Tutorial of Origin 7.0

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Origin is a kind of powerful software for numerical manipulation and data analysis. Here is a brief tutorial that explains how to do the numerical Fourier transform using Origin 7.0.

Topography of an Origin project and workspace

When you start Origin, a new project is opened and a worksheet window is displayed in the work space. Besides the worksheet, Origin also provides graph, Excel workbook, matrix and notes windows.

How to read a file

There are several ways to read your data in Origin. You can directly copy your data and paste in the work sheet (if the size of your data is not large). You also can import your data from some types of data file, such as *.txt, *.dat and *.csv. Under the menu "File", select "Import" and choose "Single ASCII". Then find your data file and select it, click "Open". Your data will be displayed in the worksheet.

How to make the plot

Highlight the columns of data that you want to plot, and click button at the left corner (See Fig 1). Then a new graph window will be opened and the plot will be shown in the window (See Fig 2). Double click the axial of the plot, there will appear a new window (See Fig 3). You can select the appropriate parameters of the plot (such as Scale, Title &

Format and so on). Double click the label of the axial, you also can
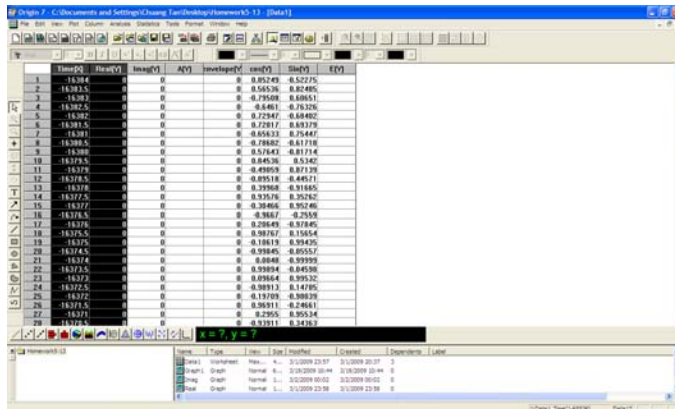
rename the axial.
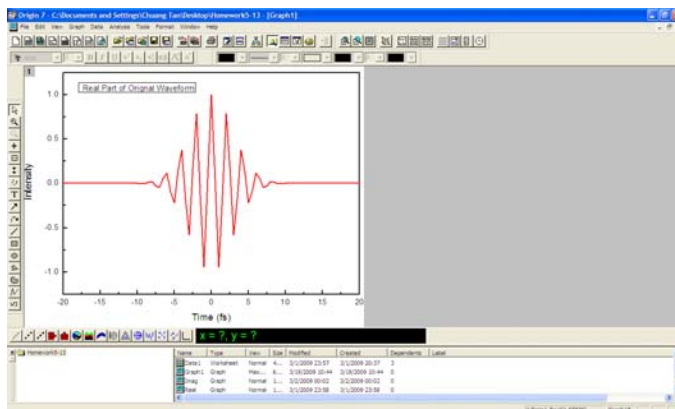

Figure 1   The worksheet window.
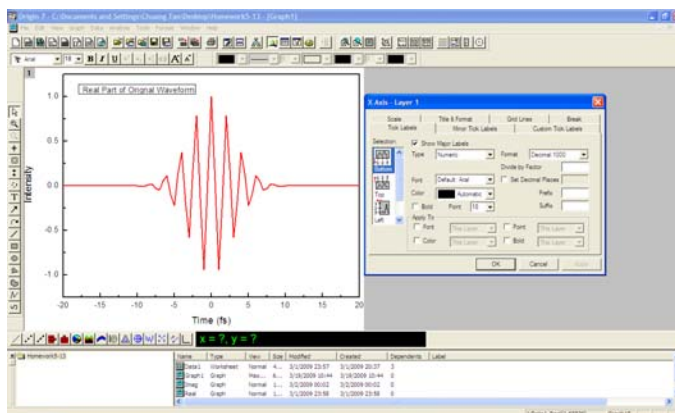

Figure 2   The graph window.

Figure 3   The properties window of the graph.

Data calculation in the worksheet

Sometimes you need to do some calculation with the data. You can highlight the column of the data, right click and select "Set Column Values". Then you can edit the formula and calculate the values.

