Data series
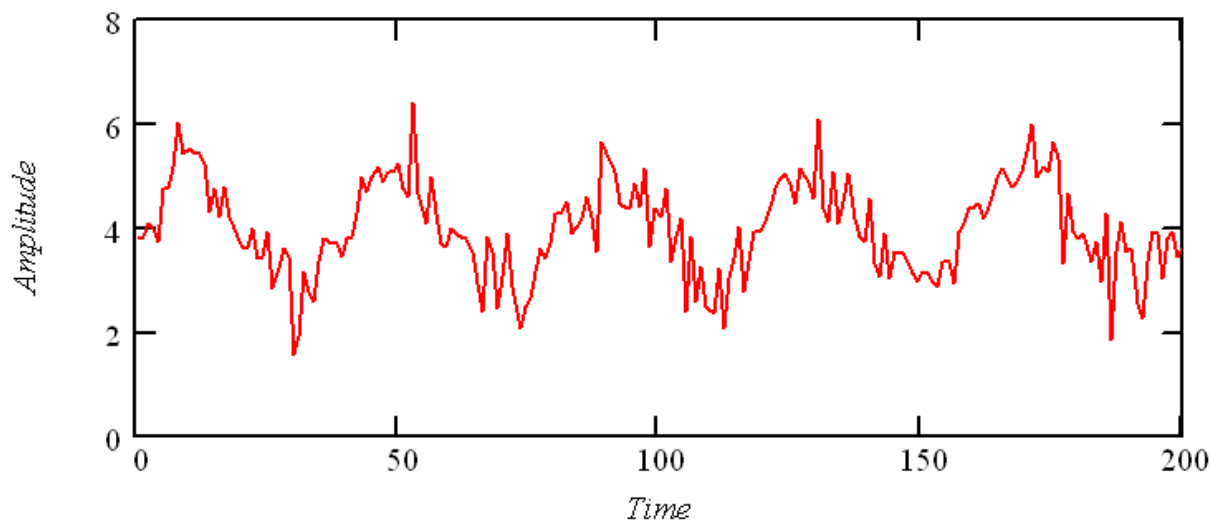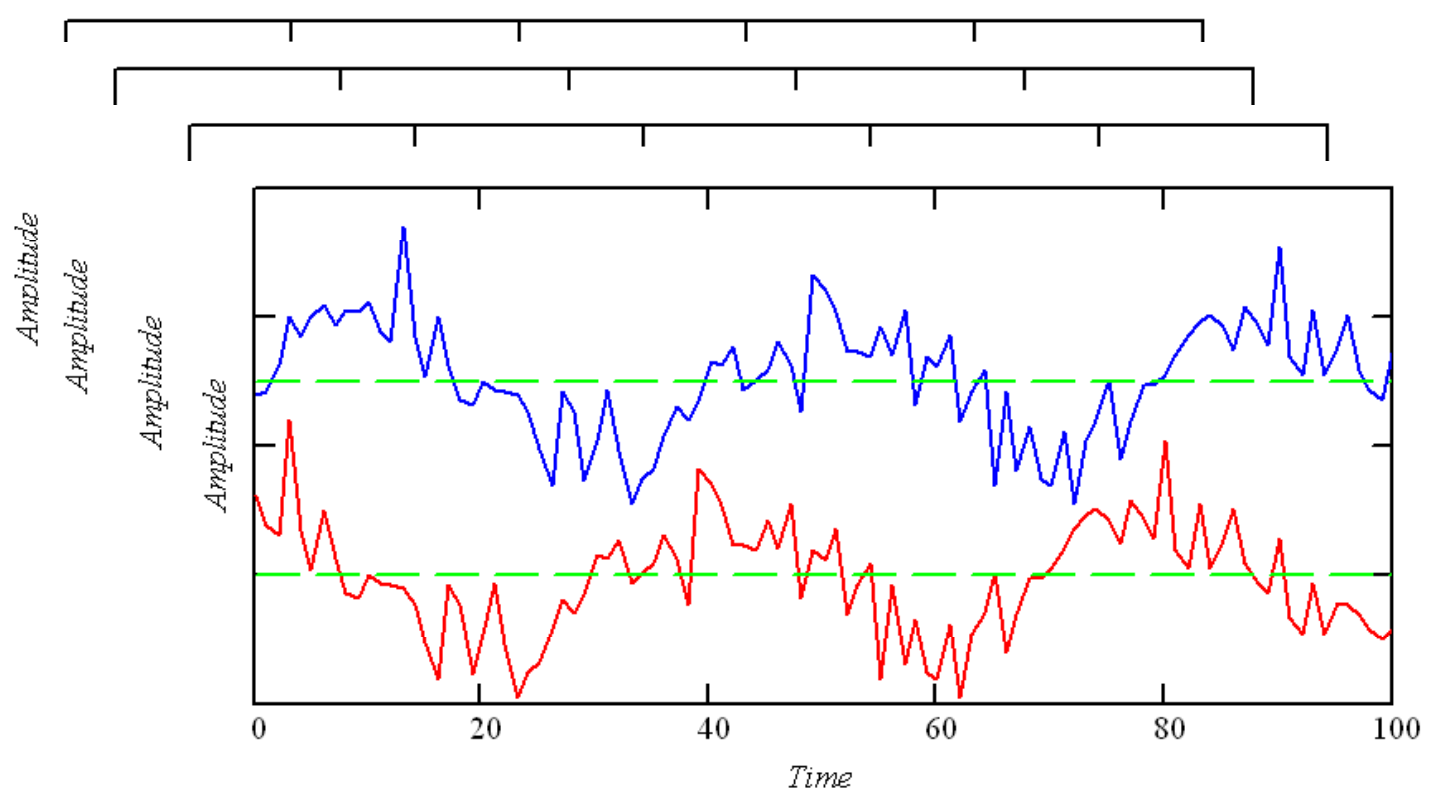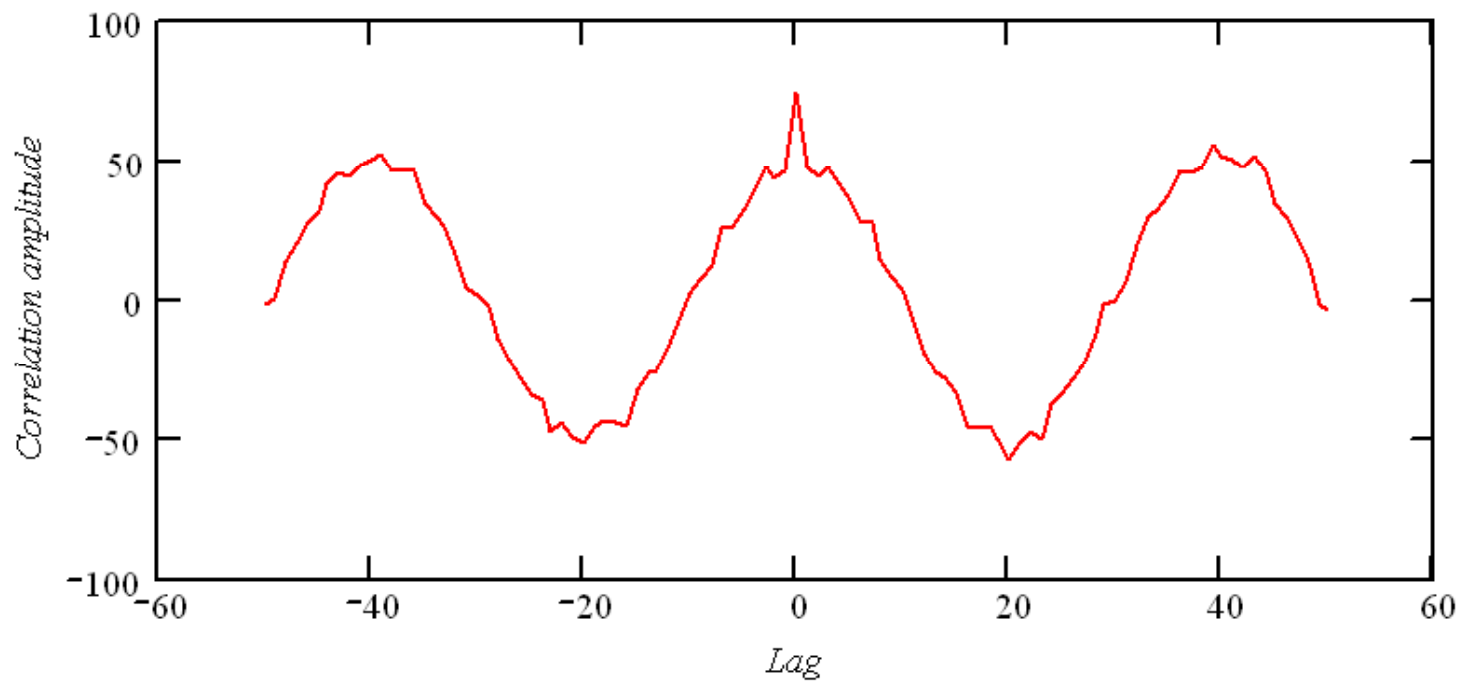

