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## Ren_data1_week4.m

```
Sea surface pressure, fitting with Fourier coefficients

A. Ren October 26, 2017
```

## load data

```
load('../Week3/scrippspier_auto_p.mat')
```

## want evenly spaced data: use January 2015

```
dataspacing = diff(SP_time_2015_mtlabtime);

inde = find(dataspacing ~= duration(0, 6, 1), 1, 'first');
disp('time increment non-uniform after: ');
disp(SP_time_2015_mtlabtime(inde))

sampledat_w = SP_press_2015(1:inde);
sampletim_w = SP_time_2015_mtlabtime(1:inde);
sampletel_w = sampletim_w - sampletim_w(1); %elapsed time since t0
sampletel_w = days(sampletel_w);            %convert to days elapsed
```

```
time increment non-uniform after:
   04-Feb-2015 09:24:36
```

## check for NaN

```
sum(isnan(sampledat_w))
```

```
ans =

     0
```

## fft

```
coefficients = fft(sampledat_w);

realpart = real(coefficients);
imagpart = imag(coefficients);

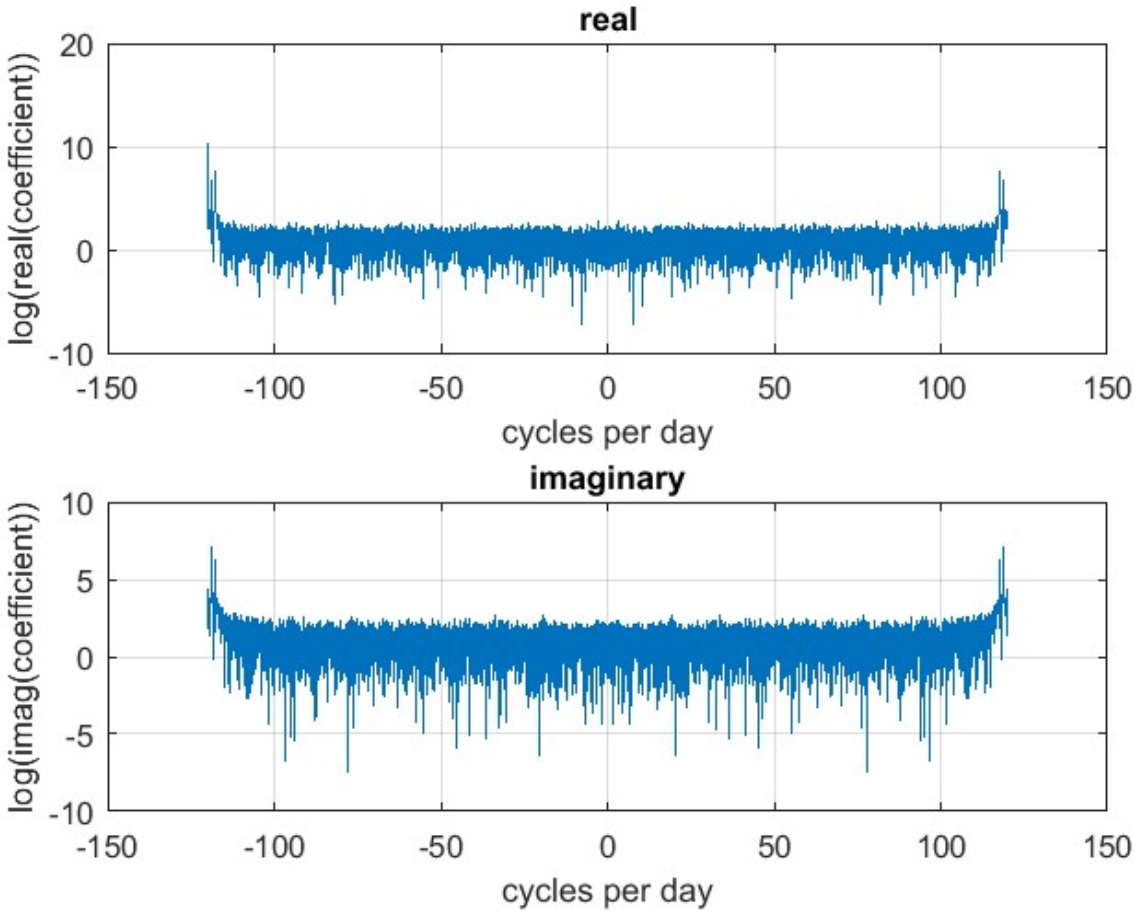
N = length(sampledat_w);
scale = 1/361 *3600*24; % cycles per day

frequencyaxis = scale* (0:N/2)/N; % even number of samples, N

negfreq = -frequencyaxis(2:end);
totfreq = [fliplr(negfreq) frequencyaxis(2:end)];
```

```
figure('Name', 'Plotting Fourier Coefficients-full')
subplot(2, 1, 1)
    plot(totfreq, log(realpart))
    title('real')
    xlabel('cycles per day')
    ylabel('log(real(coefficient))')
    grid on
subplot(2, 1, 2)
    plot(totfreq, log(imagpart))
    title('imaginary')
    xlabel('cycles per day')
    ylabel('log(imag(coefficient))')
    grid on
```

```
Warning: Imaginary parts of complex X and/or Y arguments
ignored
Warning: Imaginary parts of complex X and/or Y arguments
ignored
```




**we only need the first N/2+1**

```
coeffi = coefficients(1:N/2+1);   % because N is even, choose until N/2+1

rp = real(coeffi);
ip = imag(coeffi);
```

```
figure('Name', 'Plotting Fourier Coefficients')
subplot(2, 1, 1)
    plot(frequencyaxis, log(rp))
    title('real')
    xlabel('cycles per day')
    ylabel('log(real(coefficient))')
    grid on
subplot(2, 1, 2)
    plot(frequencyaxis, log(ip))
    title('imaginary')
    xlabel('cycles per day')
    ylabel('log(imag(coefficient))')
    grid on
```

```
Warning: Imaginary parts of complex X and/or Y arguments
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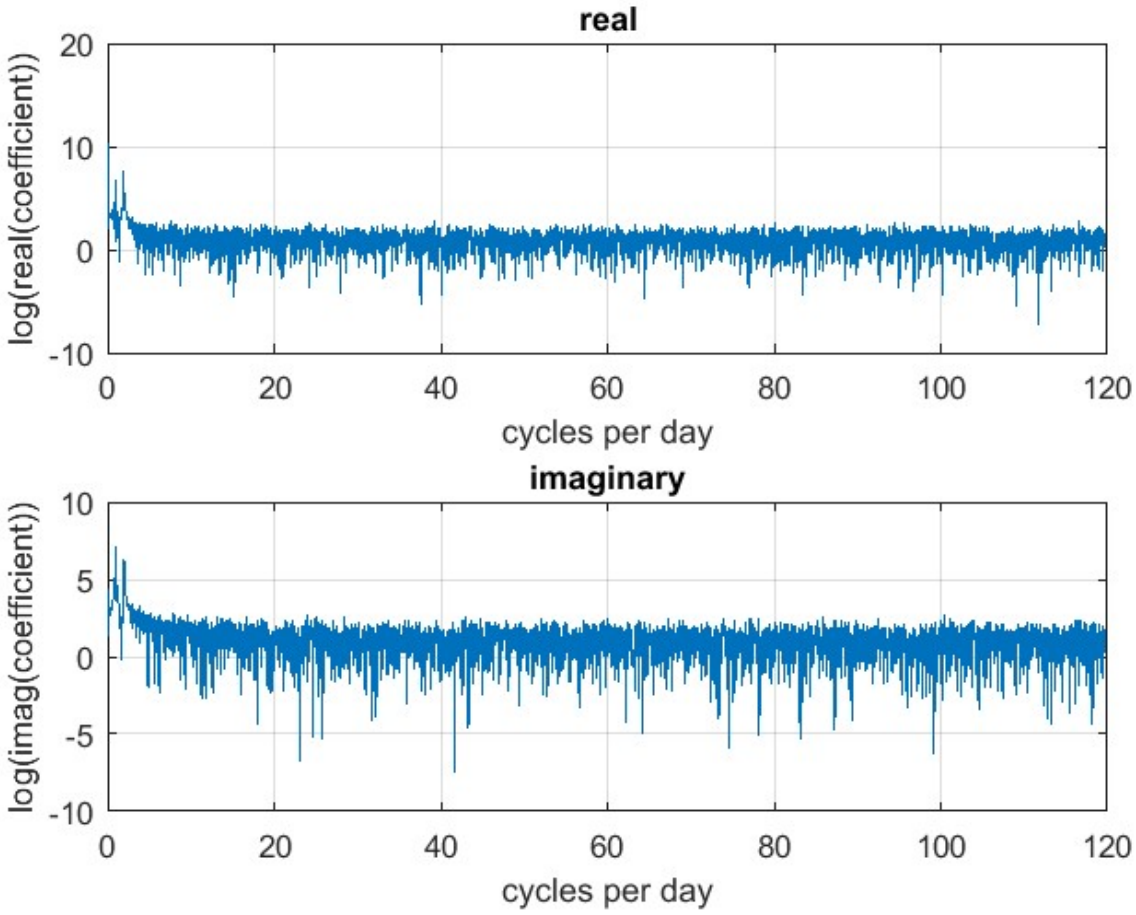


