

## Problems Week 4

*Due Monday, October 28, 2019*

We've talked about least-squares fitting, and we've talked about the Fourier transform, so it's time for us to test both strategies out using the same data set. Here we'll use the automated pressure data from the Scripps Pier. (As a reminder, you can download it here:)

<http://sccoos.org/thredds/catalog/autoss/catalog.html>,

For 2019, use data records 17873 through 26072, since these are evenly spaced in time. (If you decide you need more, you can extend to 14642 through 32189, which will give you a handful of double increments that you can fill by interpolation.) You can download the data directly into matlab using

```
filename='http://sccoos.org/thredds/dodsC/autoss/scripps_pier-2019.nc';
pressure=ncread(filename,'pressure');
time=ncread(filename,'time');
```

1. **Visual evaluation.** Plot the time series of pressure data from 2019, and examine the time increments between adjacent measurements. (You can do this in Matlab using the “diff” command, for example.) Are the data always uniformly spaced? What is the increment between measurements? How long is the time record? Are there other portions of the 2019 record that also have reliable uniform spacing?
2. **Least-squares fit.** Least-squares fit a mean and 3 major tidal constituents to your data. What is the mean, and what are the total amplitudes of the tidal constituents? (Total amplitude should be determined from the square root of the sum of the squares of the sine and cosine amplitudes.)

| Symbol | Name                    | period (hours) |
|--------|-------------------------|----------------|
| O1     | Principal lunar diurnal | 25.82          |
| K1     | Luni-solar diurnal      | 23.93          |
| M2     | Principal lunar         | 12.42          |

3. **Fourier transform.** Now Fourier transform your data. (Don't worry about any of the details of computing a spectrum for this exercise—just Fourier transform.)
  - a Plot the real and imaginary parts of the Fourier transform. Find the peaks. What frequencies correspond to these peaks? Are they what you'd expect based on the known tidal frequencies?
  - b Now use the Fourier coefficients to identify the mean pressure and the amplitudes of the major peaks. (Hint: to determine the amplitudes of the oscillatory modes, you'll need to multiply by a factor of 2 to account for both the positive and negative frequencies.)

- c Do these spectral peaks align with the results from the least-squares fit? Is there anything you could do to further check your results?
- d Now plot the spectral energy (based on the squared magnitude of the Fourier coefficients) as a function of frequency. Is the spectrum red, white, or blue?