Fourier transformations
Application for infrared spectrometry

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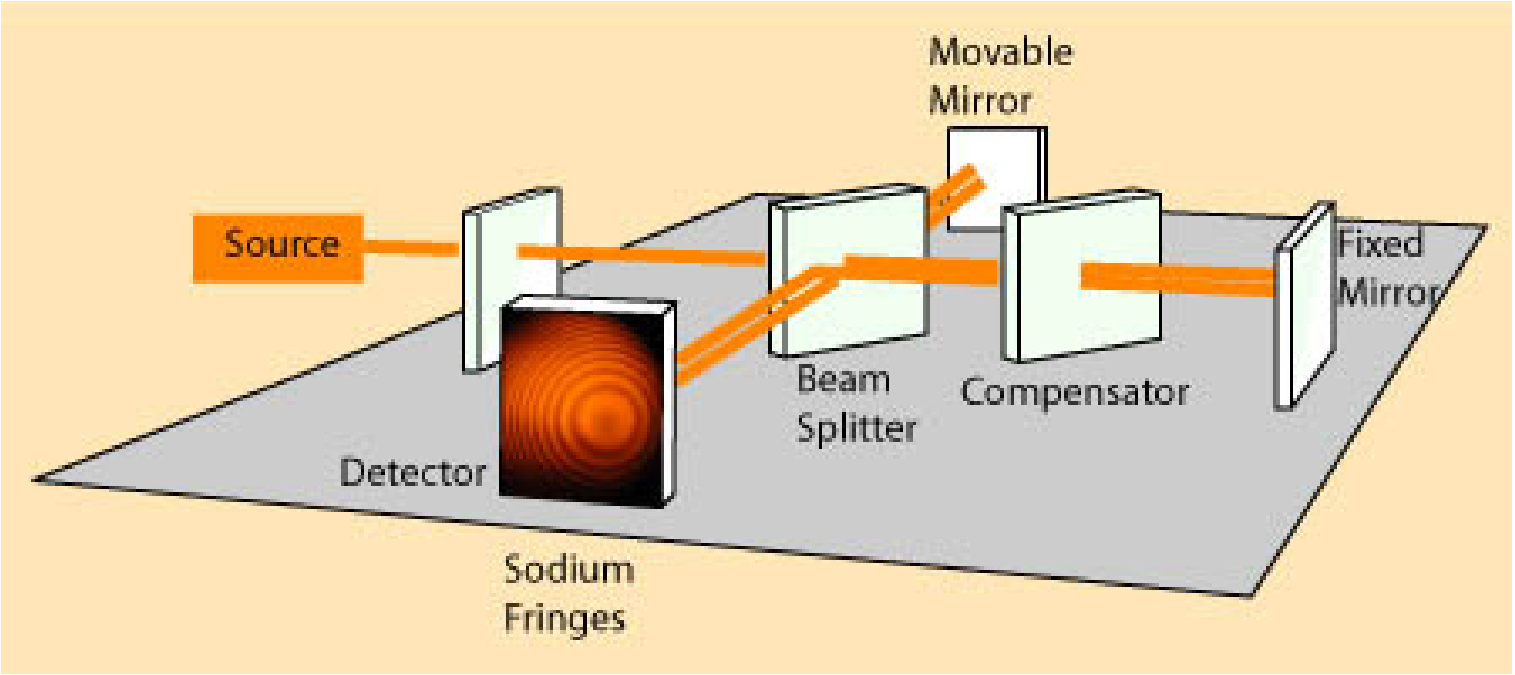
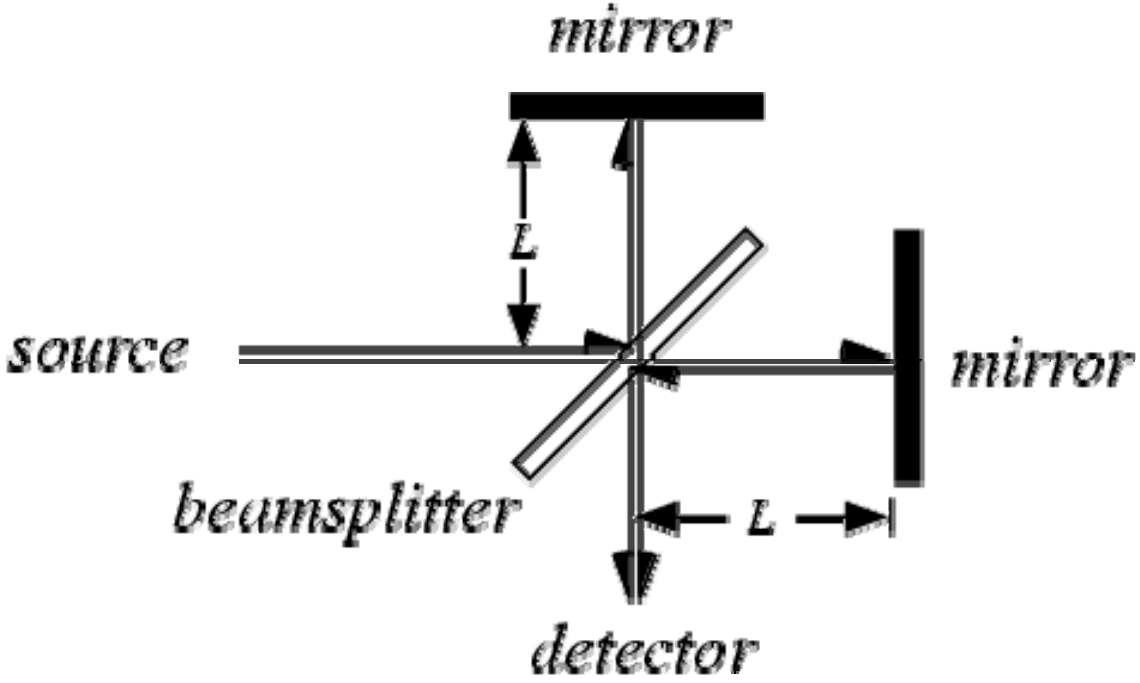
Michelson Interferometer



