

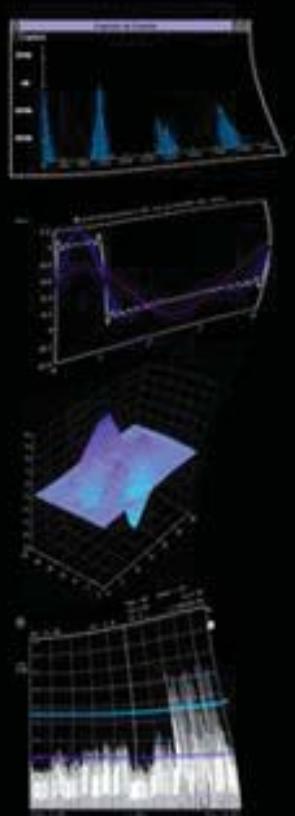
2384-20

**ICTP Latin-American Advanced Course on FPGADesign for Scientific
Instrumentation**

19 November - 7 December, 2012

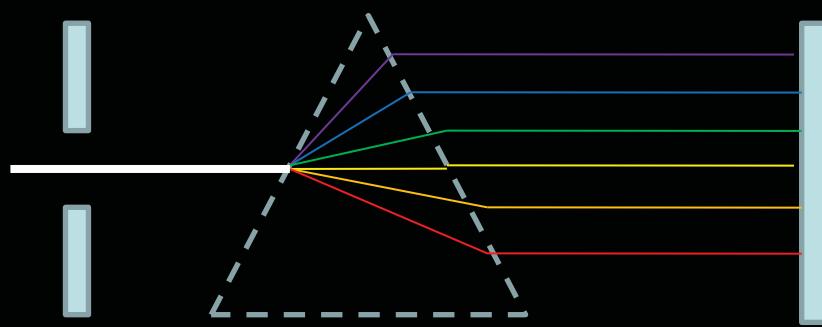
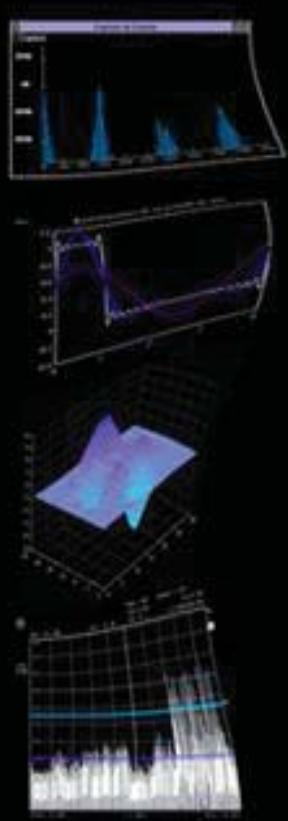
Transformada y Serie de Fourier

COSTA Diego Esteban
*Laboratorio de Electronica, Investigacion y Servicios
Fac. Cie. Fisico, Mat y Nat.
Universidad Nacional de San Luis
Av: Ejercito de los Andes, D5700HHW San Luis
ARGENTINA*

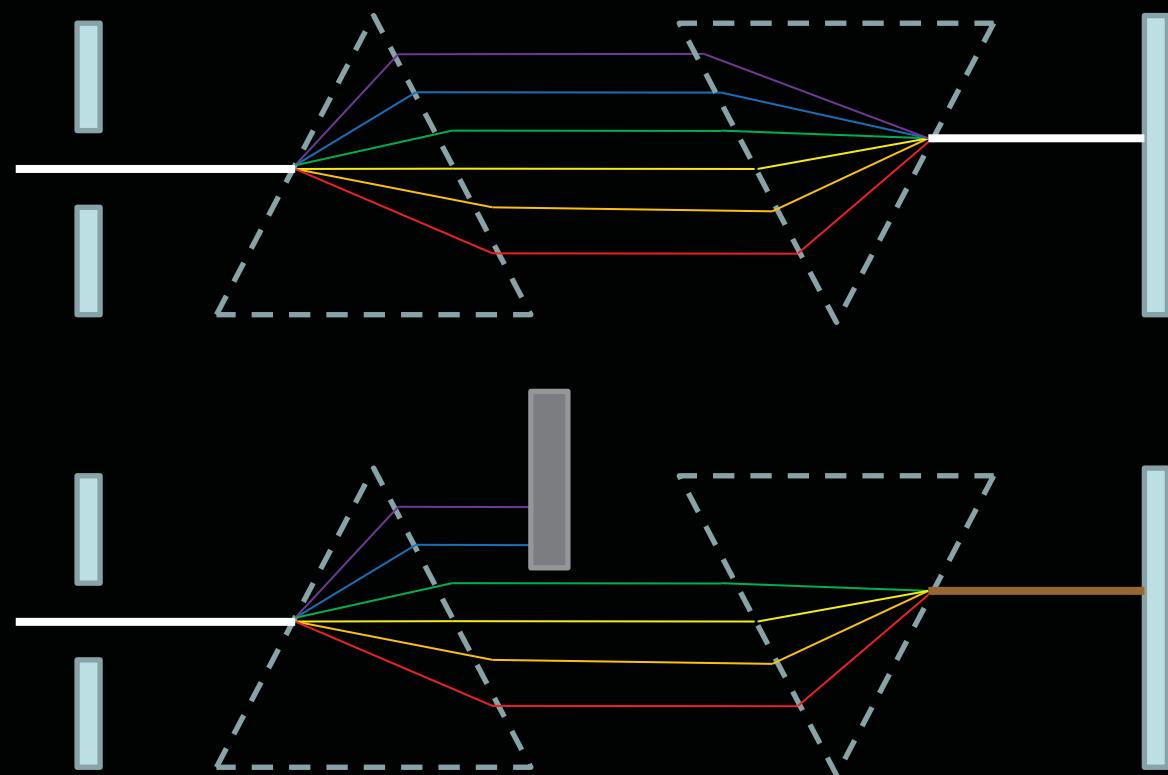
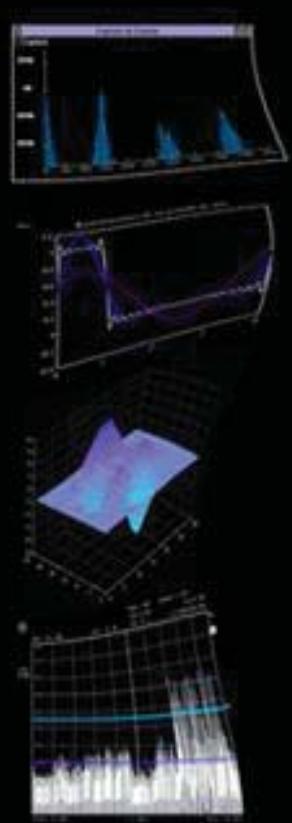