Amplitude information (statistically): $\mu = 3.99 \quad \sigma = 0.89$

Autocorrelation

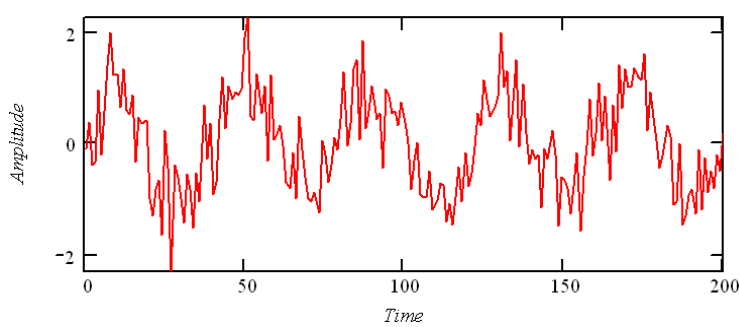$$R_{xx}(\tau) = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} V_x(t) \times V_x(t+\tau) \, dt$$

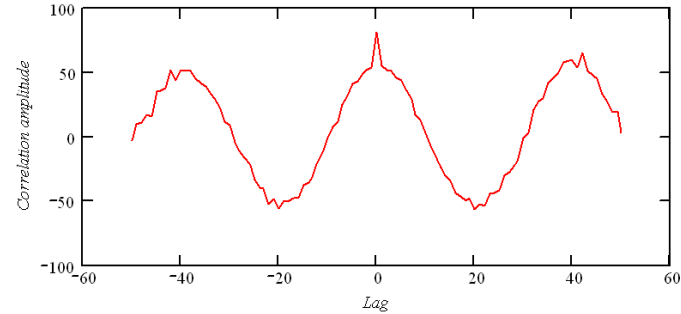# Autocorrelation function

