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Origin, while maintaining features like that of excel where manipulation of columns, rows and applying operations which are familiar, has host of other features which may require little understanding of background like simple analysis of plots to features such as command builder which requires extensive knowledge of giving codes and generating desired output. It has extensive features for statistical analysis of data but in my understanding, quite basic and simple analysis for Fourier Transforms.

Importing the data

- If data is present in raw number format, copy and save the data simply as “.text” file.
- From “File Menu”, “Import” the data as “Single ASCII” or “Multiple ASCII”.

As you can see, the data can be imported from bunch of other supported formats.

Origin has a feature of adding “Sparklines” to the Column which helps to identify which plot belongs to which column in case when one is playing with lots of columns and projects/sheets.

The screenshot displays the OriginPro 8 software interface. The 'File' menu is open, showing the 'Import' option selected. The spreadsheet shows columns A(X), B(Y), and C(Y) with data values. Sparklines are visible in the rows, and a label 'Sparkline' points to one of them.

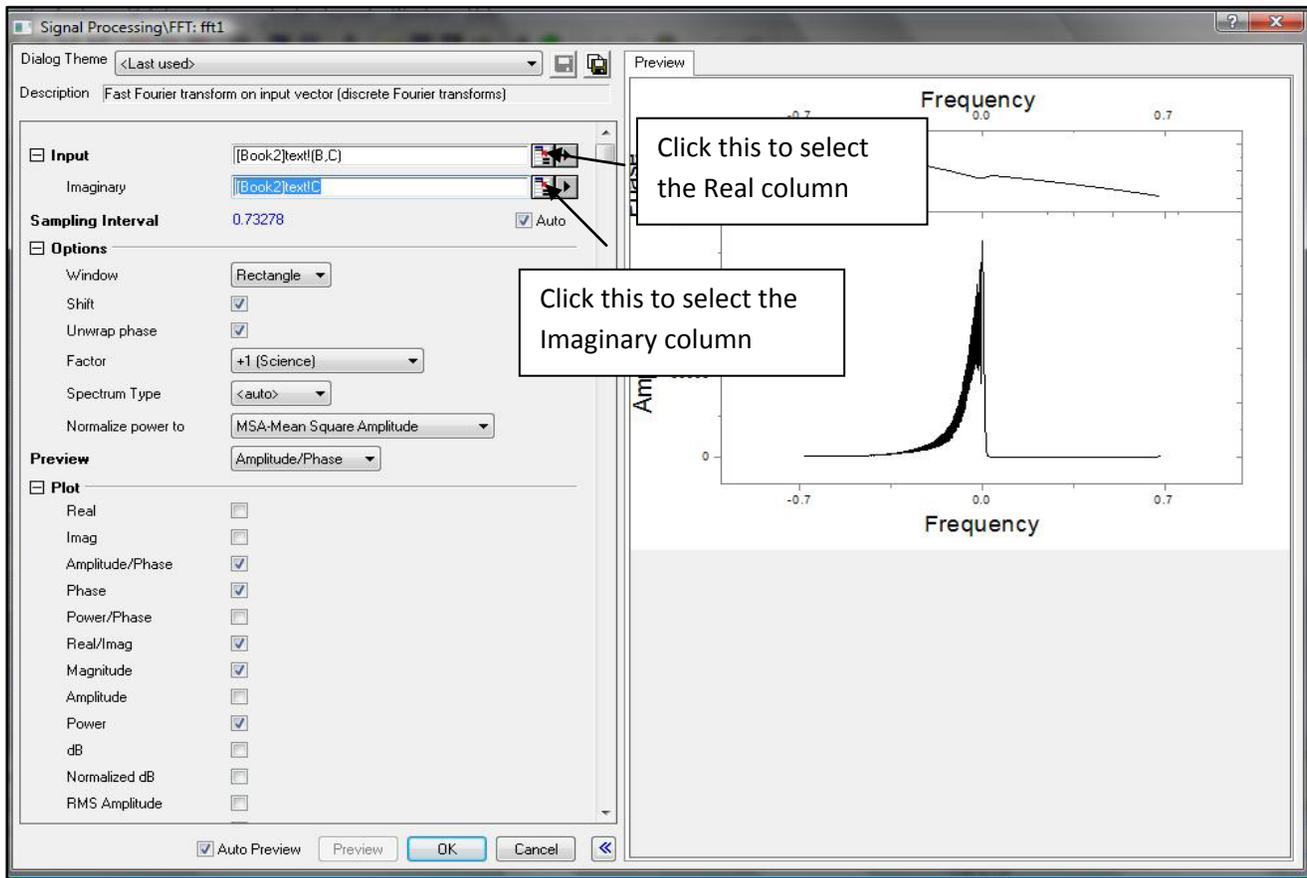
	A(X)	B(Y)	C(Y)
Name			
Units			
Comments			
Sparklines			
1	-750	1.17363E-5	7.42518E-6
2	-749.2672	1.0696E-5	-9.91244E-6
3	-748.5344	-7.4855E-6	-1.33575E-5
4	-747.8016	-1.53709E-5	4.71072E-6
5	-747.0688	1.82171E-6	1.678E-5
		8886E-5	1.05142E-6
		3289E-6	-1.82175E-5
		5032E-5	-6.24084E-6
		2773E-6	1.86849E-5
		8871E-5	1.03043E-5
		8457E-5	-1.92257E-5
		8112E-5	-1.30092E-5
		8005E-5	2.0694E-5
		9403E-5	1.41424E-5
		9427E-5	-2.35787E-5
		5912E-5	-1.30887E-5
		4269E-5	2.79124E-5
		3967E-5	8.80368E-6
		9454E-6	-3.2817E-5
		8339E-5	1.72682E-8
		7227E-6	3.5984E-5
		7068E-5	-1.39523E-5
		4551E-5	-3.33606E-5
		888E-5	3.49748E-5