http://hyperphysics.phy-astr.gsu.edu/hbase/phyopt/michel.html#c1


mirror
L
source
mirror
beamsplitter
L
detector

Fourier Transformations

The Fourier transformation (transform) defines a relationship between a signal in the time domain and its representation in the frequency domain. Being a transform, no information is created or lost in the process, so the original signal can be recovered from knowing the Fourier transform, and vice versa.

The Fourier transform of a signal is a continuous complex valued signal capable of representing real valued or complex valued continuous time signals.

The tool allows you to view these complex valued signals as either their real and quadrature (also known as imaginary) components separately, or by a magnitude and phase representation. You may switch between these two representations at any point. Mathematically switching between the two representations for a given complex value can be expressed as

$$|X| = \sqrt{X_r^2 + X_i^2} \quad \text{and} \quad \angle X = \tan^{-1}\left(\frac{X_i}{X_r}\right)$$

or equivalently,

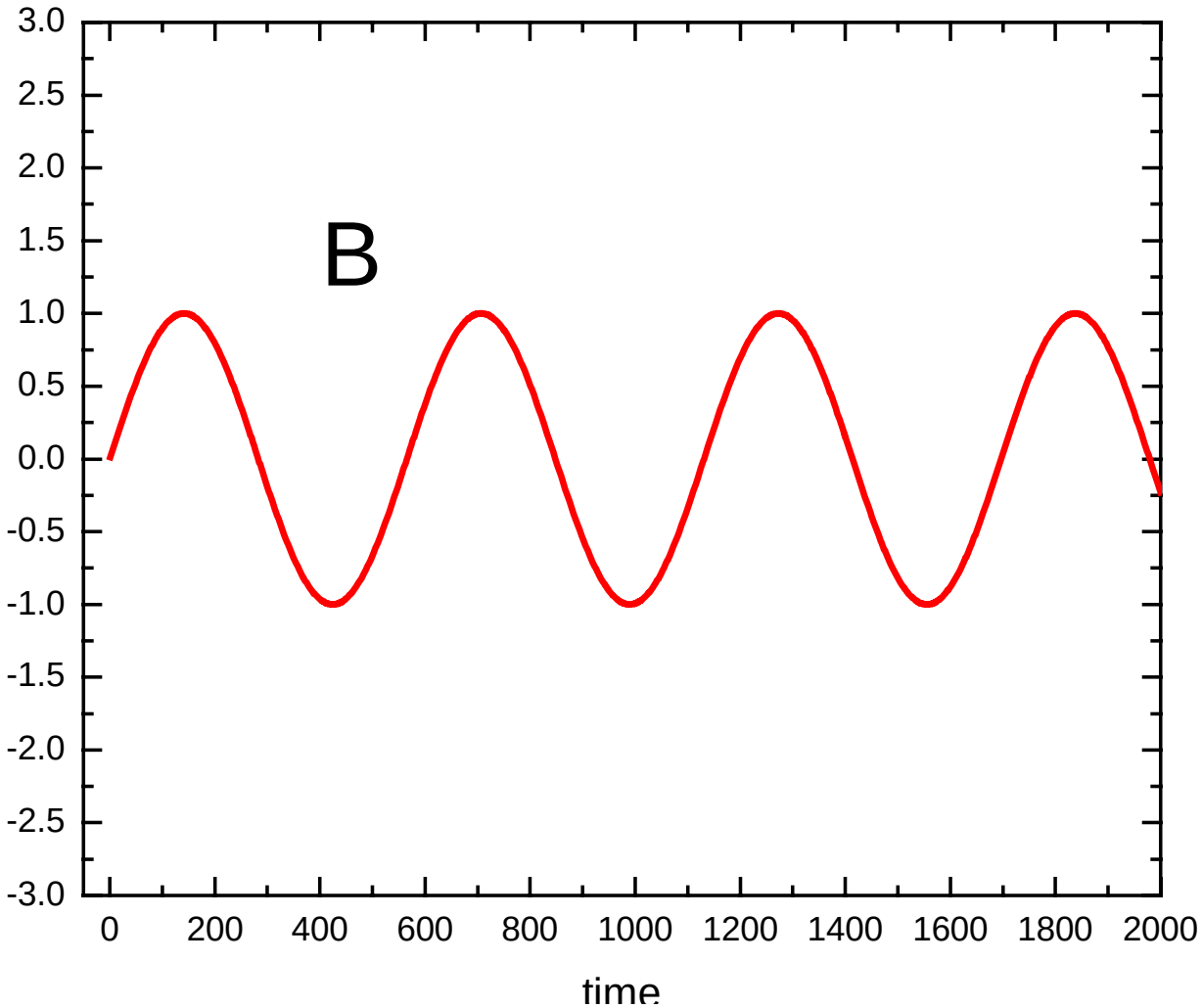
$$X_r = |X|\cos(\angle X) \quad \text{and} \quad X_i = |X|\sin(\angle X)$$