Transformada y Serie de Fourier

Transformada de Fourier

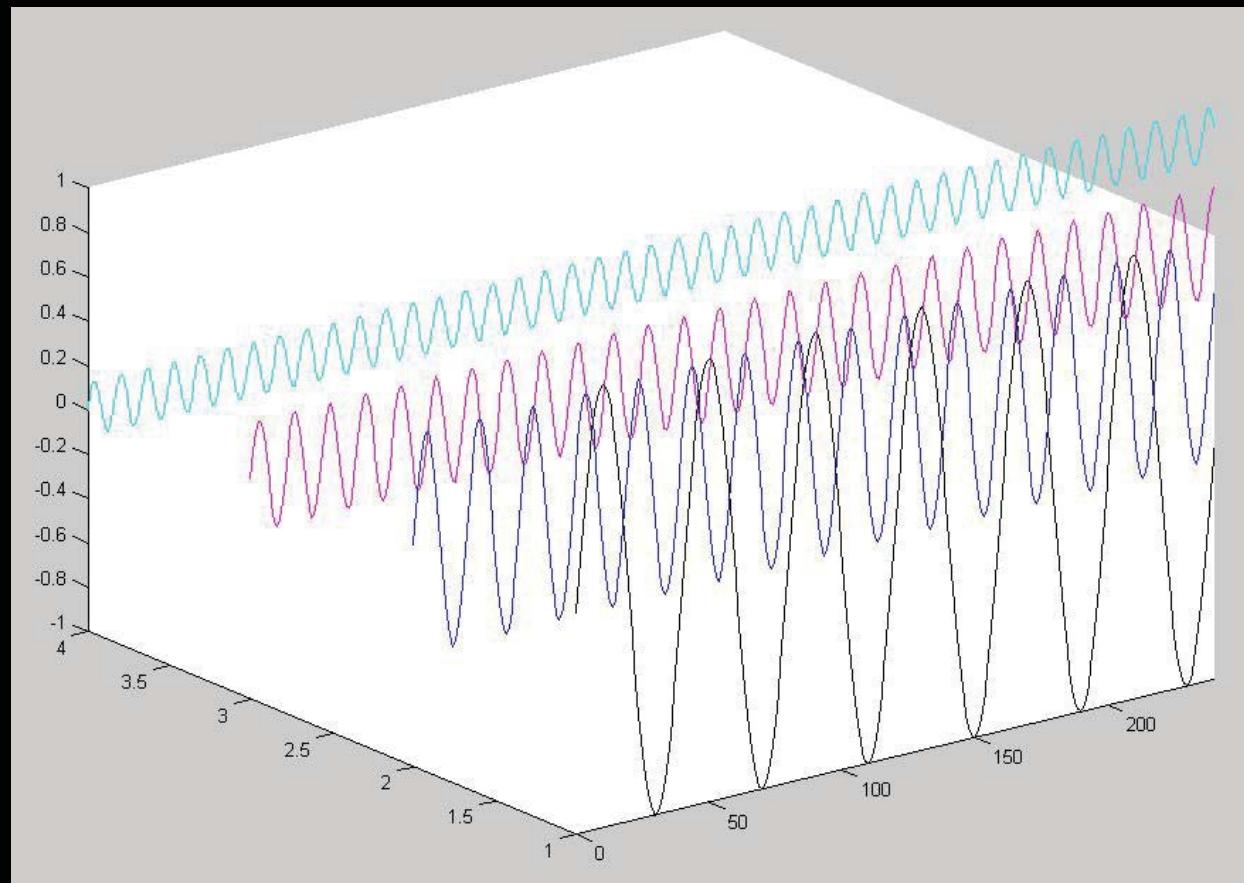
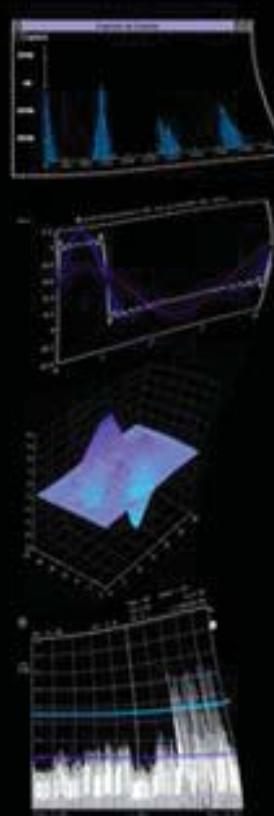