FOURIER TRANSFORM

The discrete Fourier Transform is can be performed in Origin using Fast Fourier Transform.

Analysis -> Signal Processing -> FFT

This gives following dialog box:



The dialog box for the FFT gives following options which has been listed and explained in Origin help -> Origin X Functions.

I am assuming while listing these options from Origin help file, user would not use the *Command Line* option where user can manually give written commands to perform operations instead of using well defined dialog boxes. However, some commands, I think, are better performed using *Command Line* instead of using dialog boxes, for example, changing the *Angle Unit* of phase angle while performing *Unwrapping* phase function manually from grad to Radians and vice versa. For more information about giving codes, user is recommended to Help -> Programming.

Command Line can be accessed by View -> Command Window.

The Signal Processing, FFT dialog box:

Display Name	Description	
Input	Specifies the input signal, which could be complex. The real and imaginary parts of the signal can be saved in different columns or in the same column. The default is <Active>, which corresponds to the active dataset.	
Sampling Interval	<p>Specifies the sampling interval. The default is <Auto>, which corresponds to an automatically-computed interval.</p> <p>FFT's in Origin assumes that the input signal repeats periodically and that the periodic length is equal to the length of the actual input. If it is not so, it gives rise to signal leakage.</p>	
Shift	Specifies whether the result should be rearranged so that the lower frequency components are in the center.	
Unwrap phase	Specifies whether the phase should be unwrapped or not.	
Factor	<p>Specifies whether the Electrical Engineering or Science convention is used to set the sign of the Exponential Phase factor : <i>-1 (Electrical Engineering) and +1 (Science)</i></p> <p>Note: For our Purpose, the convention of <i>-1</i> would be appropriate.</p> <p>Amplitude and Phase profiles when phase factor is <i>-1</i> and <i>+1</i> respectively.</p> <div style="display: flex; justify-content: space-around; align-items: center;">  </div>	
Plot Options	<i>AP:Amplitude/Phase</i>	Both the amplitude and the phase.
	<i>PP:Power/Phase</i>	Both the power and the phase = $\left\{ -\tan^{-1} \frac{Im}{Re} \right\}$
	<i>Amp:Amplitude</i>	The amplitude = $\frac{\sqrt{Re^2 + Im^2}}{n}$
	<i>Img:Imaginary</i>	The imaginary parts of the transformed data
	<i>Mag:Magnitude</i>	<p>The magnitude = $\sqrt{Re^2 + Im^2}$</p> <p>Note: "The complex amplitude" of the FFT spectrum is reported as "Magnitude".</p>
	<i>Phase:Phase</i>	<p>The phase</p> <p>Note: Origin reports phase in <i>degrees</i>. This can be changed to <i>radians</i> manually by method described later.</p>

	<i>Power:Power</i>	The power spectrum or power density
	<i>Real:Real</i>	The real parts of the transformed data
	<i>RI:Real/Imaginary</i>	Both the real parts and imaginary parts of the transformed data
	<i>DB:dB</i>	The amplitude in dB
	<i>NDB:Normalized dB</i>	The normalized amplitude in dB
	<i>RMS:RMS Amplitude</i>	The RMS amplitude
	<i>SqAmp:Square Amplitude</i>	The square amplitude
	<i>SqMag:Square Magnitude</i>	The square magnitude
Spectrum Type	<p>Specifies the Sampling interval over which power is calculated. Options list includes One-Sided Power or Two-sided Power calculation which is normalized by methods listed next. For more details, http://www.indiana.edu/~statmath/stat/all/power/power.pdf can be used or any statistics reference.</p> <p>Normalize power Method features in Origin : MSA:MSA-Mean Square Amplitude; SSA:SSA-Sum Square Amplitude & TISA:TISA-Time Interval Square Amplitude</p>	

The default X-axis is column A, however, preferences can be changed by selecting the column, right click and then selecting "Set Column as" to required axis.

Getting to know the work area

Standard Toolbar for different windows and project exploration

Project Explorer

Comments	Freq(Y)	Complex	Real(Y)	Imag(Y)	Magn(Y)	Ampl(Y)	Phase(Y)
Long Name	Frequency	Complex	Real	Imaginary	Magnitude	Amplitude	Phase
Sparklines							
1	-6.81667E14	-107887.17838 - 37764.28808i	-107887.17838	-37764.28808	114305.66353	55.81331	-160.70817
2	-6.81001E14	27323.60019 - 102224.09132i	27323.60019	-102224.09132	105812.77793	51.6664	-75
3	-6.80334E14	93652.25904 + 61743.81535i	93652.25904	61743.81535	112174.16974	54.77254	33
4	-6.79668E14	-50676.96262 + 92471.17967i	-50676.96262	92471.17967	105447.01802	51.4878	116
5	-6.79002E14	-74617.06947 - 80786.70991i	-74617.06947	-80786.70991	109973.63118	53.69806	227.27349
6	-6.78335E14	70909.89932 - 77739.99413i	70909.89932	-77739.99413	105222.24341	51.37805	312.36925
7	-6.77669E14	52213.95445 + 94126.92416i	52213.95445	94126.92416	107639.09555	52.55815	420.98205
8	-6.77003E14	-86890.03806 + 59012.63523i	-86890.03806	59012.63523	105035.08857	51.28666	505.81704
9	-6.76336E14	-28227.36765 - 101538.32415i	-28227.36765	-101538.32415	105388.87777	51.45941	614.46422
10	-6.7567E14	98047.43239 - 37259.66572i	98047.43239	-37259.66572	104888.42495	51.21505	699.19237
11	-6.75004E14	4087.1417 + 103016.13781i	4087.1417	103016.13781	103097.18414	50.34042	807.72799
12	-6.74337E14	-103810.86749 + 13674.72129i	-103810.86749	13674.72129	104707.66071	51.12679	892.49579
13	-6.73671E14	18696.68527 - 98873.47186i	18696.68527	-98873.47186	100625.68994	49.13364	1000.70803
14	-6.73005E14	104140.7423 + 10224.84651i	104140.7423	10224.84651	104641.49126	51.09448	1085.6075
15	-6.72338E14	-39075.82691 + 90187.67485i	-39075.82691	90187.67485	98289.04793	47.9927	1193.42575
16	-6.71672E14	-99187.44826 - 33479.86158i	-99187.44826	-33479.86158	104685.48621	51.11596	1278.65166
17	-6.71006E14	56466.15301 - 77731.80217i	56466.15301	-77731.80217	96076.32125	46.91227	1385.99551
18	-6.70339E14	88871.64918 + 54902.20273i	88871.64918	54902.20273	104462.53823	51.0071	1471.70651

Topic/Help Finder

Command Line

```

//--3/19/2009 03:05
unwrap unit:=RAD ox:=<new>
    
```

Menu for additional Plot settings

Layer switch

Axis Settings

Axis - Layer 1

Selection: Horizontal Vertical

From: 2.7442E-18

To: 1.19857E-12

Type: Linear

Rescale: Normal

Increment: 3E-13

Major Ticks: 4

Minor Ticks: 1

First Tick:

OK Cancel Apply

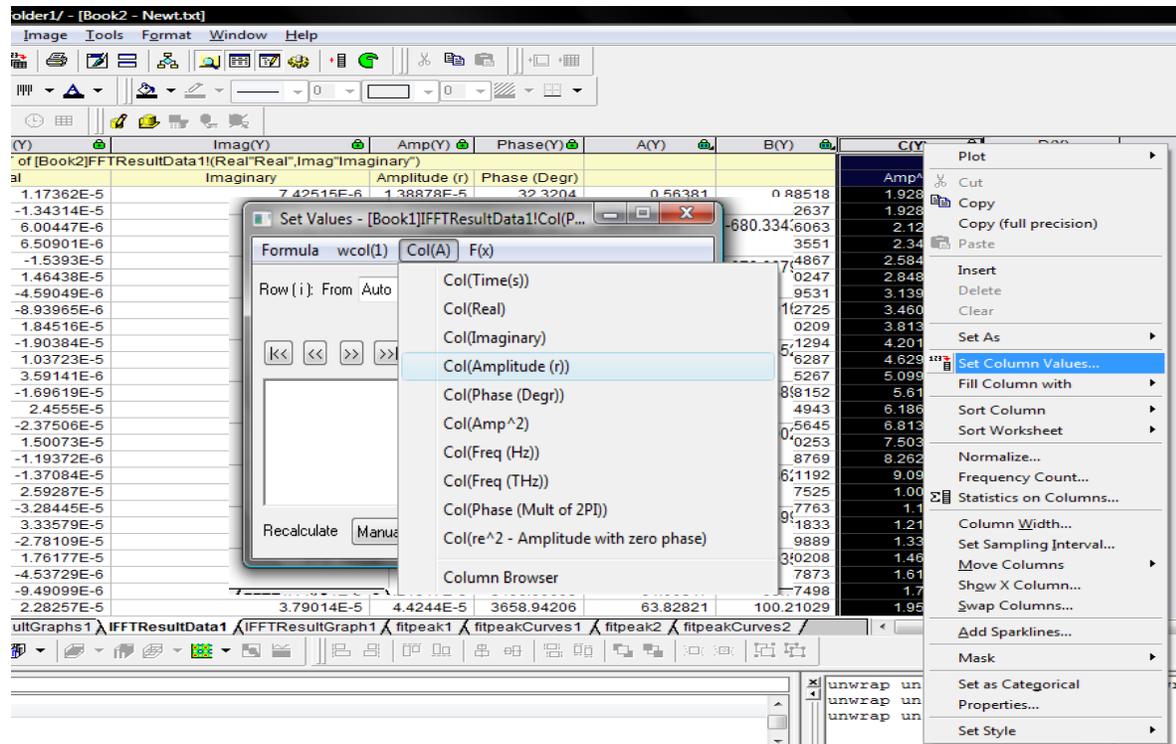
Performing manual calculations on columns.

To perform additional mathematical operations on column values:



Click on Add the column (from standard toolbar) -> Select the Column -> Right Click -> Select "Set column Values" from the drop down menu

Following snapshot will make it clear:



A small dialog box at the center of screen is where necessary operation on column can be performed.

I have found that Origin does not support global symbols such as π unless and until specified in its code directory. So it will be better while performing manual calculations to use value of 3.14 or write Pi directly instead of looking for symbol.

To define global constants, Origin help file states following:

Open the configuration file, orgsys.cnf, located in the program folder. You can edit this file from Code Builder (**View:Code Builder**) or any text editor, such as Notepad. At the top of the file you'll see the following:

```
// const defined here are global constants
```

```
Const pi = 3.141592653589793. You can add a new constant just below this.
```

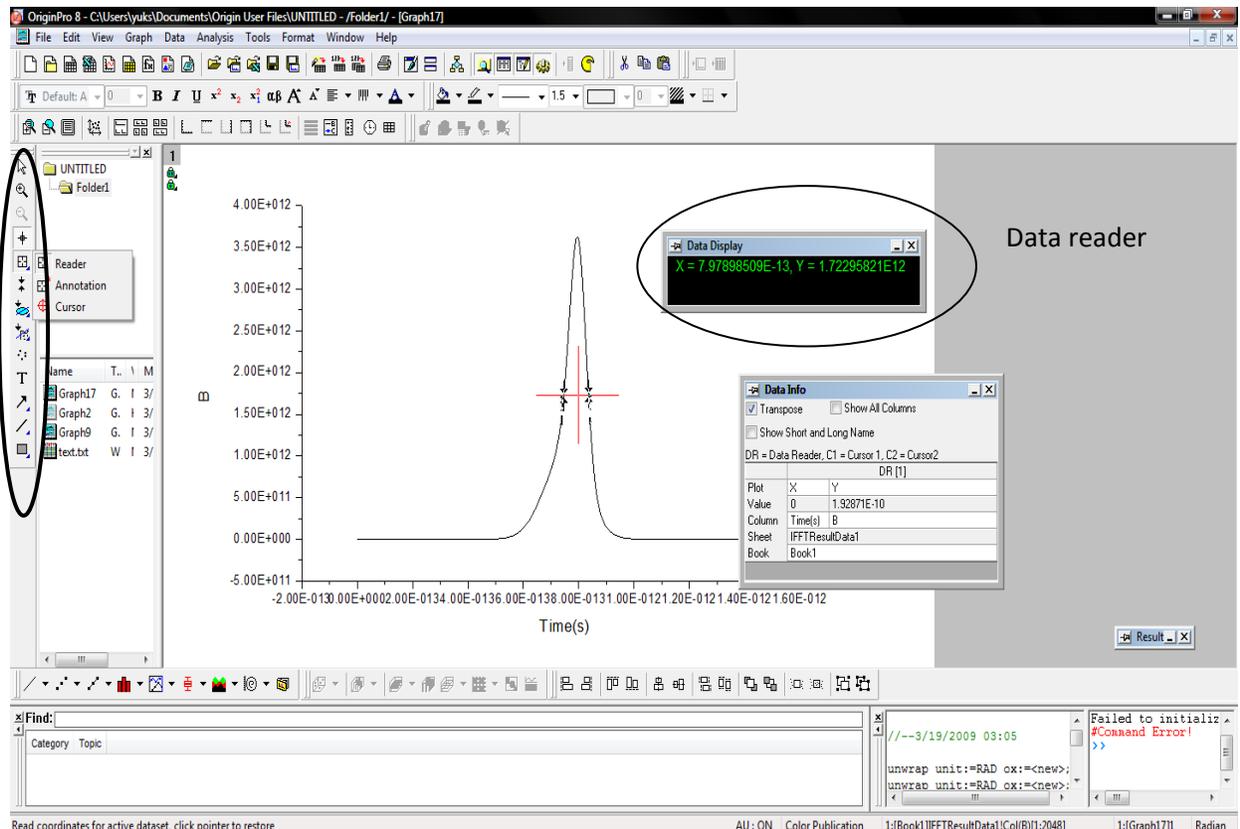
INVERSE FOURIER TRANSFORM

Performing IFFT is essentially the same in Origin: Analysis -> Signal Processing -> IFFT.

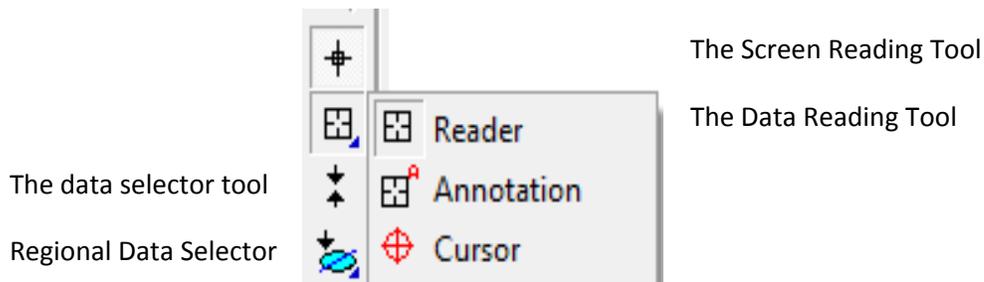
The options include specifying input, sampling interval, plotting Amplitude or phase, specifying phase factor. The dialog box also has options of Unwrapping phase or undo shift Input data. However, a word of caution on Origin help is given. If an IFFT is performed on a complex FFT result computed by Origin, this will in principle transform the FFT result back to its original data set. However, this is true only when the *Window* option and *Factor* option are the same for IFFT and FFT. Additionally, if *Shift* is checked in FFT, *Undo Shift Input Data* must be checked in IFFT. Conversely, if *Shift* is cleared in FFT, *Undo Shift Input Data* should not be checked in IFFT, otherwise IFFT will not get the FFT result back to its original data.