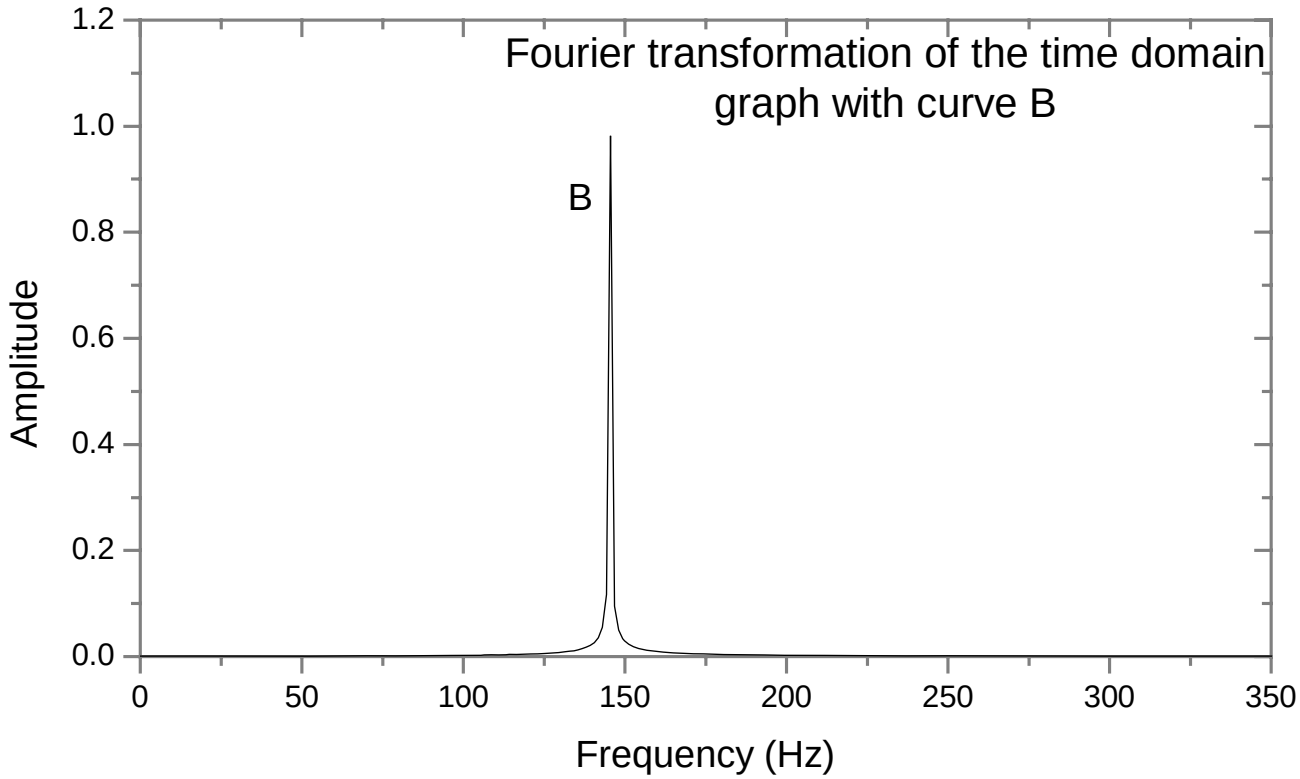
Where |X| and <X are the magnitude and phase of the complex number, and X_r and X_i are the real and quadrature components of the complex number. In this tool, the magnitude is plotted on a dB scale. Select a few signals, such as unit pulses and sine waves, and view them using the two methods to see how they are related.

