

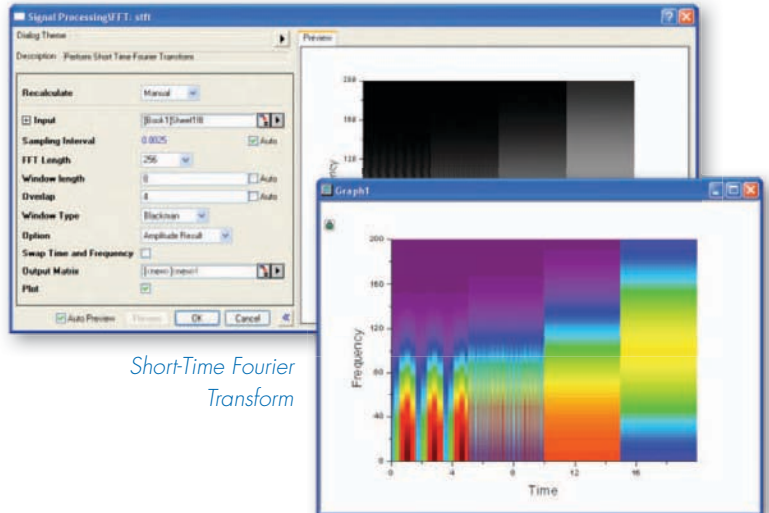
# Signal Processing

Origin provides tools for smoothing and filtering, convolution, correlation, and Fast Fourier Transforms (FFT). OriginPro contains many additional routines for advanced signal processing, which are described in this page.

## Fourier Transform **PRO**

Many additional options for FFT-based analysis are available in OriginPro:

- Advanced features for FFT:
  - Power Density Normalization
  - Spectrum Type, One-sided or Two-sided
  - Output dB of Amplitude
  - Output Normalized dB of Amplitude
  - Output RMS Amplitude
  - Output Square Amplitude
  - Output Square Magnitude
- 2D FFT & 2D Inverse FFT
- Short-Time Fourier Transform

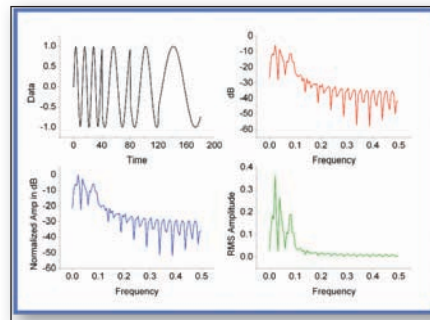


Short-Time Fourier Transform

## Decimation **PRO**

Decimation is used to reduce the number of elements in an input sequence. Every N samples are merged into one. Two filters are available:

- Moving Average
- Finite Impulse Response (FIR)



Results of FFT, including original signal and results in frequency domain

## Coherence **PRO**

Coherence—the degree of linear dependency of two signals—is evaluated by testing whether the signals contain similar frequency components.

## Envelope Curves **PRO**

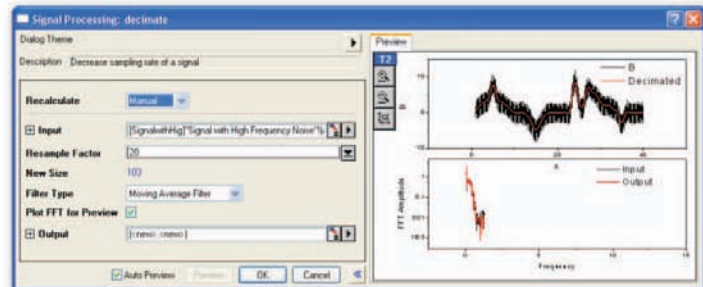
An envelope curve traces the crests and troughs of a periodic signal.

- Choose upper, lower or both
- Smoothing option during envelope detection

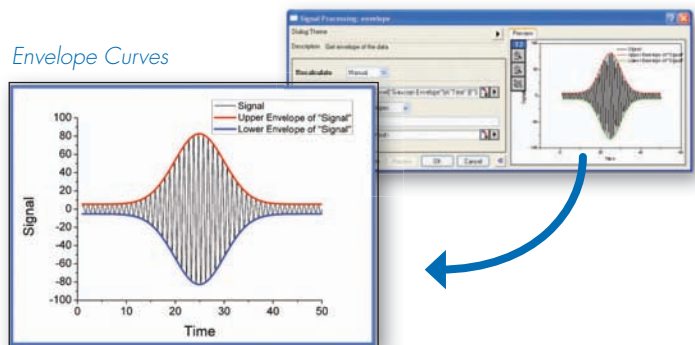
## 2D Correlation **PRO**

Two methods of 2D correlation are supported:

- FFT
- Shift Accumulation
- Linear Correlation
- Circular Correlation



Decimation on Signal with High Frequency Noise



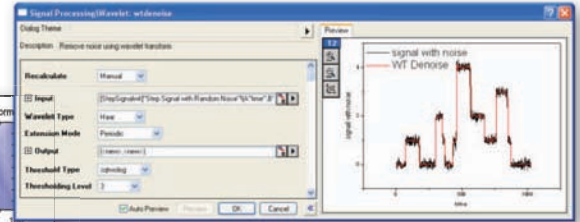
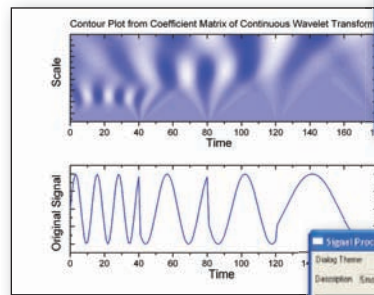
Envelope Curves

## Wavelet Analysis **PRO**

Wavelet Transforms are used in many applications, including data compression, signal smoothing, noise removal, and image analysis. Wavelet analysis tools include:

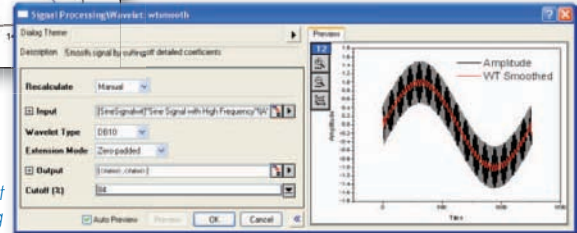
- Continuous Wavelet Transform
- Discrete Wavelet Transform
  - (Decomposition)
- Inverse Discrete Wavelet Transform
  - (Reconstruction)
- Multi-Scale Wavelet Decomposition
- Smoothing
- Noise Removal
- 2D Wavelet Decomposition
- 2D Wavelet Reconstruction

Continuous Wavelet Transform



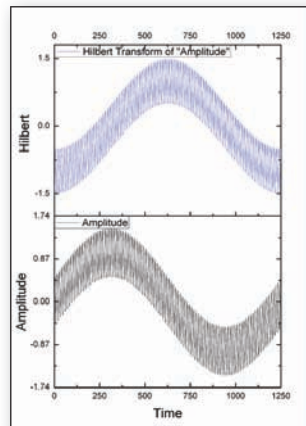
Remove Noise Using Wavelet Transform

Wavelet Smoothing



## Hilbert Transform **PRO**

The Hilbert Transform of a signal results in a +90 degree shift of the signal's negative frequency components, and a -90 degree phase shift of its positive frequency components. The Hilbert Transform tool will calculate both the Hilbert Transform and the analytic representation of the input signal.

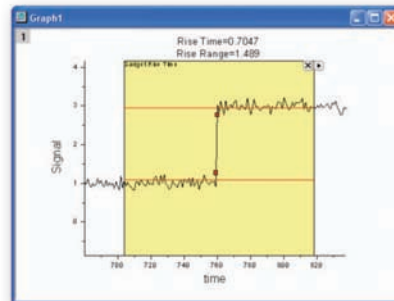


Hilbert Transform

## Rise Time Gadget **PRO**

Three methods of finding the rise/fall time are supported:

- Linease arch
- Histogram
- Largest triangle
- Select a specific region of the signal by moving and resizing a region of interest (ROI)
- Easily select desired data plot from the graph layer with multiple plots
- Display low and high levels inside the ROI control
- Display rise/fall time and rise/fall range on top of ROI



Rise Time Gadget