```
figure('Name', 'Plotting Fourier Coefficients')
subplot(2, 1, 1)
    plot(frequencyaxis, log(rp))
    title('real')
    xlabel('cycles per day')
    ylabel('log(real(coefficient))')
    grid on
    xlim([0, 5])
subplot(2, 1, 2)
    plot(frequencyaxis, log(ip))
    title('imaginary')
    xlabel('cycles per day')
    ylabel('log(imag(coefficient))')
    grid on
    xlim([0, 5])
```

```
Warning: Imaginary parts of complex X and/or Y arguments
ignored
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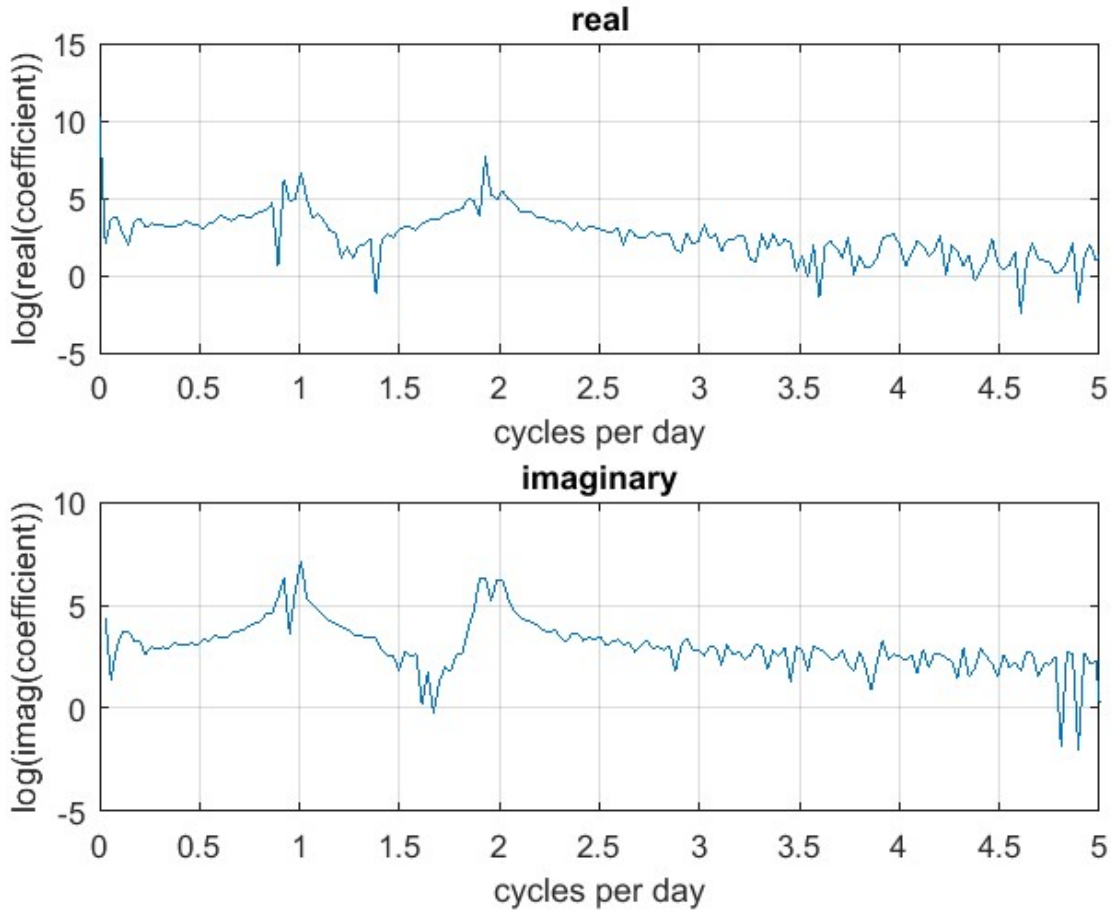
ignored
```




### amplitude of major peaks