How to perform a fast Fourier transform

In this example, we use the Gaussian pulse with the carrier $E(t) = e^{-at^2} e^{i\omega_0 t}$. Then we would like to perform a both forward and backward FFT by using origin. Right click on the column, choose "Set column value", and type the formula you need. Then, highlight the three columns of the x data set, the real data set and the imagine data set. Under the menu "Analysis", select "FFT". There will appear a new window of FFT. Select the appropriate method for your FFT calculation.

The Operation Tab

Select this tab to access the "Operation" options.

The FFT Group

Origin offers a convenient way to do both forward and reverse FFT.

Select the "Forward" to perform a forward FFT.

Select the "Backward" to perform a backward FFT.

The Spectrum Group

Select the "Amplitude" to plot amplitude and phase data. This option is straightforward to get a amplitude spectrum. Select the "Power" to plot the power spectrum and phase data. The power spectrum is a

frequency-domain plot of power, which propotional to the square of magnitude per Hz vs frequency.

We usually select the "Amplitude".

The Settings Tab

Select this tab to access the "Settings" options.

The Sampling Text Box

Type a data set to be used for time or frequency information.

The Real Text Box

Type a data set to be used as the real component for the FFT calculation.

The Imaginary Text Box

Type a data set to be used as the imaginary component for the FFT calculation.

The Sampling Interval Text Box

Type the time or frequency interval to be used in the FFT calculation.

*The above four box are selected from the highlighted column by default.

The Window Method Group

1) Rectangular Window:

   $w[n] = 1$ for $0 \le n \le N-1$ and zero otherwise.

2) Welch Window:

   $$w[n] = 1 - \frac{[n - \frac{1}{2}(N-1)]^2}{[\frac{1}{2}(N+1)]^2}$$

4

3) Hanning Window:

$$w[n] = \frac{1}{2}[1 - \cos(\frac{2\pi n}{N-1})]$$

4) Hamming Window:

$$w[n] = 0.54 - 0.46\cos(\frac{2\pi n}{N-1})$$

5) Blackman Window:

$$w[n] = 0.42 - 0.5\cos(\frac{2\pi n}{N-1}) + 0.08\cos(\frac{4\pi n}{N-1})$$

Since the Rectangular is general, we usually choose it for convenience.

The Output Options Group

1) Select the Normalize Amplitude check box to perform amplitude normalization. This will reveal the true amplitudes in the original data set.

2) The Shift Results check box determines how the transformed data will be presented. If the check box is cleared, the transform is displayed for positive frequencies only, with the phase in the range of 0°to 360°. If the check box is selected, the transform is shifted to be displayed with both positive and negative frequencies centered at zero, with the phase in the range of -180° to 180°.

3) Select the Unwrap Phase check box to keep the phase unwrapped, to maintain the true phase data.

The Exponential Phase Factor Group

Select the Electrical Engineering with the sign of -1.

After select all the parameters appropriately, click button "OK" to run FFT. It will automatically produce a new worksheet window FFT1 (See Fig 4) and a new graph window (See Fig 5). The new worksheet contains the transformed data of "Freq", "Real", "Imag", amplitude "r", phase "Phi" and "Power". The new graph plots the amplitude and phase data. The reverse FFT is very similar to the forward. The only difference is to check the "Backward" button instead of the "Forward" button.
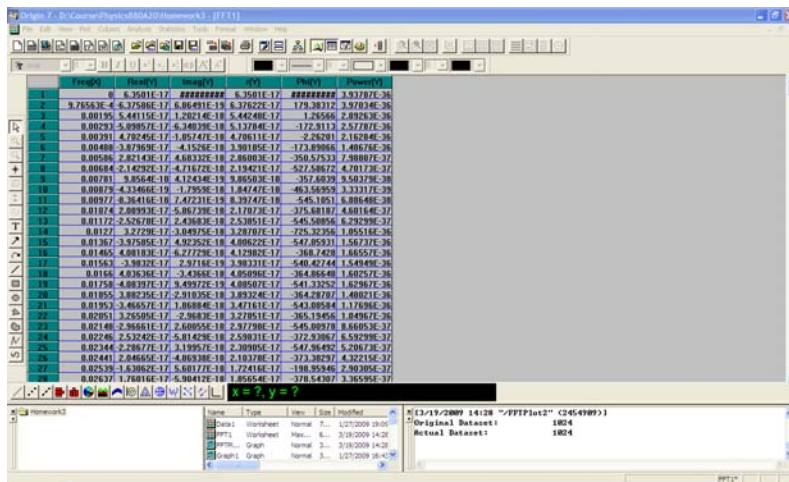