Transformada de Fourier



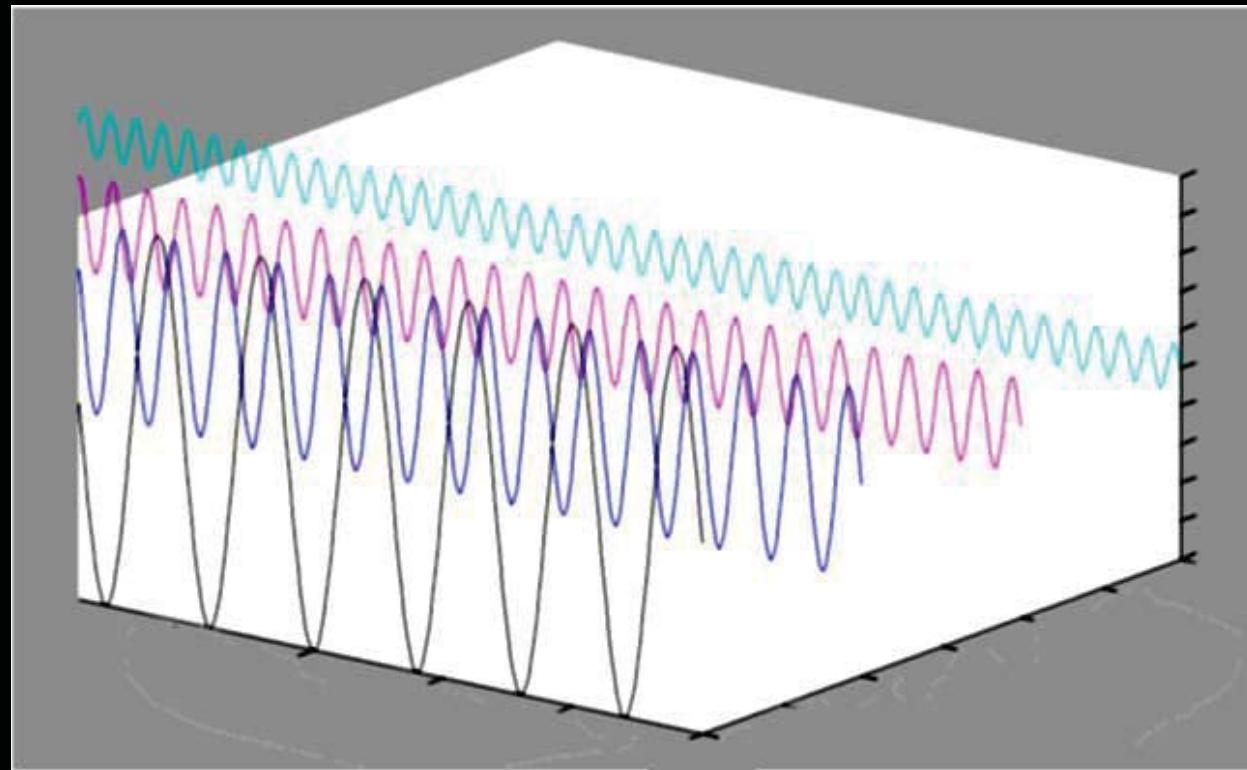
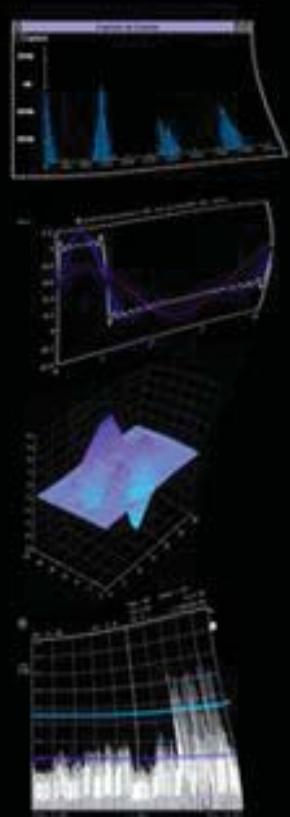
Transformada de Fourier

Análisis espectral



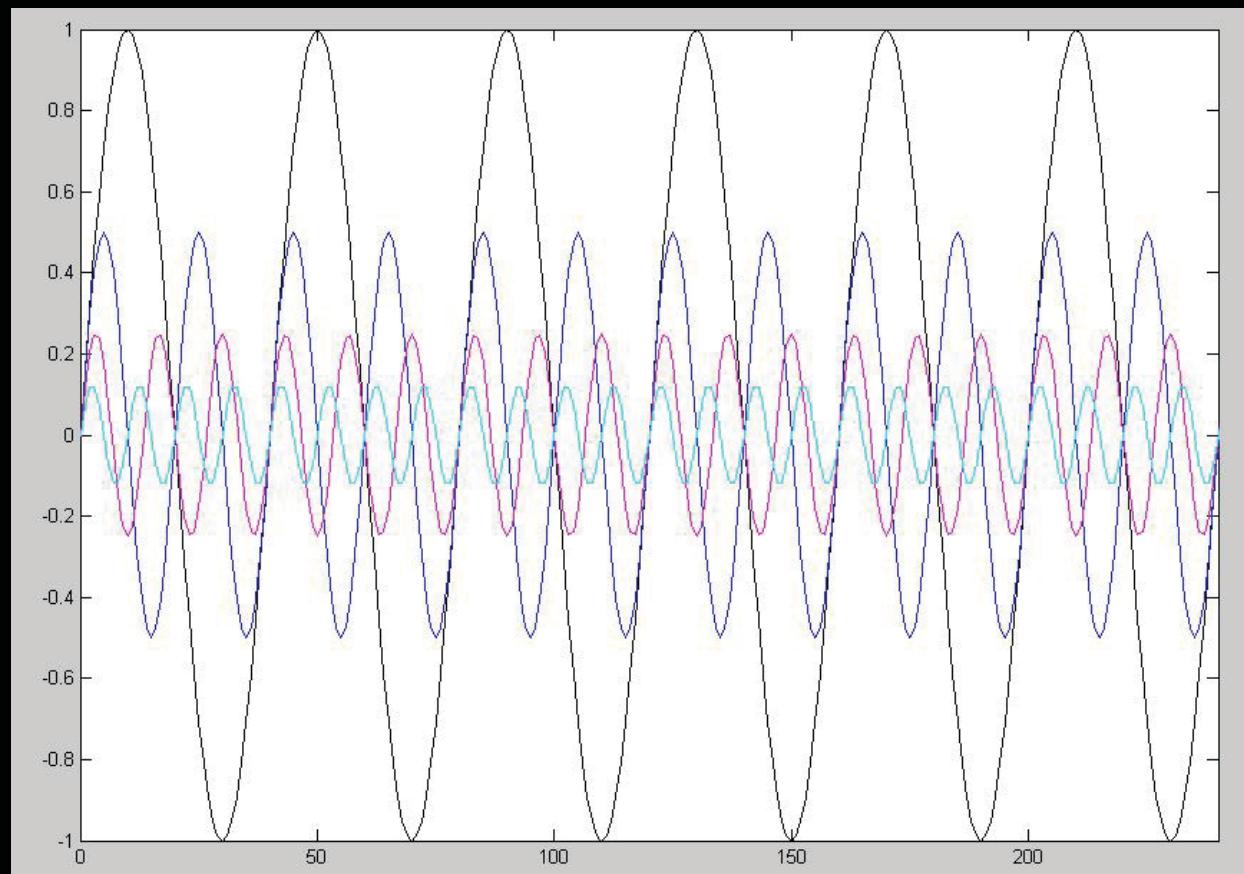
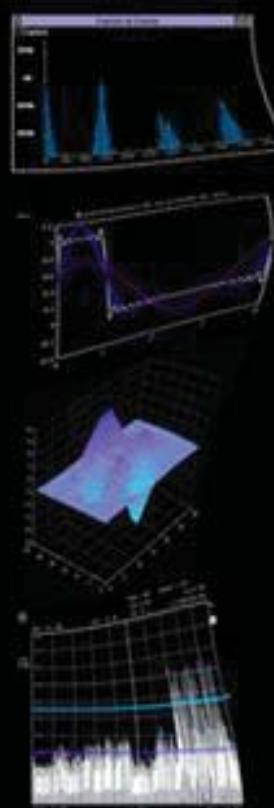
Transformada de Fourier

Análisis espectral



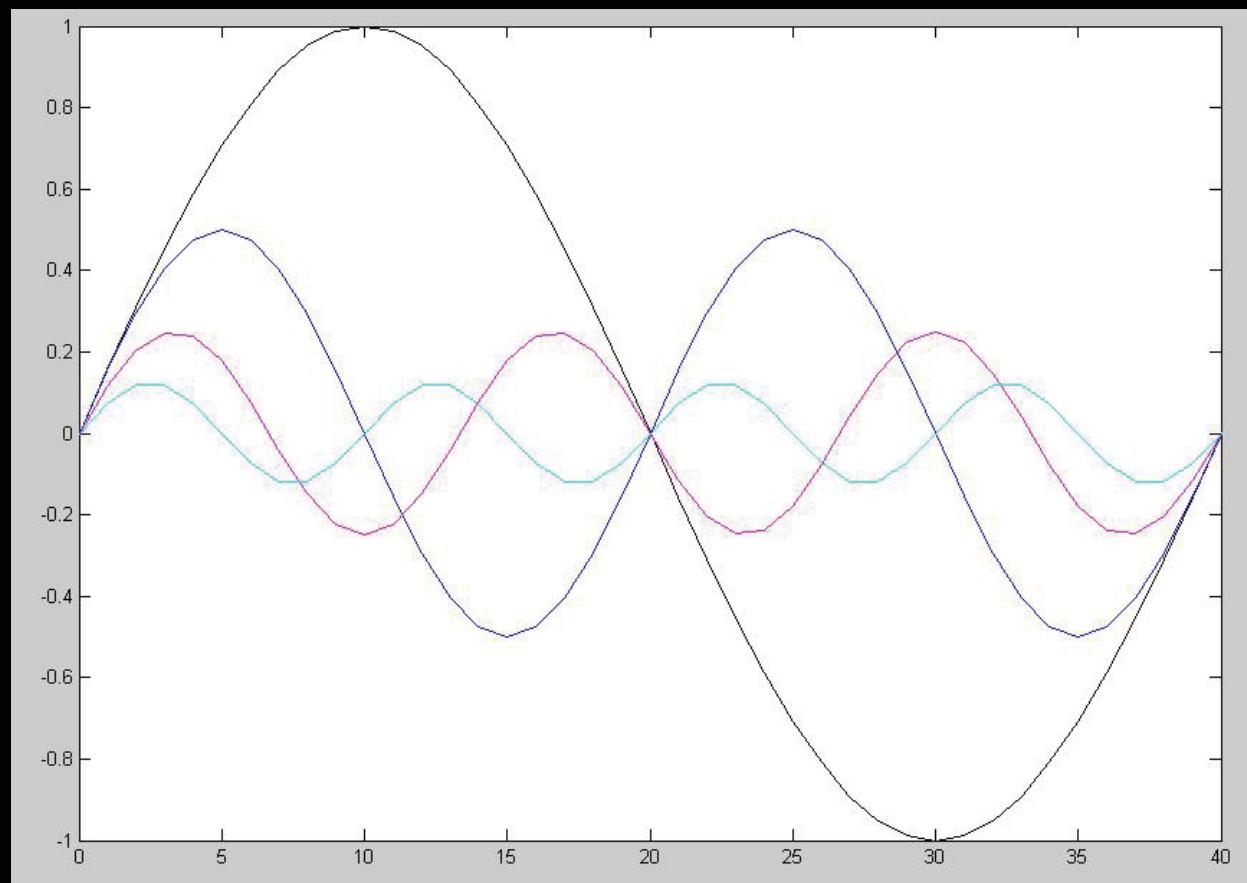
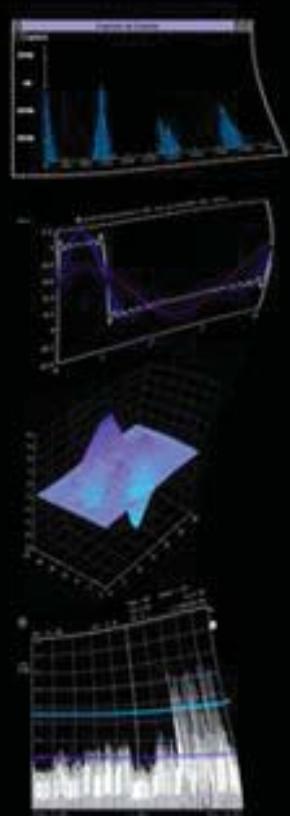
Transformada de Fourier

Análisispectral



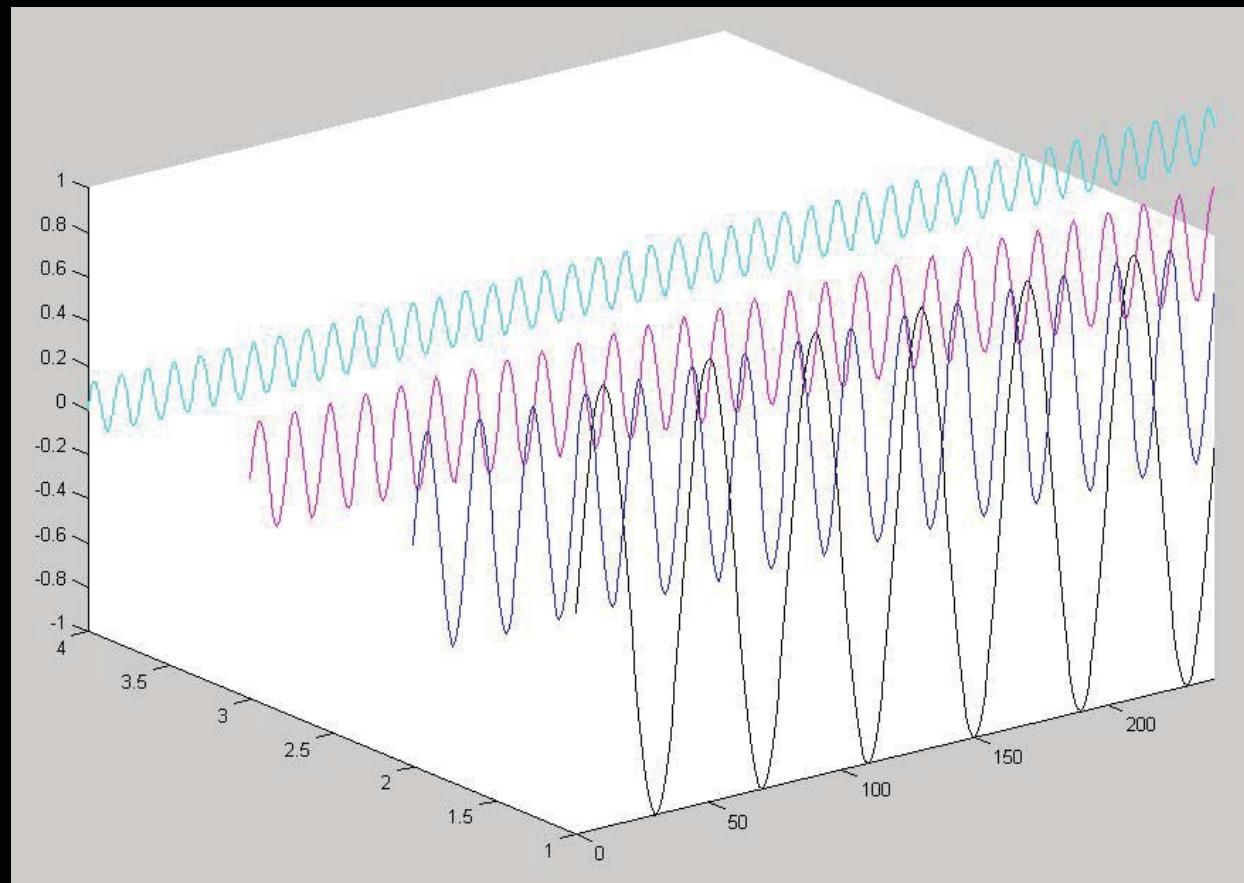
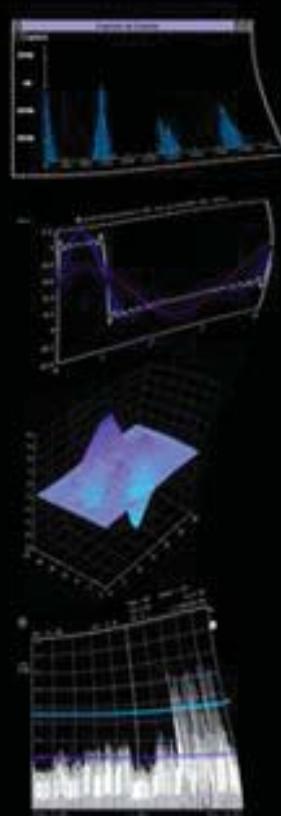
Transformada de Fourier