```
amplitude = sqrt(rp.^2 +ip.^2)/N;       %magnitude of coeff, normalize by n
amplitude(2:end-1) = 2*amplitude(2:end-1);  %account for pos and neg freqs

meanofdata = amplitude(1);
disp('mean pressure: '); disp(meanofdata);

valdif = abs(frequencyaxis-1.929);
ind1 = find(valdif == min(valdif));
valdif = abs(frequencyaxis-1.008);
ind2 = find(valdif == min(valdif));
valdif = abs(frequencyaxis-0.9214);
ind3 = find(valdif == min(valdif));

ampm2 = amplitude(ind1)
ampk1 = amplitude(ind2)
ampo1 = amplitude(ind3)
```

```
mean pressure:
    3.4861


ampm2 =

    0.5215
```

```
ampk1 =

    0.3591


ampo1 =

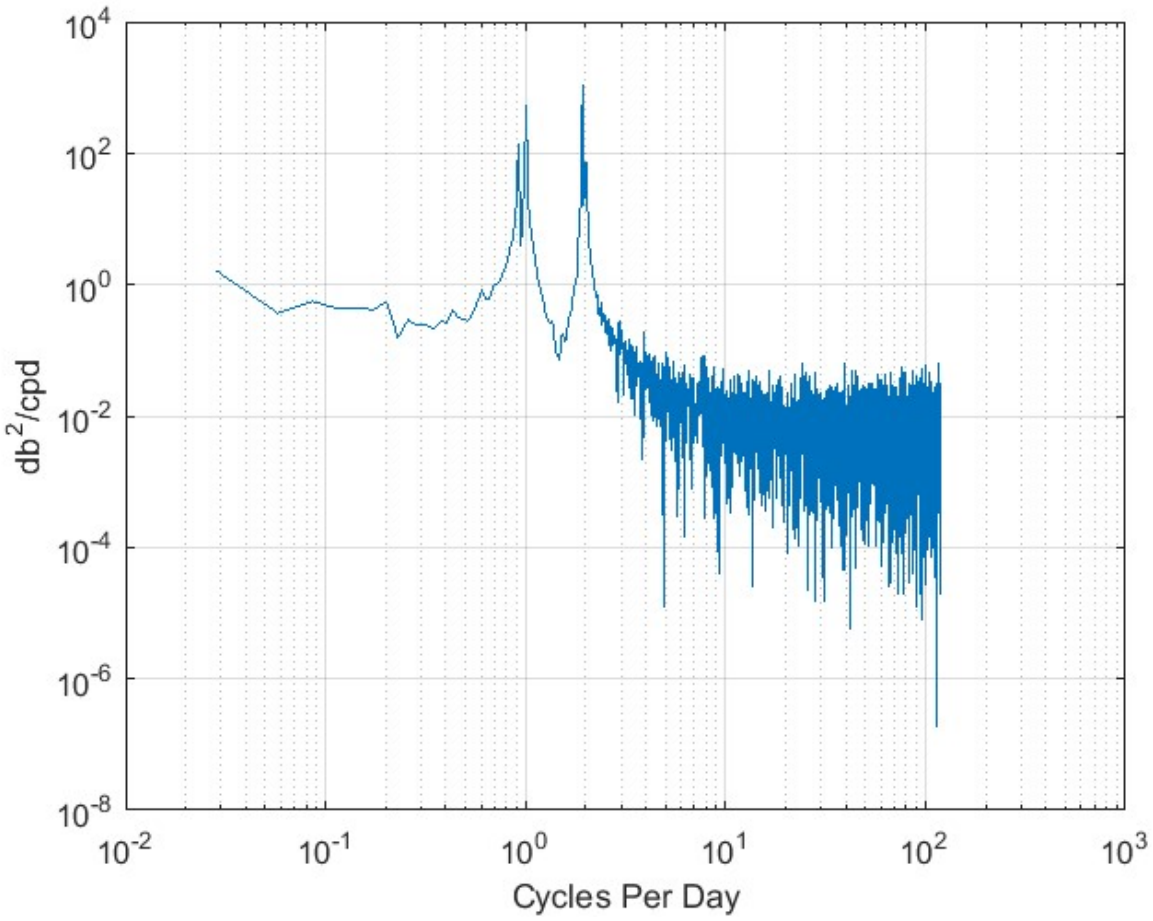
    0.1802
```

### amplitude - spectral power