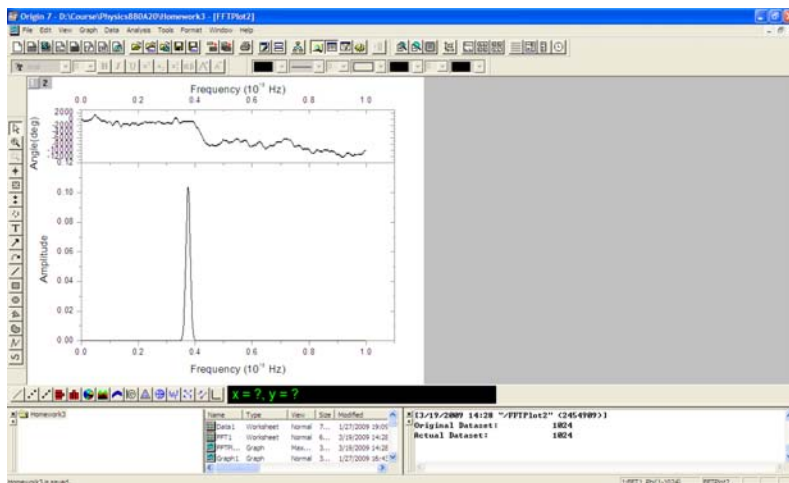Figure 4   The forward FFT worksheet.

Figure 5   The forward FFT plot.

Also, when you get data of the forward FFT, you can do a reverse FFT

operation which will provide you the Gaussian pulse in time domain.
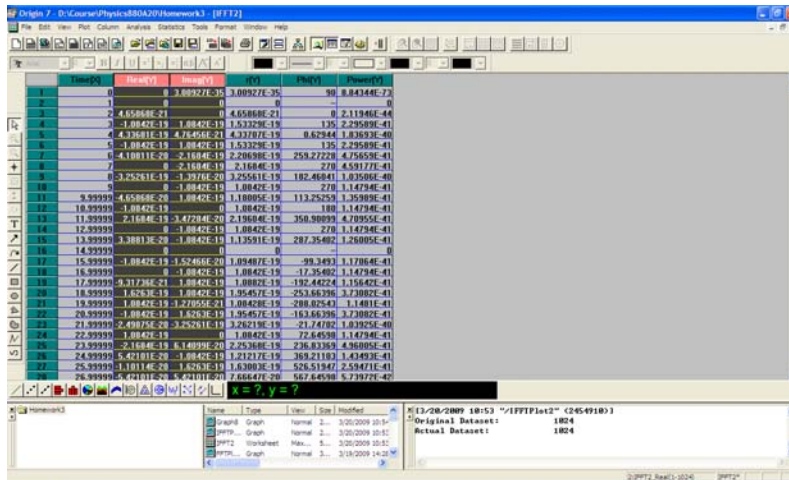

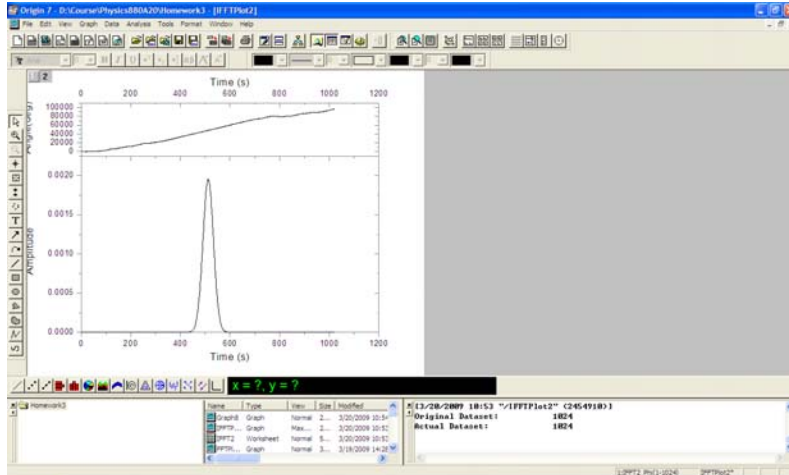Figure 6   The reverse FFT worksheet.

Figure 7   The reverse FFT plot.

In a word, the origin software is a powerful and convenient tool to do the

FFT operation for the numerical data.