Análisis espectral



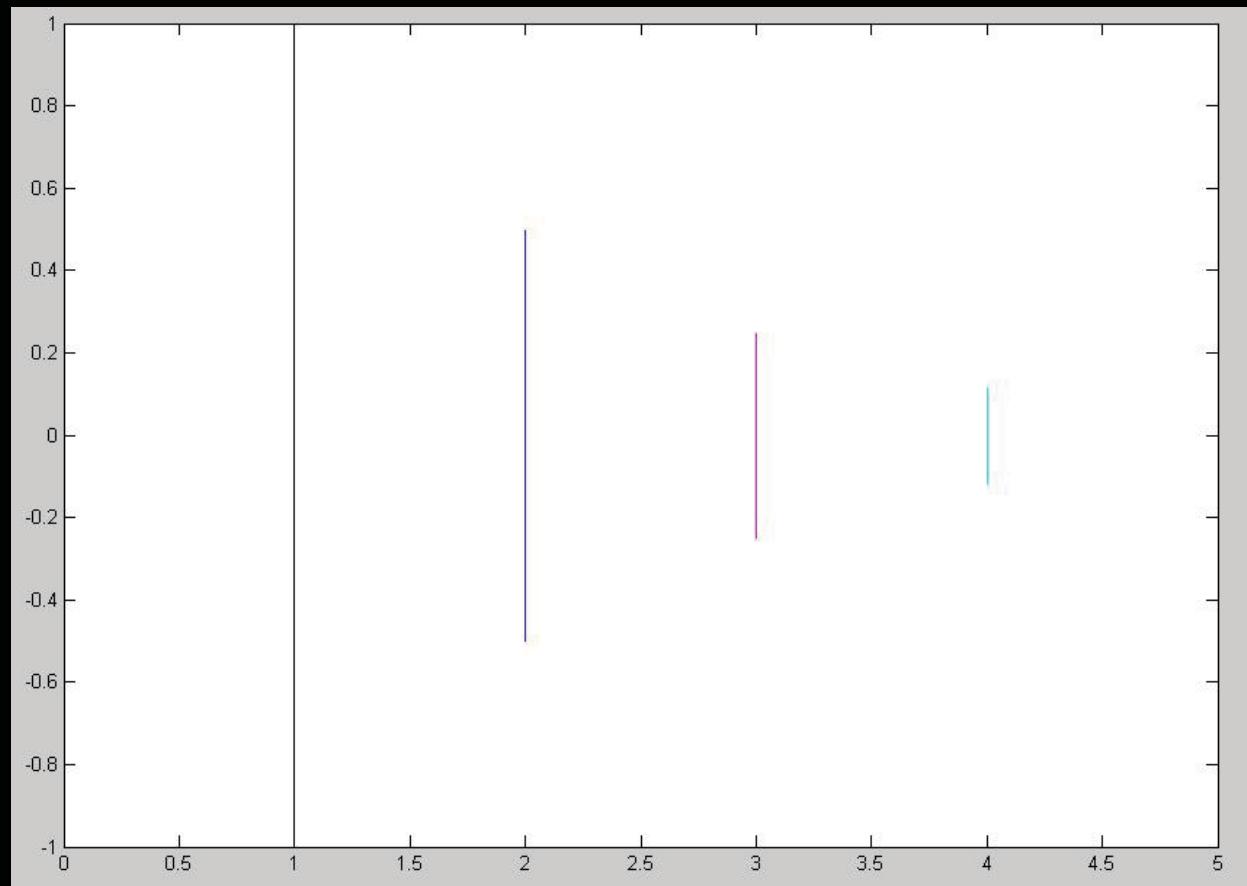
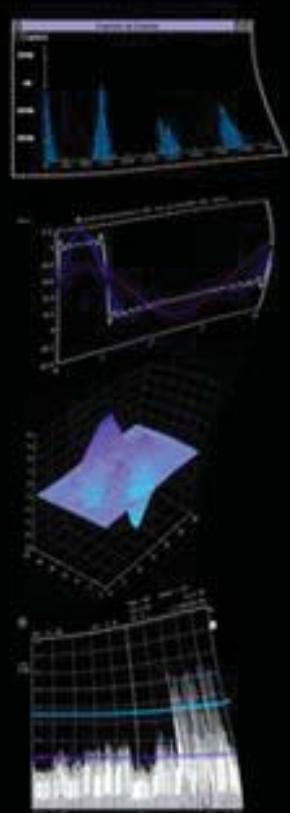
Transformada de Fourier

Análisis espectral



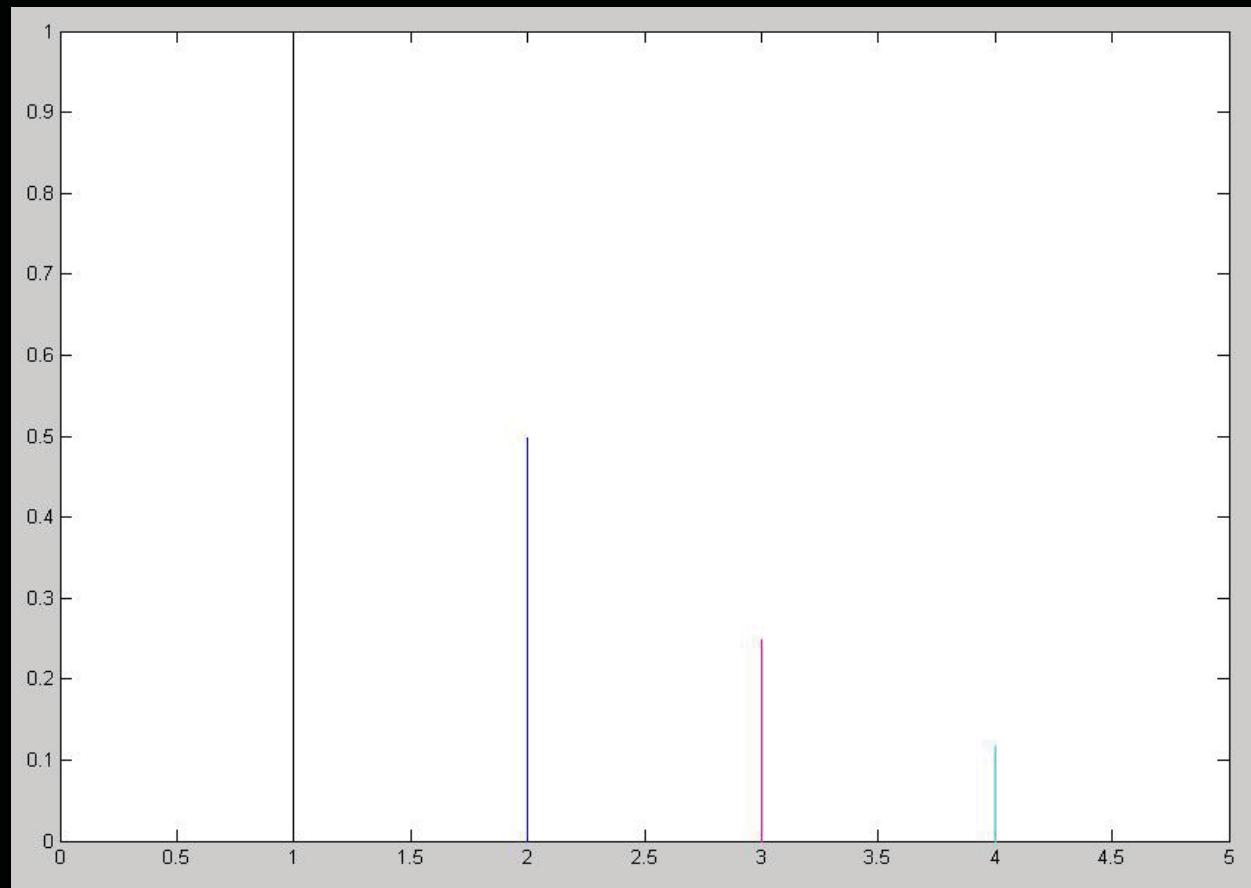
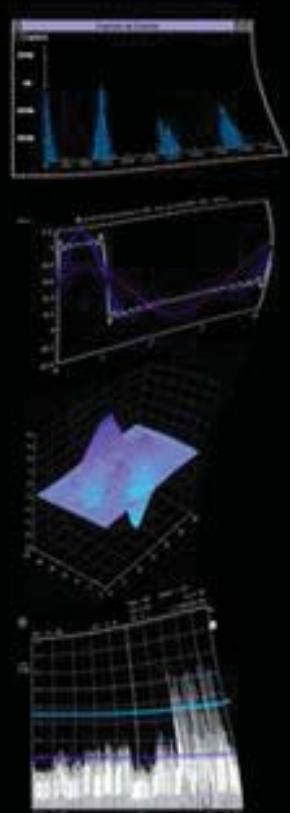
Transformada de Fourier