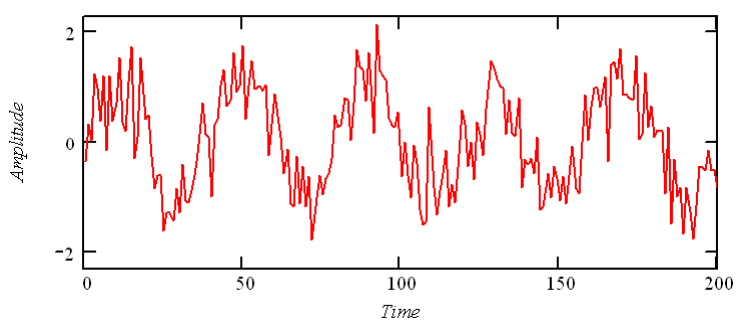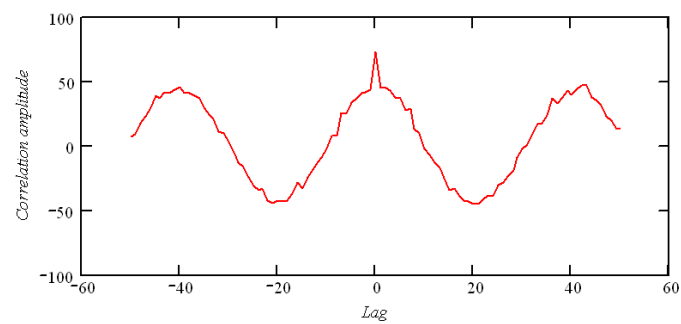# ACF's shape remains stable
(within noise)

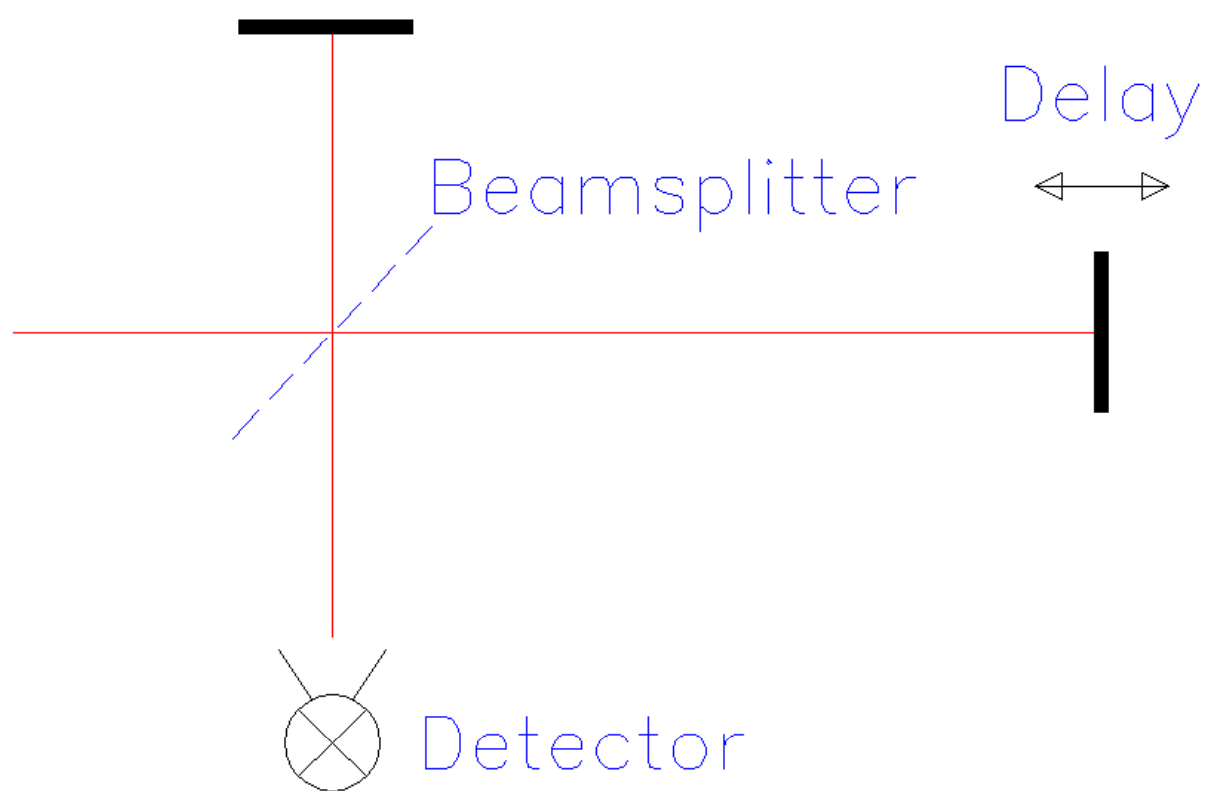Time series   Autocorrelation function
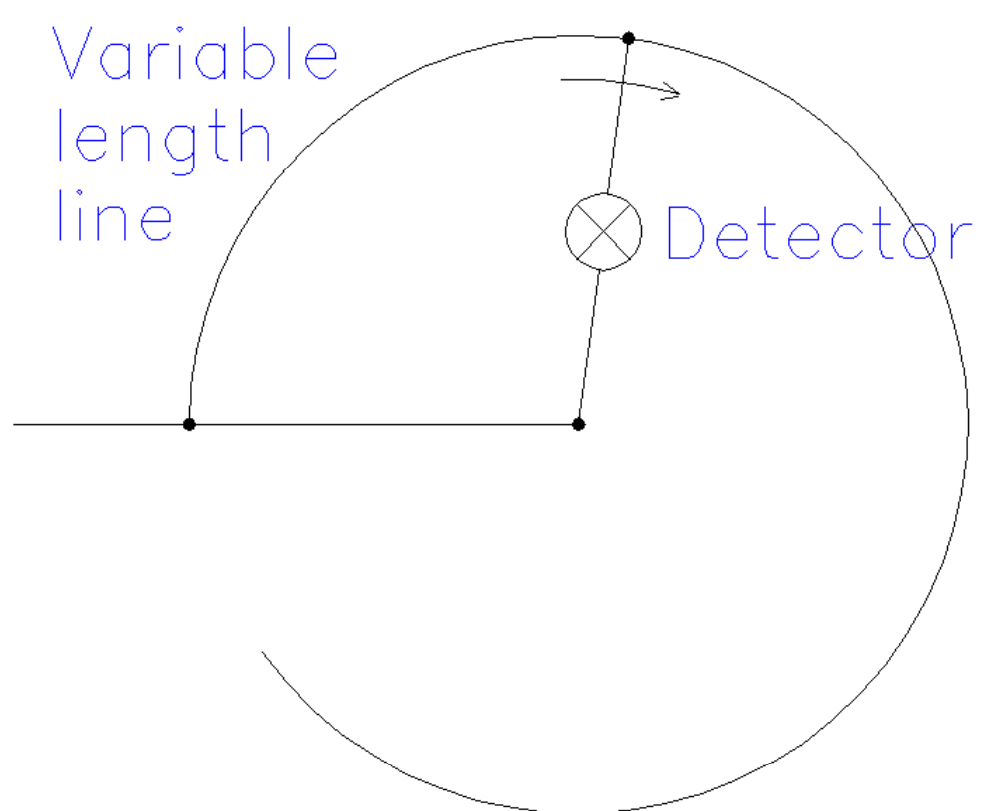