```
amp = abs(coeffi).^2;      % square of magnitude of the coefficients=power
amp(2:end-1) = 2*amp(2:end-1); % pos and neg frequencies (other than zero)

amp = amp/N;               % normalize

figure
loglog(frequencyaxis, amp)
grid on
    xlabel('Cycles Per Day')
    ylabel('db^{2}/cpd')
```

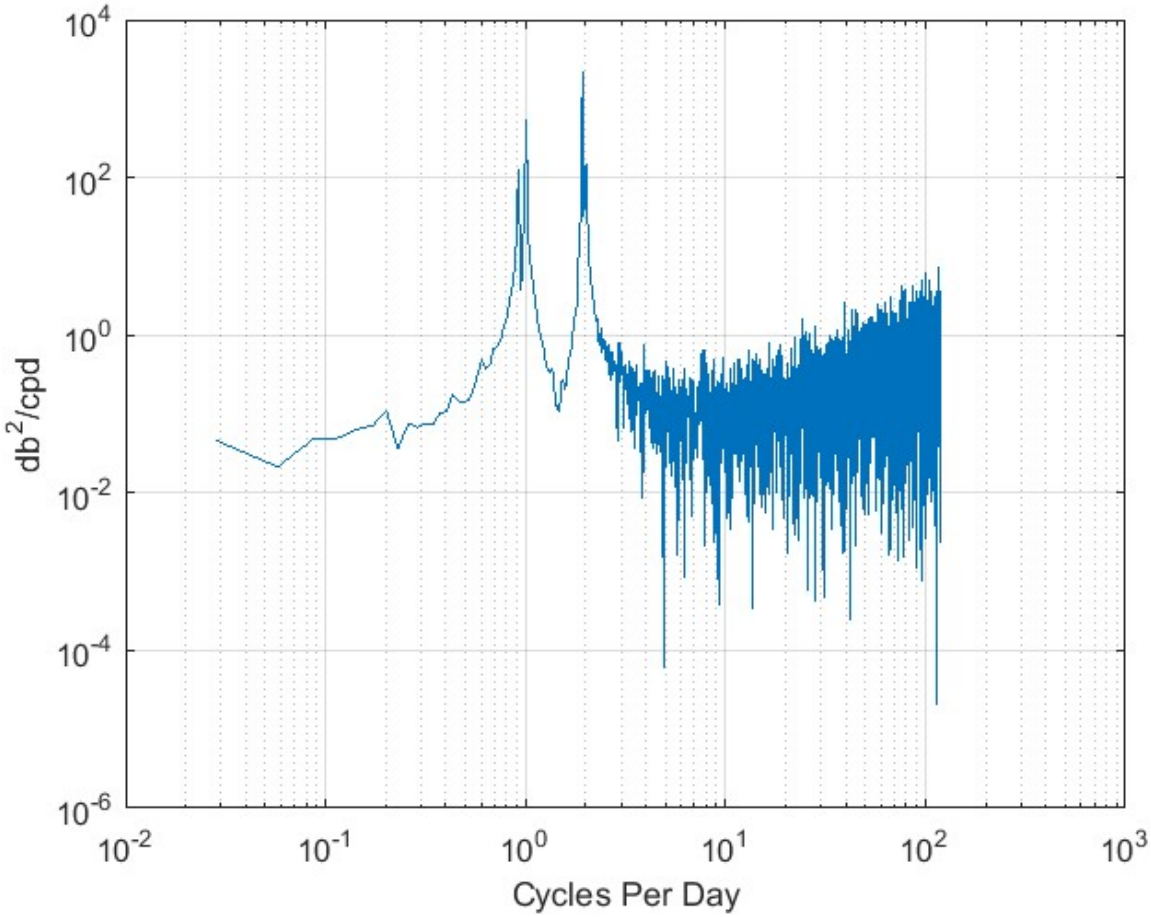



### derivative

```
%   in fourier space the time derivative is equal to multiplying by the
```

```
%   frequency

figure('Name', 'Power Spectrum, first derivative')
loglog(frequencyaxis, amp.*frequencyaxis')
grid on
    xlabel('Cycles Per Day')
    ylabel('db^{2}/cpd')
```

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