Análisispectral



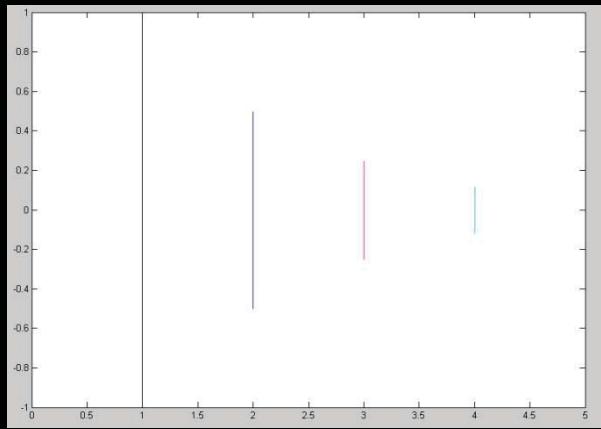
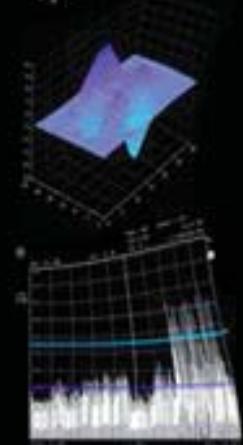
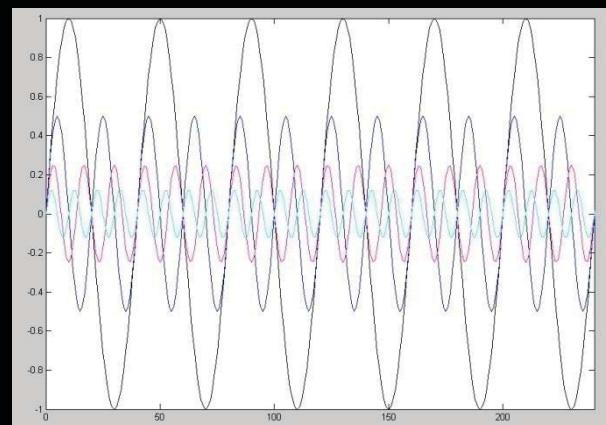
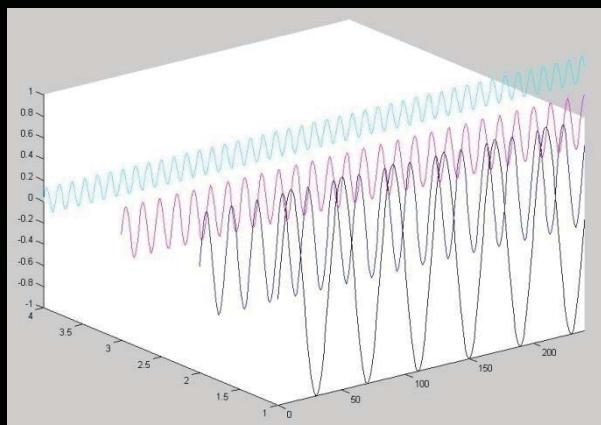
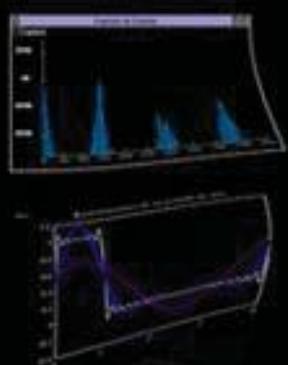
Transformada de Fourier