Lag is a <u>relative</u> time shift, eliminating information about absolute time.
Time and phase are related, so phase information is also lost.
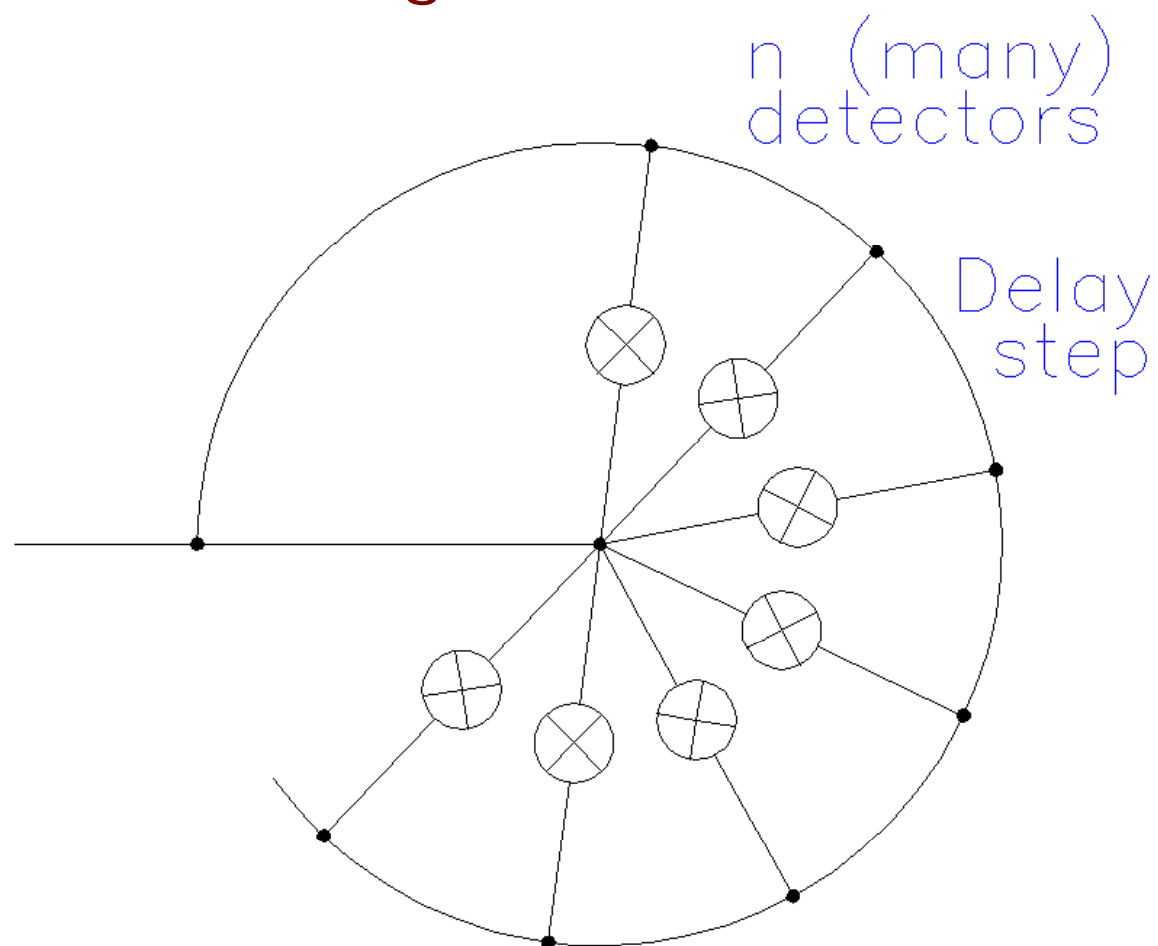Fourier transform thus gives *power* spectrum.

Michelson interferometer

Delay

Beamsplitter

Detector

Radio version of a Michelson interferometer

Variable
length
line
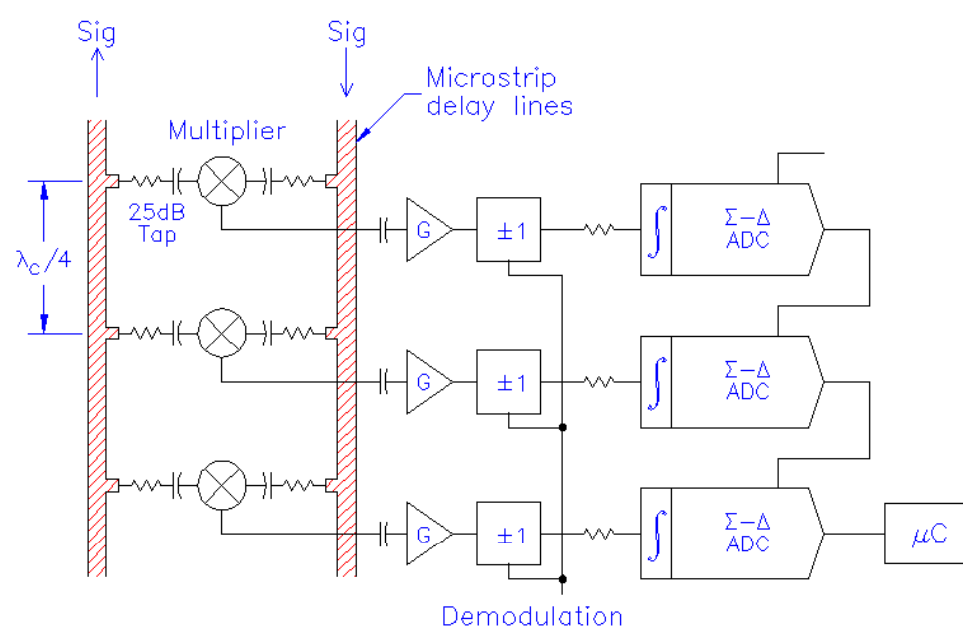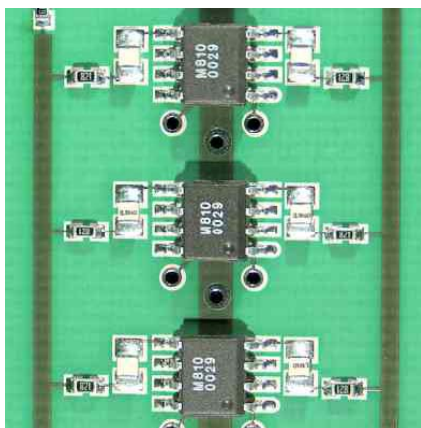
Detector
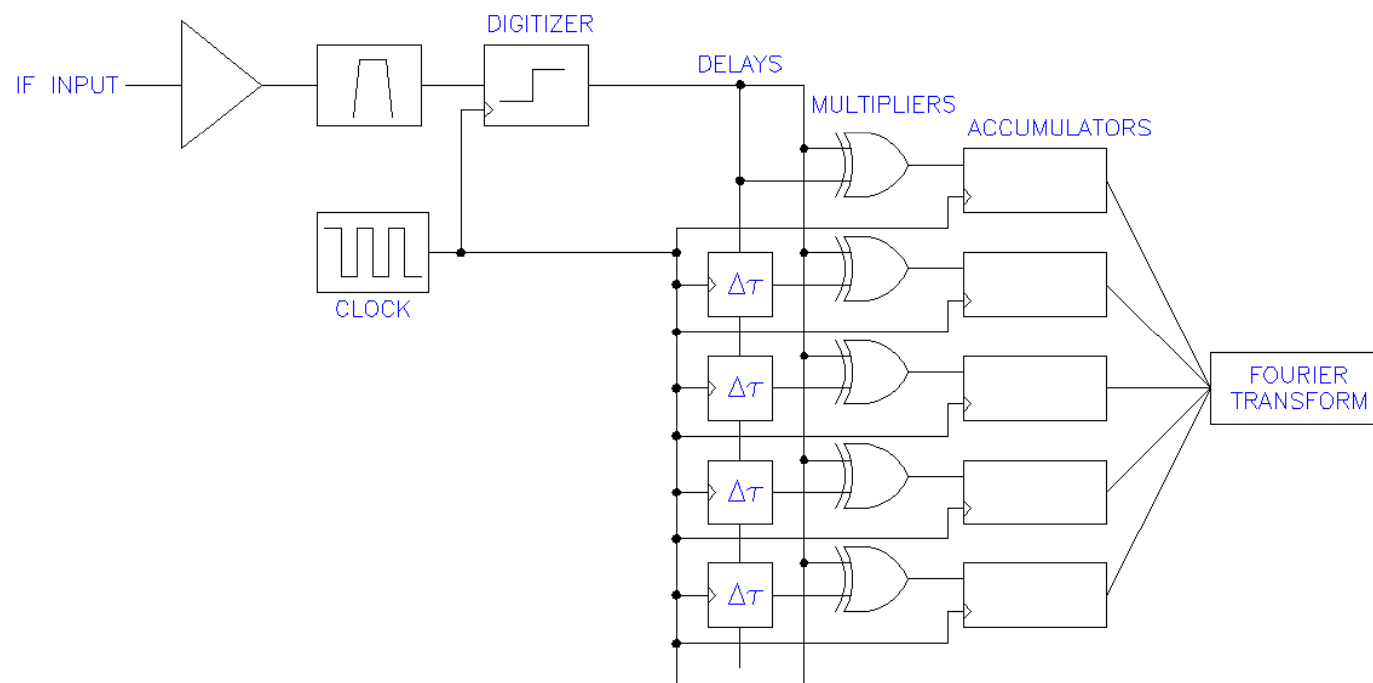
Lag correlator

n (many) detectors

Delay step

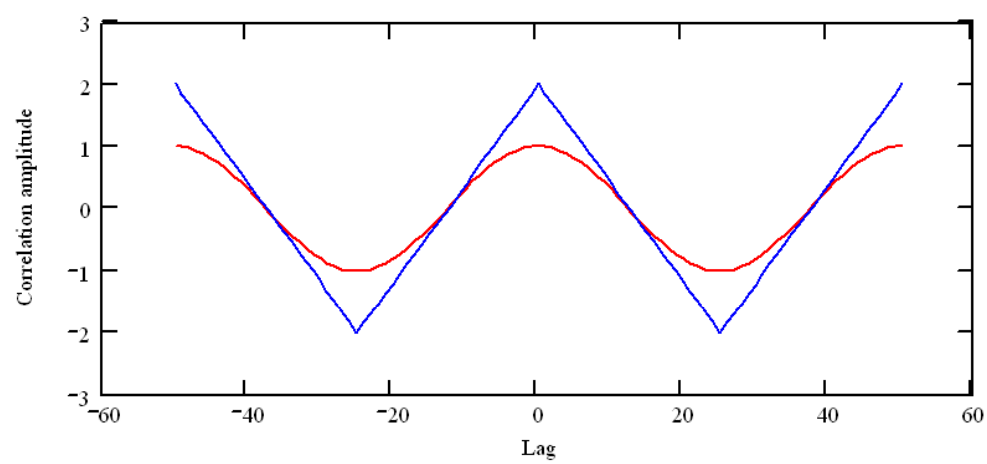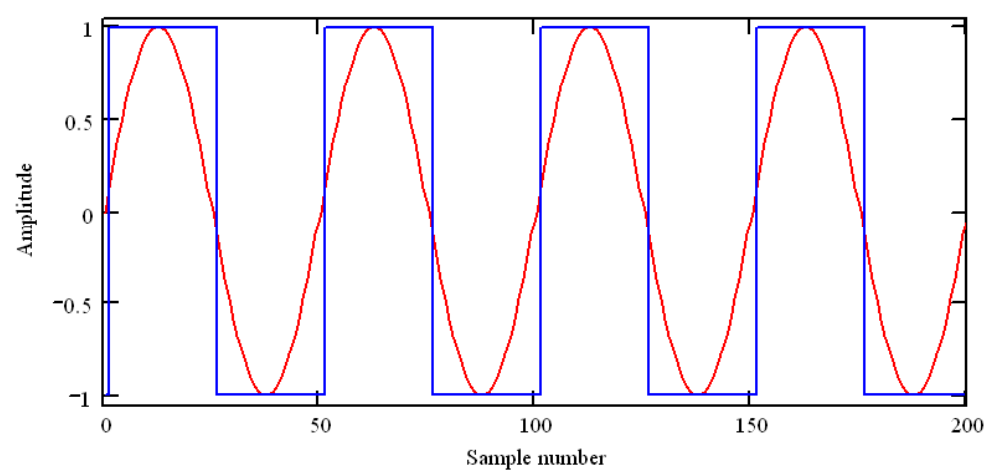## WASP2 analog correlator
(A radio Fourier Transform spectrometer)

$$S_{xy}(f) \leftrightarrow R_{xy}(\tau) \qquad R_{xy}(\tau) = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} V_x(t) \times V_y(t+\tau)\, dt$$
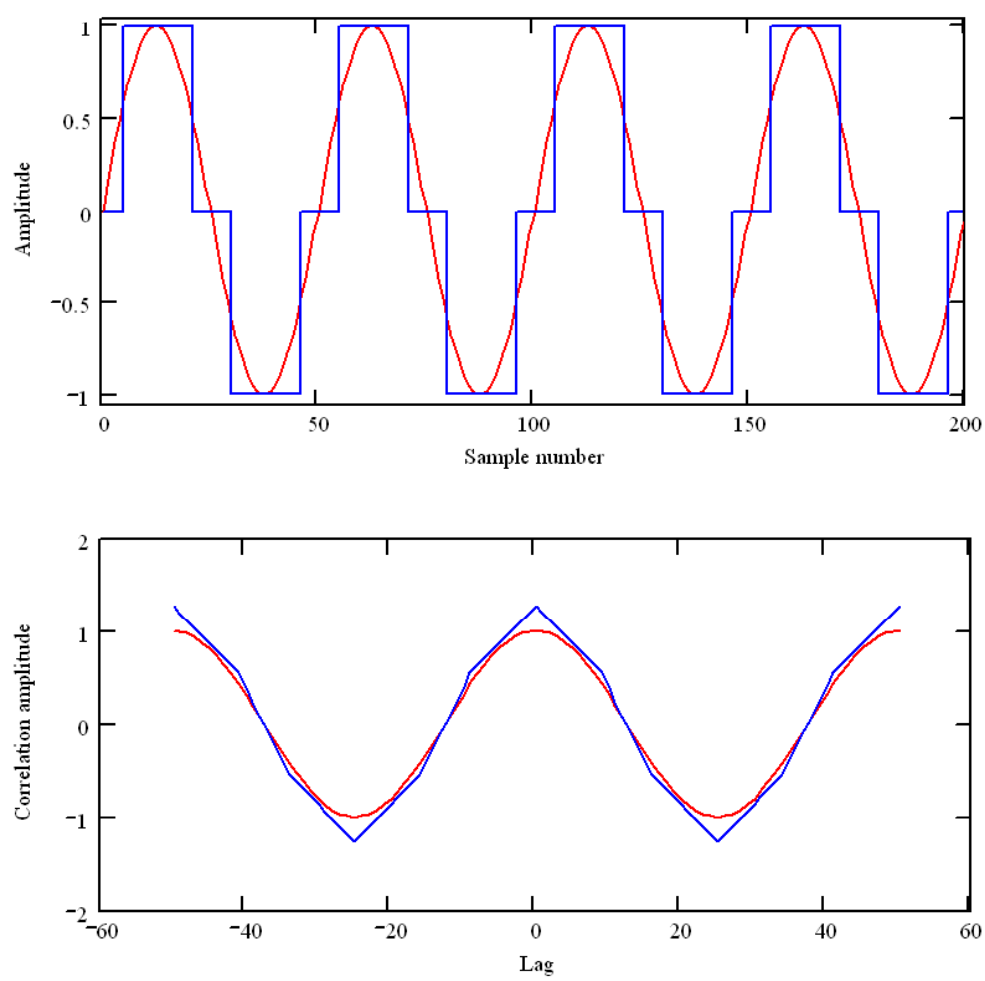
Sig   Sig

Microstrip delay lines

Multiplier

25dB Tap

$\lambda_c/4$

G   ±1 $\int$ Σ−Δ ADC

G   ±1 $\int$ Σ−Δ ADC

G   ±1 $\int$ Σ−Δ ADC   μC

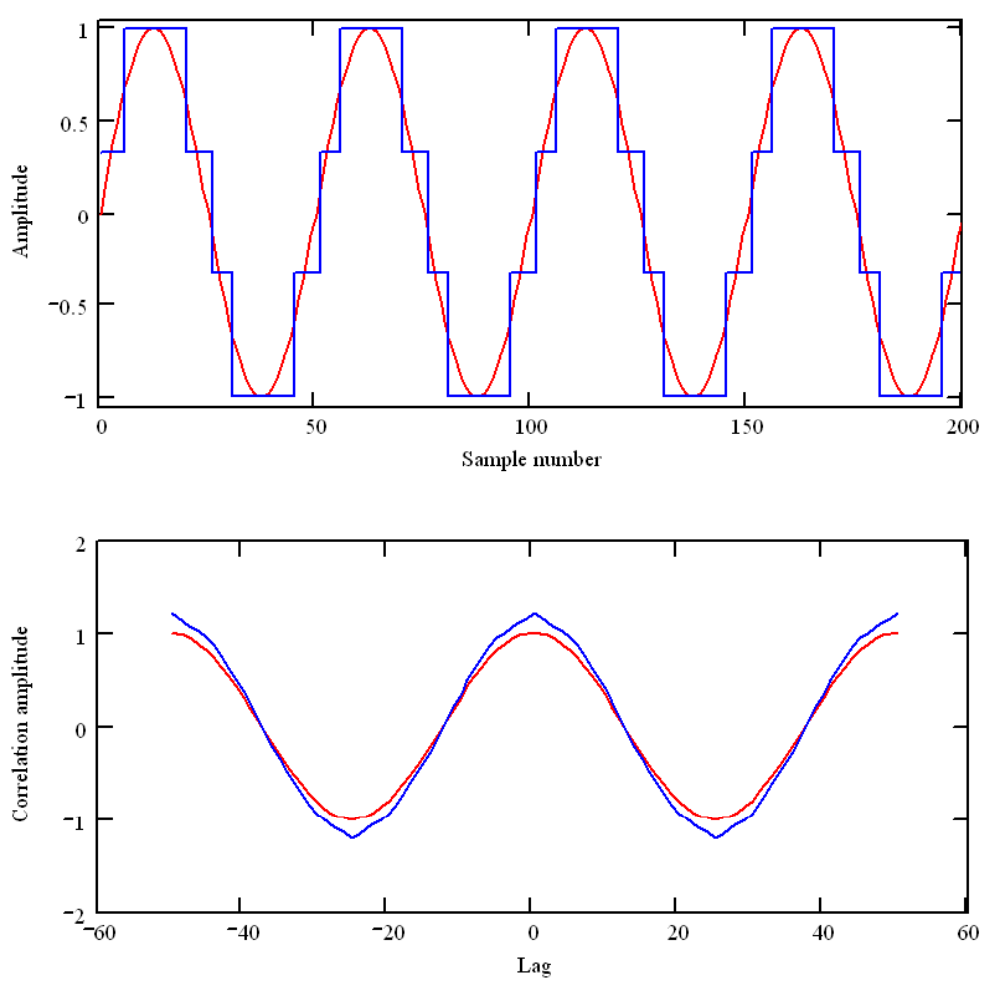Demodulation

Digital correlator

1-bit, 2 level digitization

2-bit, 3-level digitization

2-bit, 4-level digitization

FX and XF correlators

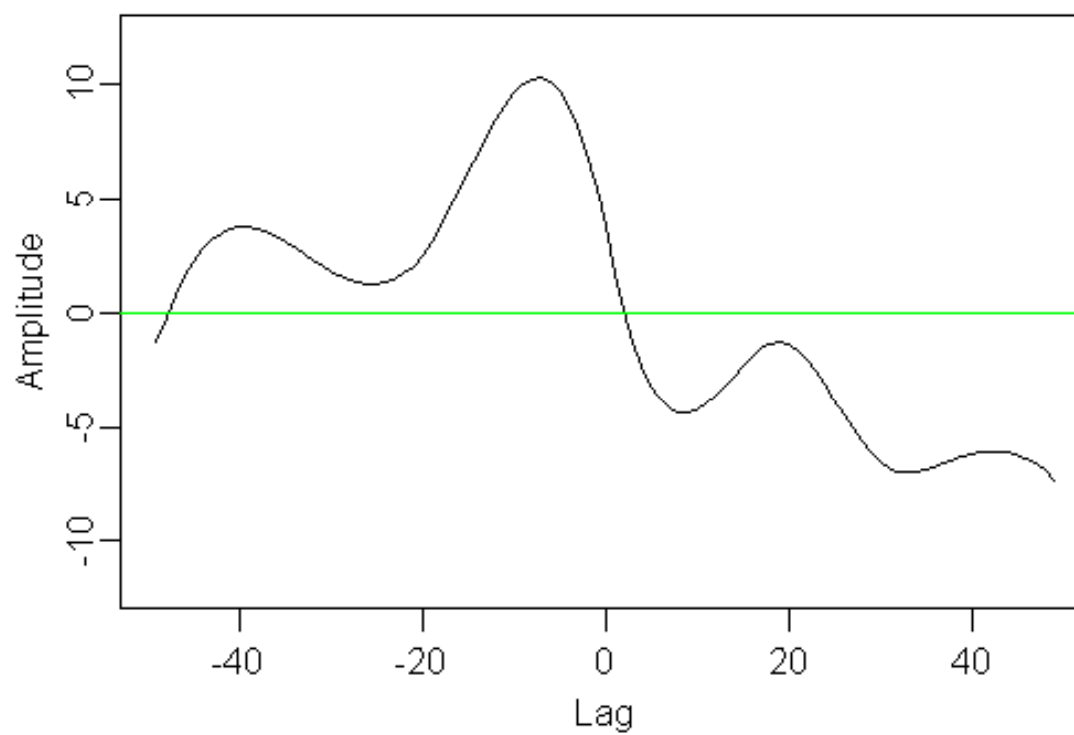**Filter bank correlator
(FX correlator)**

**Lag correlator
(XF correlator)**
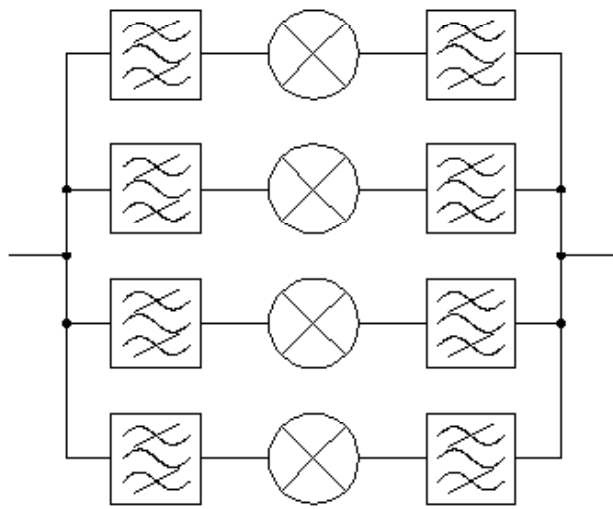
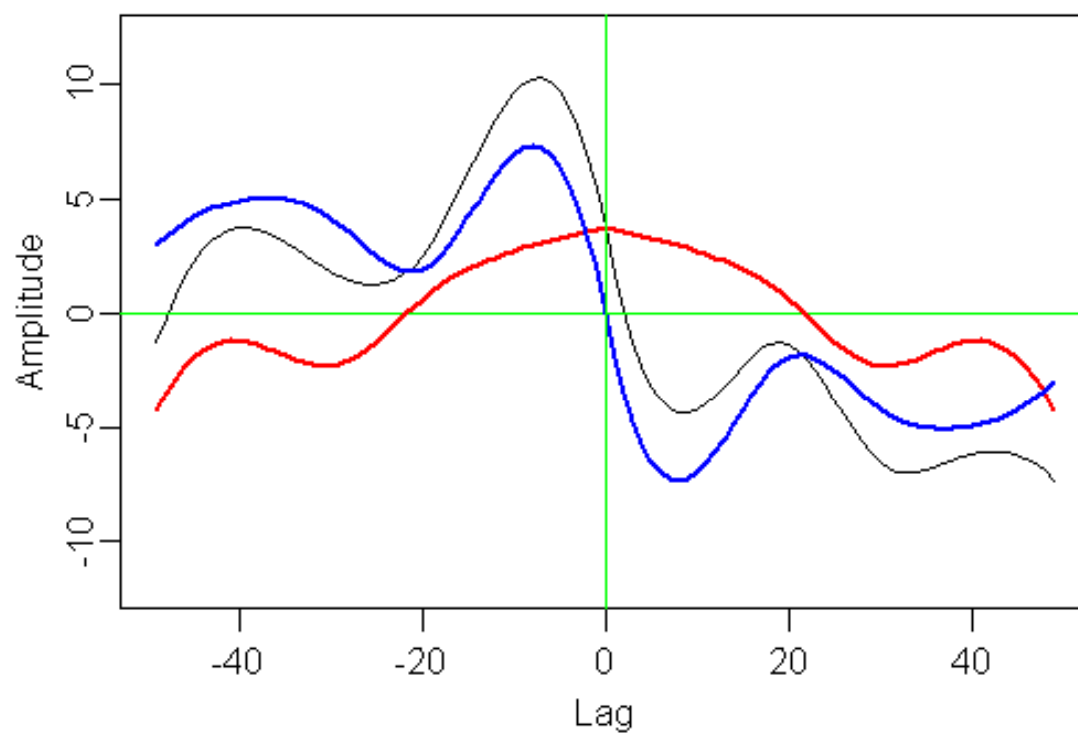Single correlator per frequency bin
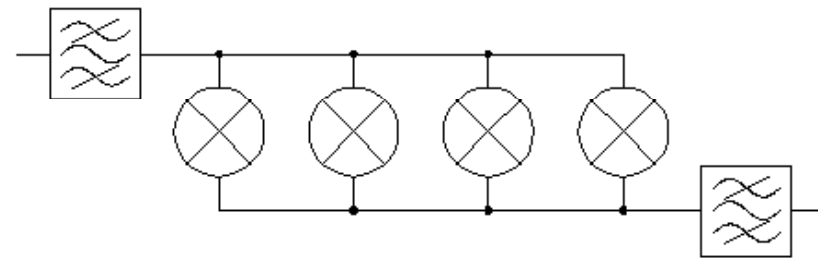
Multiple correlators per frequency bin

An arbitrary cross-correlation function

Even and odd parts

Even $\Rightarrow$ cosine transform, odd $\Rightarrow$ sine transform
A "complex" correlator