarily a multiple of nfft in some reasonable fashion.

3. Subsample the shear data by a factor of 10 (i.e. make a new time series using every 10th data point) and take a power spectra with $nfft = 256$ and compare with the power spectra from

above with $nfft = 2560$. Calculate the variance from each spectra and from the raw time series. Does the variance change? Why or why not?

4. Redo the above, but smooth the data first to something close to 10 samples and then subsample. Compare the spectra and the variances. (HINT: to smooth, use some of the techniques Andrew and Chris are teaching you, but in 1-D. You may want to look up `conv2` and `filter` or `filtfilt` in Matlab. A simple boxcar (running average) filter should be more than adequate).

5. Plot and describe the differences (in a few sentences) between the spectra of `dat.s` from an "active" time (200 to 250 s) to a "quiet time" (50 to 100 s).

6. In the spectra above, estimate the coherence between the `dat.ac` signal and the `dat.s` signal. Which is more coherent - the "active" or "inactive" region? (HINT: remember that you need more than one degree of freedom to do this properly).

7. Compare windowing the data with a Hanning window in the "active" region to not windowing. Is there any advantage to windowing this data set? Why or why not.