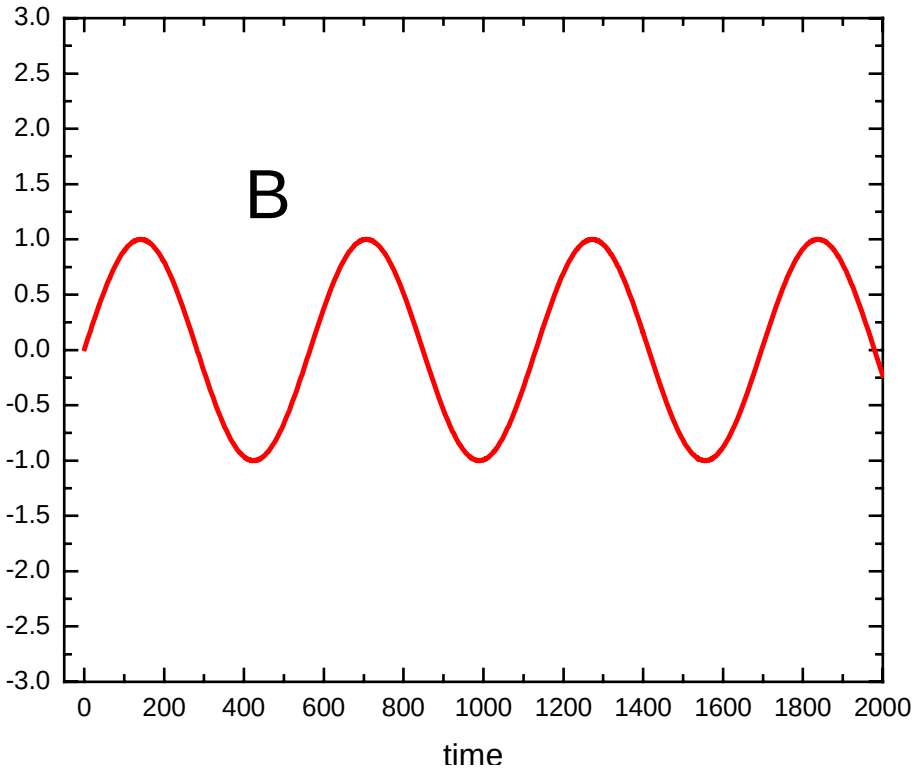
The Fourier transform itself is defined by the equation

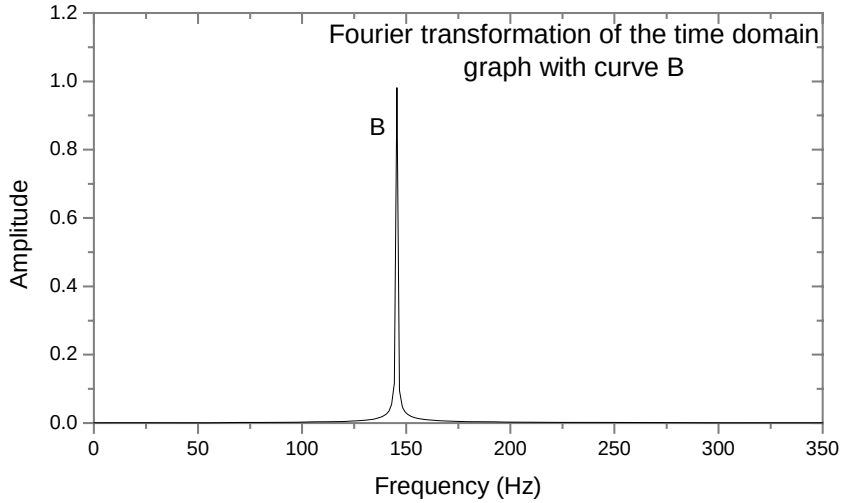
$$X(f) = \int_{-\infty}^{\infty} x(t)\, e^{-j2\pi f t}\, dt$$

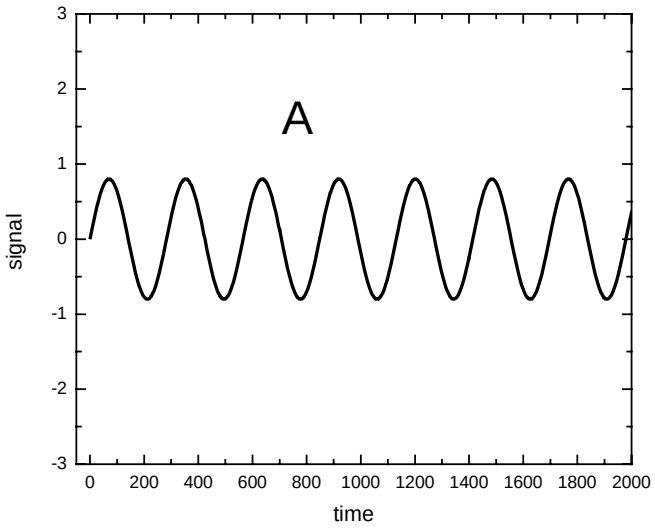
where X(f) is the Fourier transformation of x(t). Frequency is measured in hertz, with *f* as the frequency variable.