Window option basically specifies accuracy of sampling intervals. FFT assumes that the input signal repeats periodically and that the periodic length is equal to the length of the actual input. However, if the true signal is *not* periodic or if the assumed periodic length is *not* correct, "leakage" will occur. This will cause both the amplitude and position of a frequency measurement to be inaccurate. A bunch of Window options are given in Origin to correct the problem which should be appropriately used.

Annotating Data



Data can be read or annotated in following ways.

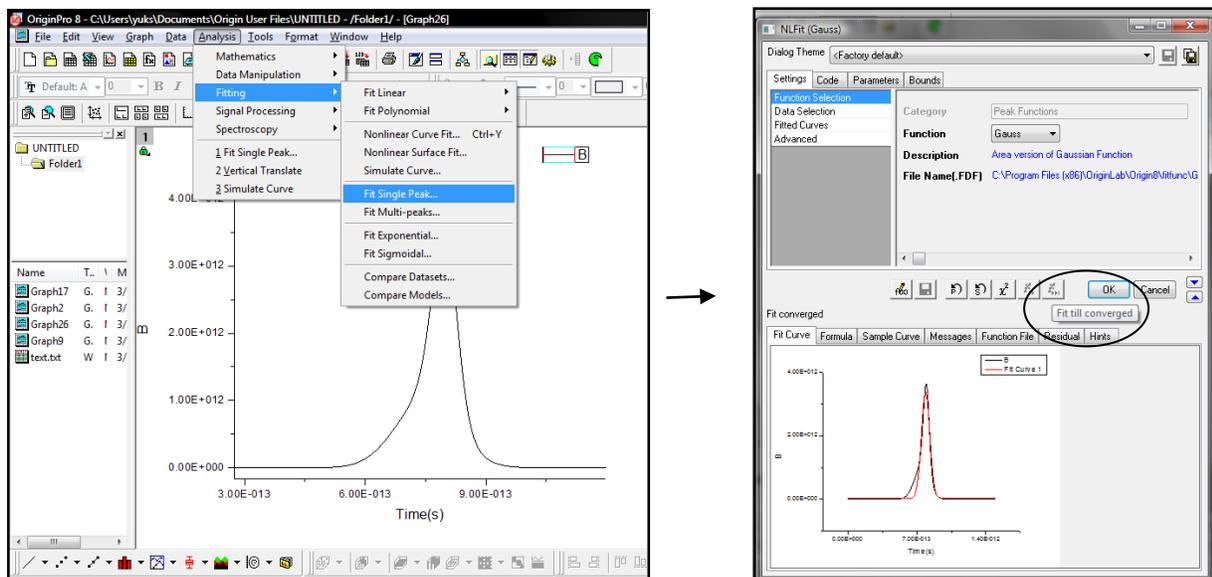


The data selector tool can be used to mark the points and the annotation tool can be used to annotate those points to make data reading easy which can be used in reading spectral or temporal bandwidth. Instructions to use it appear as you will select the pointer. Hit enter after clicking with Annotation pointer to print the plot values.

This data reading tool box can be used to zoom the region of plots in addition to other annotations.

Fitting the peak

Also pertinent to reading FWHM off the plot, fitting the peak will help in reading the data efficiently.



In the dialog box of NLFit (Gauss), option of fit till converged can be used to obtain close fit to Intensity spectrum and data sheet is generated for Fit values. This finishes essential overview to perform Fourier Transform using Origin.