

## Homework 4:

## Geophysical Data Analysis (16:712:615)

### Due Monday April 5

1. Re-write Bob's m-file `lsq1.m` to solve the harmonic problem by performing a direct solution of the model design matrix using the matlab matrix left divide. Her is a template for `lsq2.m`:

```
function [x]=lsq2(om,H,t);
% x = lsq2(om,H,t)
% where om is a vector of harmonic frequencies
%       H is a vector of height (or other) data to
%       be fitted
%       t is the time vector
%       (the units of om and t must be consistent)

% force time and data to be column vectors
H = H(:);
t = t(:);

% force harmonics to be a row vector
om = om(:)';

% obtain number of harmonics to fit from length of om
m=1+2*length(om);

% build the model design matrix and solve by backslash
% (the matrix left divide least squares solution)

% HINT: Having made H,t column vectors, and om a row
% vector, you can complete this function in 3 lines
% of matlab code
```

2. Load file **tuckertonweather.mat** located in the class matlab directory <http://marine.rutgers.edu/dmcs/ms615/matlab>. These are meteorological data for 2003 from the Rutgers Marine Field Station (RUMFS) at Tuckerton.

The air temperature (`tair`), air pressure (`pair`) and 10-meter wind speed (`u10`, `v10`) time series in the file have gaps. Experiment with using the 1-dimensional quadratic loess smoother to fill ONLY the missing values to produce a regular interval time series. Compare the spectra you get for different interpolation scales to the “true” spectra computed from data in the file **Metdata2003rodan.mat** (which has no gaps).

Use the loess smoother with a long time scale to remove low frequency variability, and plot the normalized autocorrelation function for air temperature, pressure, and

wind for time lags up to 10 days. Describe what you notice about how the functions differ, and speculate on physical reasons for the differences.

Try fitting Gaussian:  $f = \exp(-0.5*(t/a).^2)$  and

Markov:  $f = (1+t/a).*\exp(-t/a)$

functions to the data using the Matlab function `fminsearch`