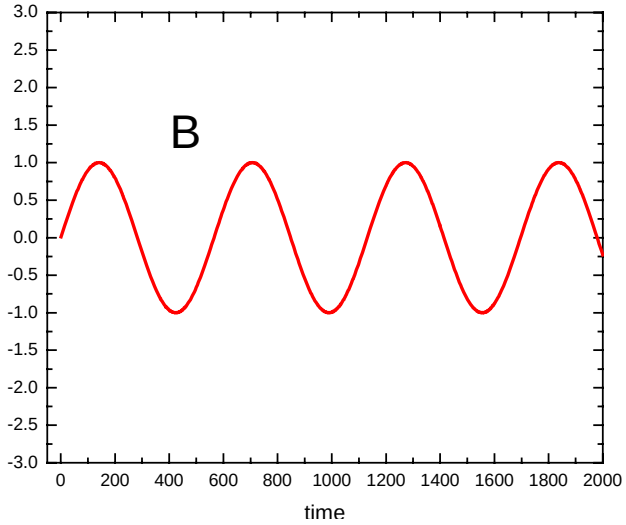

B
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
time

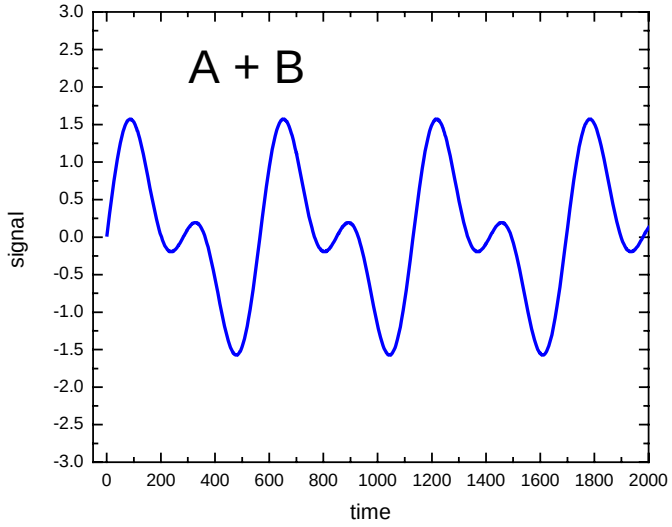

Fourier transformation of the time domain graph with curve B
B
Amplitude
Frequency (Hz)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350

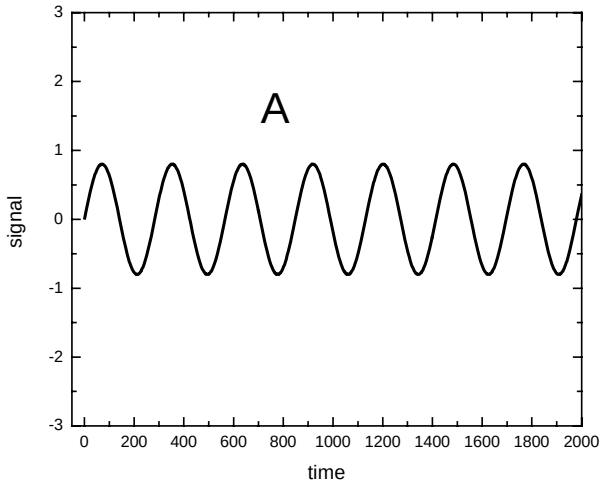

B
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
time

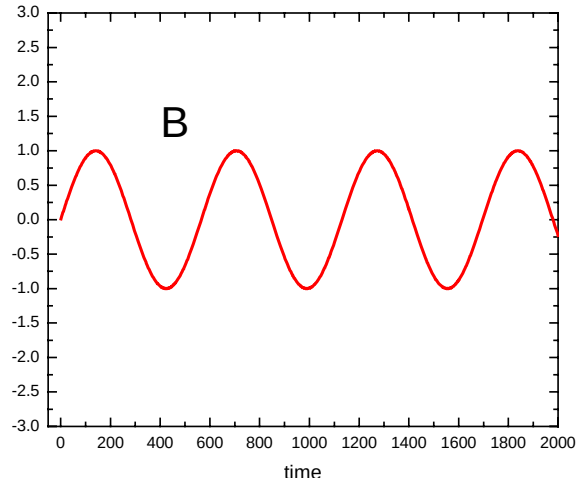

Fourier transformation of the time domain graph with curve B
B
Amplitude
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
Frequency (Hz)

