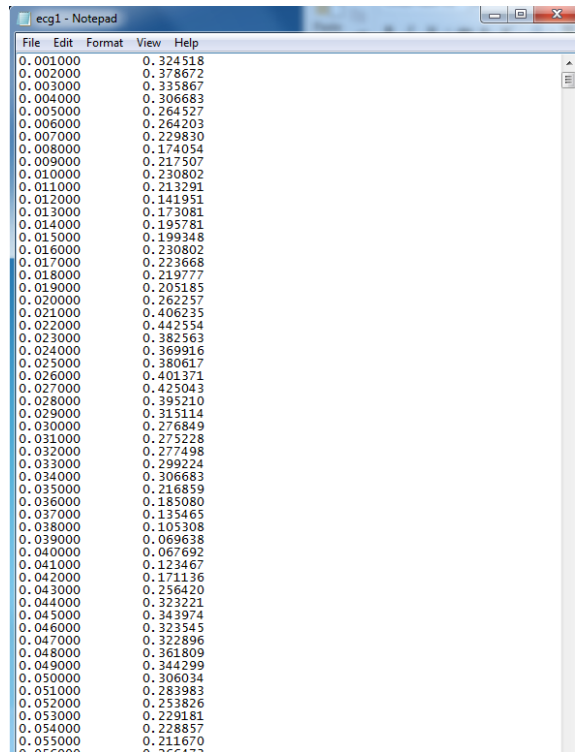


Notes on Matlab for Fourier Transforms

Matlab is a data analysis and visualization system for performing both simple and complex numeric computations, engineering analysis and scientific graphics. It is installed on the lab PC's, and can use a text-based interface (i.e. you type in commands at a prompt) for computation.

We will only be using Matlab for one simple analysis in this example, but it has many other uses and high-tech interfaces for solving scientific problems.

For our ECG recording, Matlab can be used to calculate the Fourier transform of a function or data set, and display the results on the screen. To do this, you first need to have a data file with some form of periodic function in the file (i.e. your ECG text-formatted data file). For this example to work, use your previously saved *.txt file (the Labview output file, without a header and only 2 columns of x-y data). Open the file in WordPad or Notepad to verify the format of the x-y values as expected. The ECG data file should look something like:



```
ecg1 - Notepad
File Edit Format View Help
0.001000 0.324518
0.002000 0.378672
0.003000 0.335867
0.004000 0.306683
0.005000 0.264527
0.006000 0.264203
0.007000 0.229830
0.008000 0.174054
0.009000 0.217507
0.010000 0.230802
0.011000 0.213291
0.012000 0.141951
0.013000 0.173081
0.014000 0.195781
0.015000 0.199348
0.016000 0.230802
0.017000 0.223668
0.018000 0.219777
0.019000 0.205185
0.020000 0.262257
0.021000 0.406235
0.022000 0.442594
0.023000 0.382563
0.024000 0.369916
0.025000 0.380617
0.026000 0.401371
0.027000 0.423043
0.028000 0.395210
0.029000 0.315114
0.030000 0.276849
0.031000 0.275228
0.032000 0.277498
0.033000 0.299224
0.034000 0.306683
0.035000 0.216859
0.036000 0.185080
0.037000 0.135465
0.038000 0.105308
0.039000 0.069638
0.040000 0.067692
0.041000 0.123467
0.042000 0.171136
0.043000 0.256420
0.044000 0.323221
0.045000 0.343974
0.046000 0.323545
0.047000 0.322896
0.048000 0.361809
0.049000 0.344299
0.050000 0.306034
0.051000 0.283983
0.052000 0.253826
0.053000 0.229181
0.054000 0.228857
0.055000 0.211670
0.056000 0.366477
```

After starting Matlab from the Windows start menu, enter the following commands in the Command Window to produce the Fast Fourier Transform (FFT) of the data file. The commands to be typed at the Matlab prompt (the ">>") are in red; your specific information is in green; comments for each line follow the command in blue (you don't have to type the comments, they are shown to help you understand what is going on!). A semicolon after a line tells Matlab not to print out the results to the screen (this can be very annoying for long files!)

You may also use the command "clear" to clear all data from memory, and the up and down arrow keys give the previous typed commands, so you don't have to type them all a second time.

```
cd c:\users\be172s\desktop %Change the working directory to the location of the data file (here in a desktop folder)
```

```
dir %Check listing to make sure the ECG data file is there; the file may also be seen in the "Current Folder" pane in Matlab.
```

```
load ecg1.txt %load file "ecg1.txt" from the working directory into Matlab; note file names should not have spaces. You should see the variable "ecg1" appear in the right "Workspace" window; new variables will appear here when defined.
```

```

y = fft(ecg1(:,2)); %Compute FFT of data in the file, column 2 (your y-data). The new variable “y” will contain the FFT data.

sec = length(ecg1)/1000 %Compute the number of seconds of data (here acq. rate = 1000 samples/second), typically around 3.0
seconds for your data file

y(1) = []; %Delete the first value of the resulting array, which is the DC offset component

mag = abs(y).^2; %Compute square of the magnitude of the FFT (Note that a Fourier transform is a complex function). The
magnitude squared gives the power spectrum. Note the “.” must be included.

power = mag(1:ceil(length(mag)/2)); %Compute the power spectrum from mag as 1/2 the array (use only positive frequencies
which are in the first 1/2 of the resulting array)

freq = (0:length(power)-1)/sec; %Compute the frequencies (x-values) to match the above magnitudes, scaled to the actual
number of seconds

plot (freq(1:100),power(1:100)) %Plot the first 100 points of spectrum as Power vs. Frequency in a new window. Can try more
or less points to visualize the important parts of the plot.

xlabel ('Hz') %Add and x-label

ylabel ('Power') %Add and y-label

```

Save your final plot as an image file (i.e. *.jpg). The plot should show the frequency content of your ECG, including a larger peak at your heart rate (in Hz). An example of such a power spectrum plot is:

