# Extract the Envelope and Instantaneous Phase of a Signal using the Hilbert Transform

The Hilbert transform has many practical applications. These include vibration analysis and amplitude modulation in communication systems.

This application computes the envelope and instantaneous frequency of a signal using the Hilbert transform.

- The signal envelope is the magnitude of the Hilbert transform.
- The instantaneous frequency is the time derivative of the phase angle of the Hilbert transform (only for single-component signals).

The magnitude of the analytic signal captures the slowly varying features of the signal, while the phase contains the high-frequency information

Common plot options

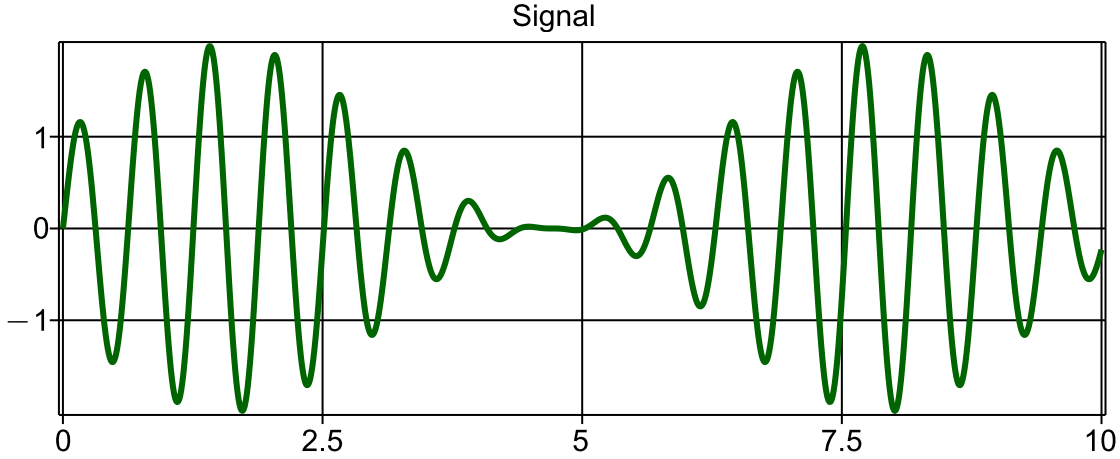
```
plot_opts := thickness = 3, color = "DarkGreen", font = [Arial], axes = boxed,
axis = [gridlines = [5, color = black]]
```

Signal

```
t := Vector([seq(0..10, 0.01)], datatype = float[8])
```

```
sig := (1+~sin~(t))·~sin~(10·t)
```

```
p1 := plot(t, sig, plot_opts, title = "Signal") =
```



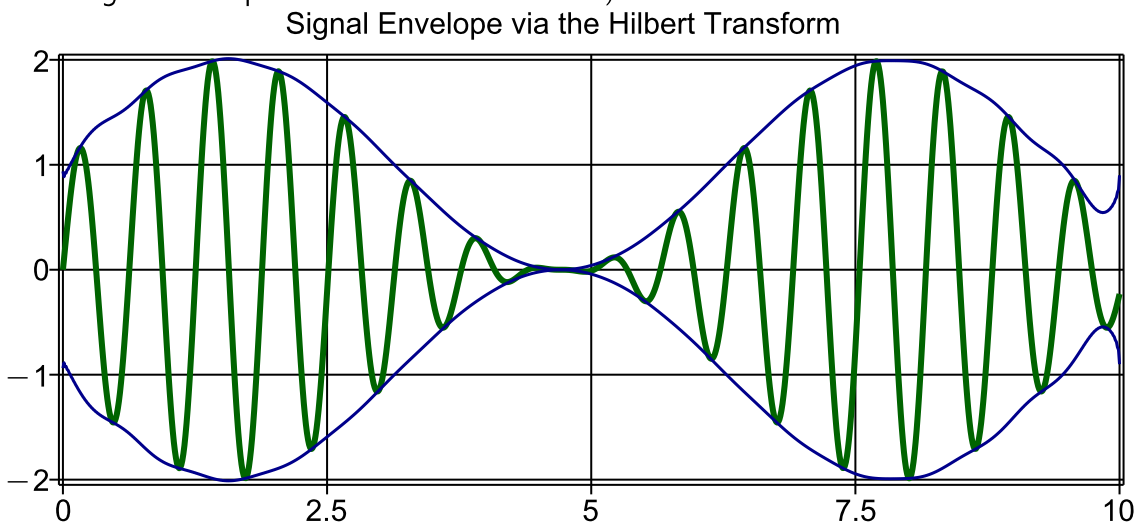
Envelope

```
envelope := abs( SignalProcessing:-Hilbert( sig ) )

p2 := plot( t, envelope, color = "DarkBlue" )

p3 := plot( t, -envelope, color = "DarkBlue" )

plots:-display( p1, p2, p3,
title = "Signal Envelope via the Hilbert Transform" ) =
```




Phase

```
phase :=
MTM:-unwrap( Re ~ ( argument ~ ( convert ~ ( SignalProcessing:-Hilbert( sig ), float ) ) ) )

plot( t, phase, title = "Instantanous Phase of the Signal", plot_opts ) =
```