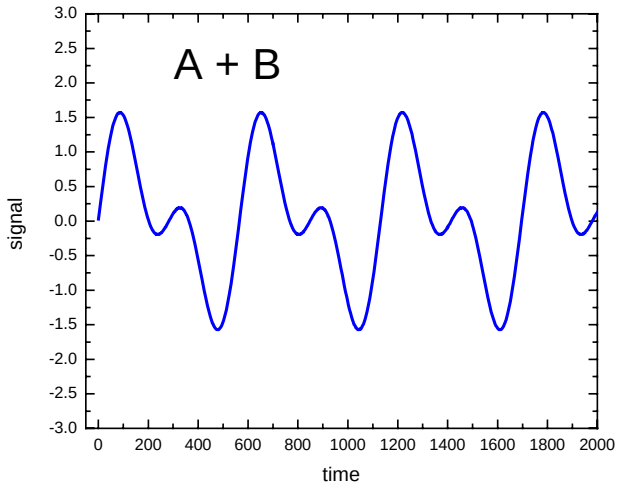

A
signal
time
3
2
1
0
-1
-2
-3
0
200
400
600
800
1000
1200
1400
1600
1800
2000

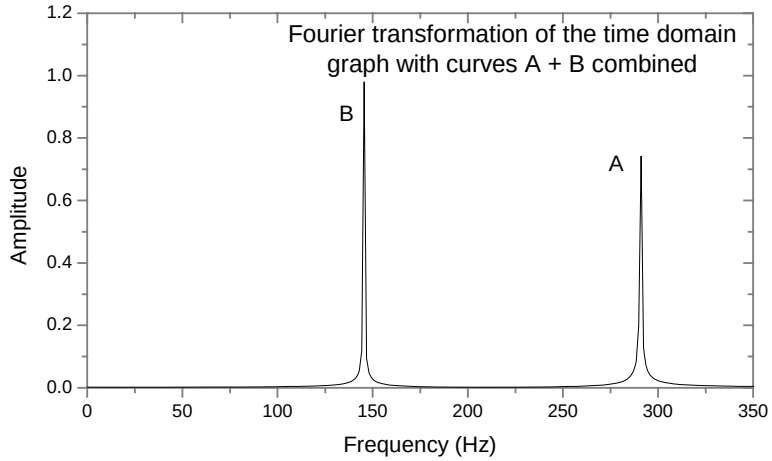

B
time
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000

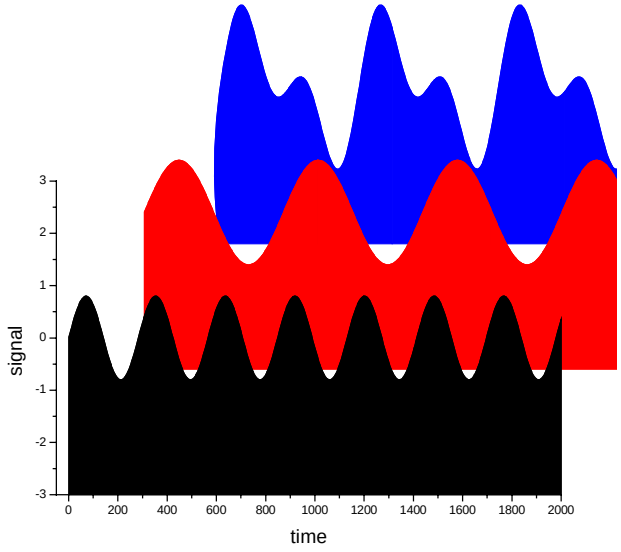

A + B
signal
time
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000

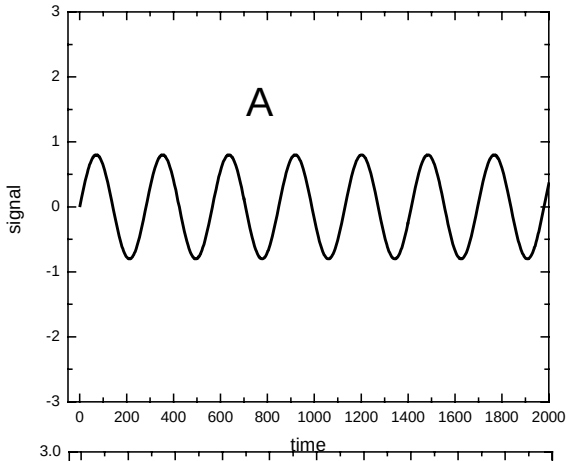

A
signal
time

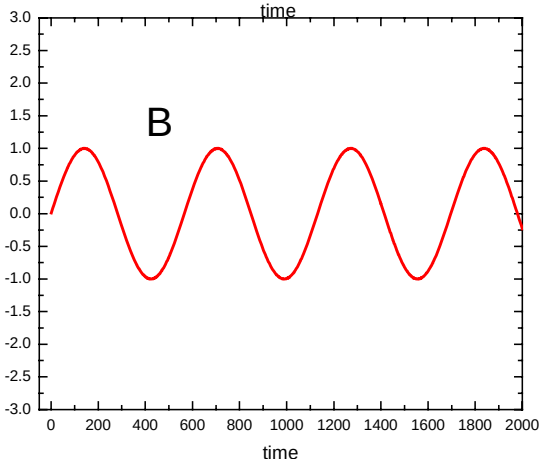

B
time

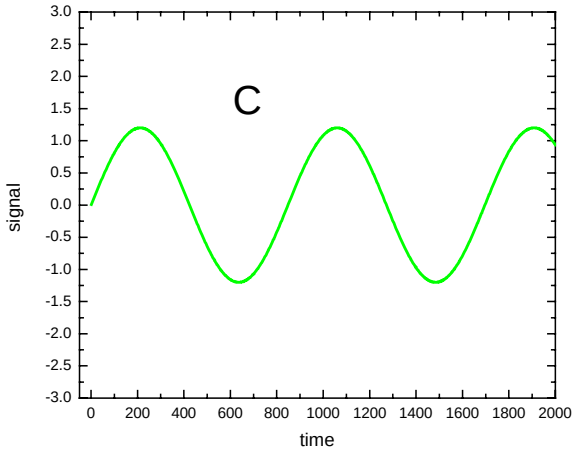

A + B
signal
time

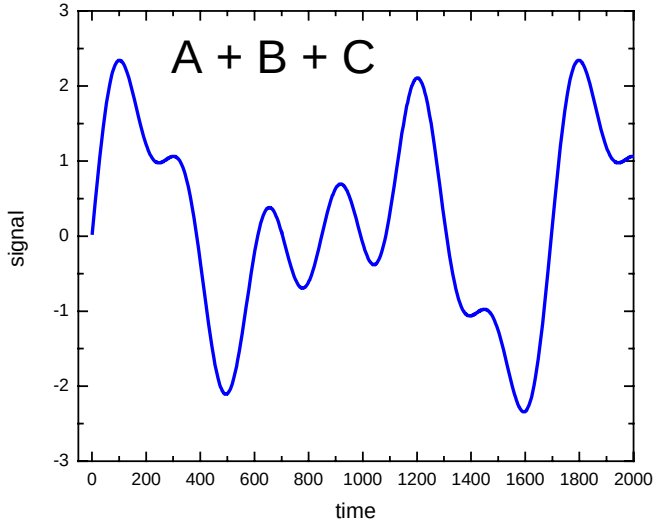

Fourier transformation of the time domain graph with curves A + B combined
B
A
Amplitude
Frequency (Hz)

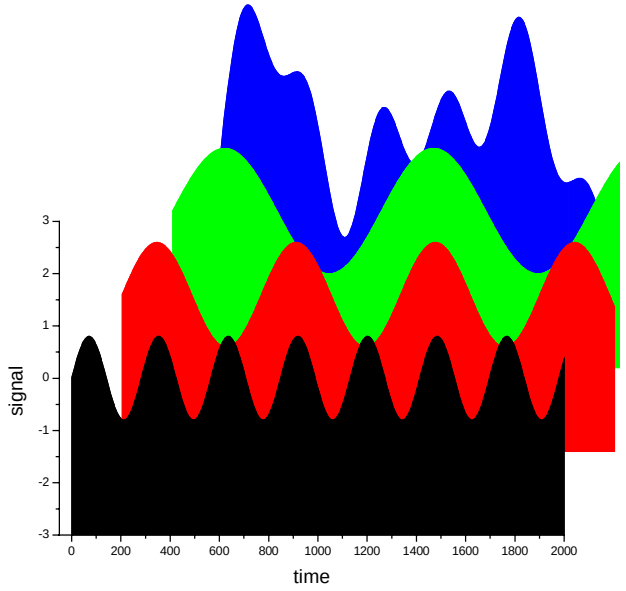

signal
time

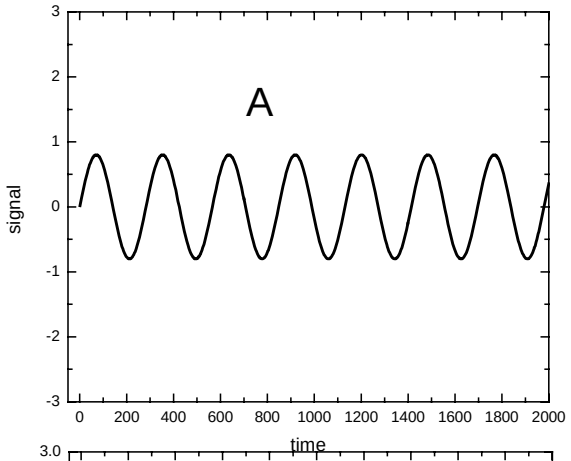

A
signal
time

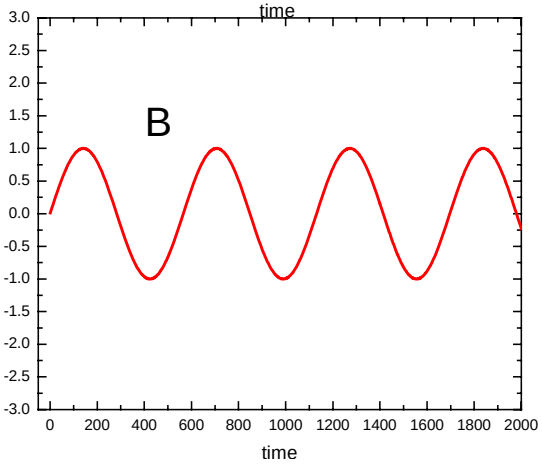

B
time

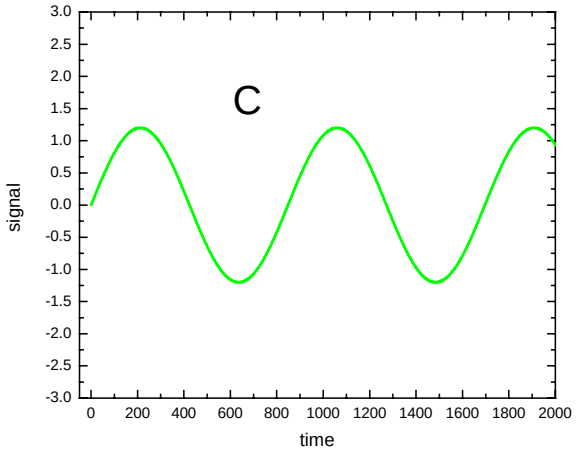

C
signal
time

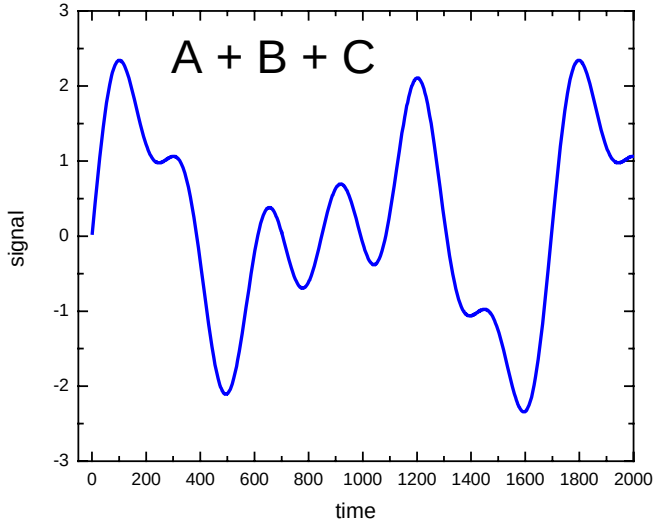

A + B + C
signal
time

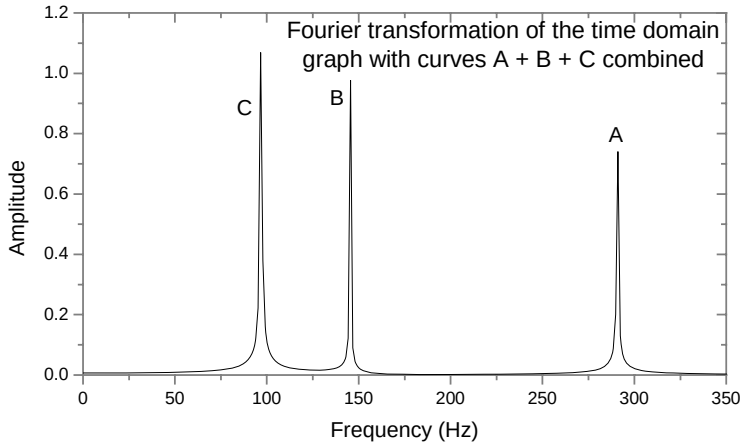

signal
time


A
signal
time


B
time


C
signal
time


A + B + C
signal
time


Fourier transformation of the time domain graph with curves A + B + C combined
C
B
A
Amplitude
Frequency (Hz)