Análisispectral



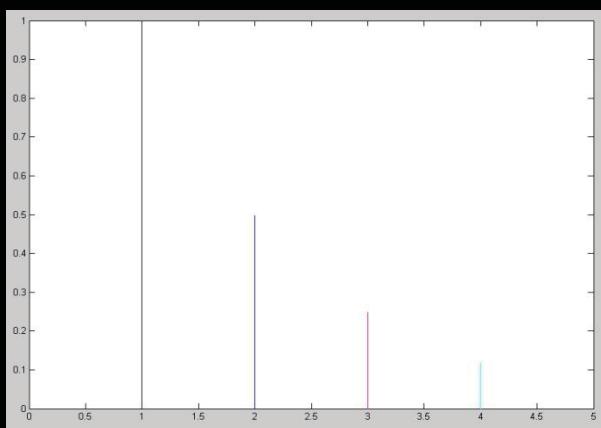
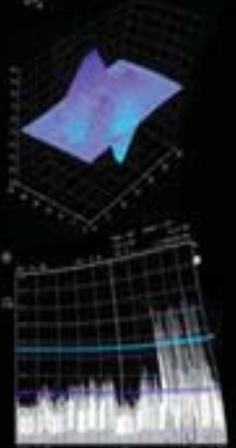
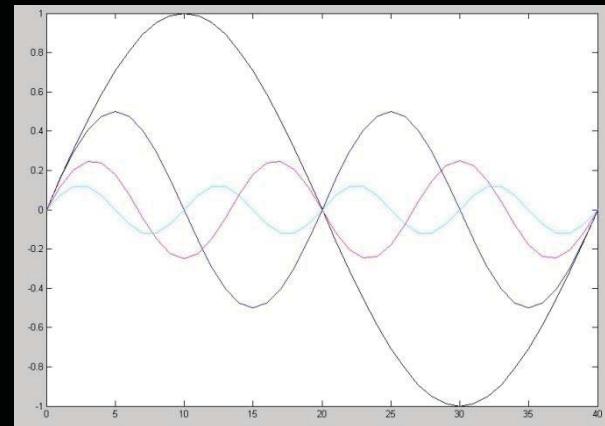
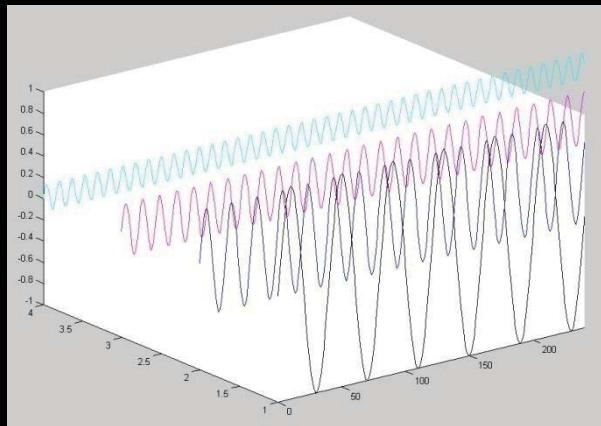
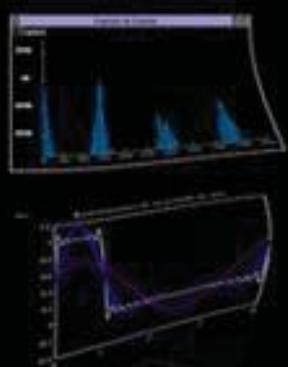
Transformada de Fourier

Análisis espectral



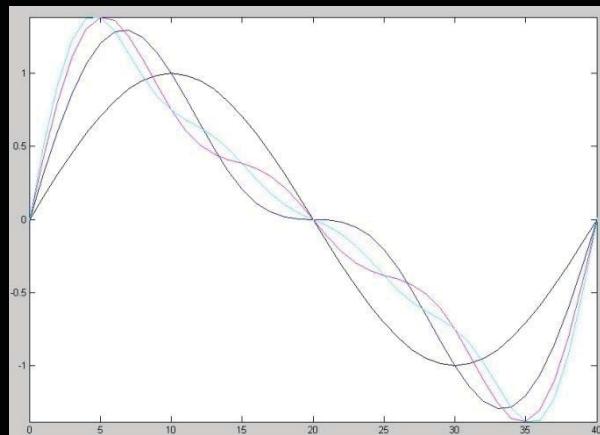
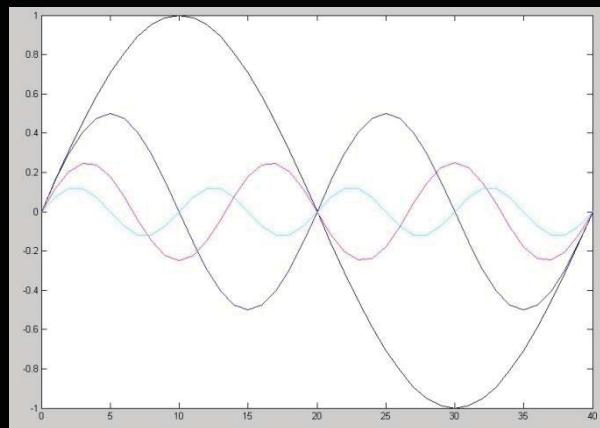
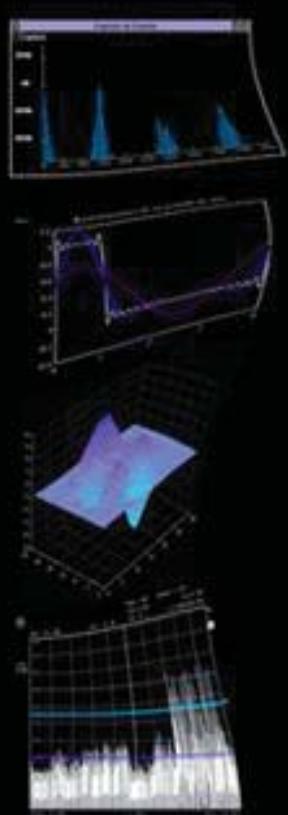
Transformada de Fourier

Análisis espectral



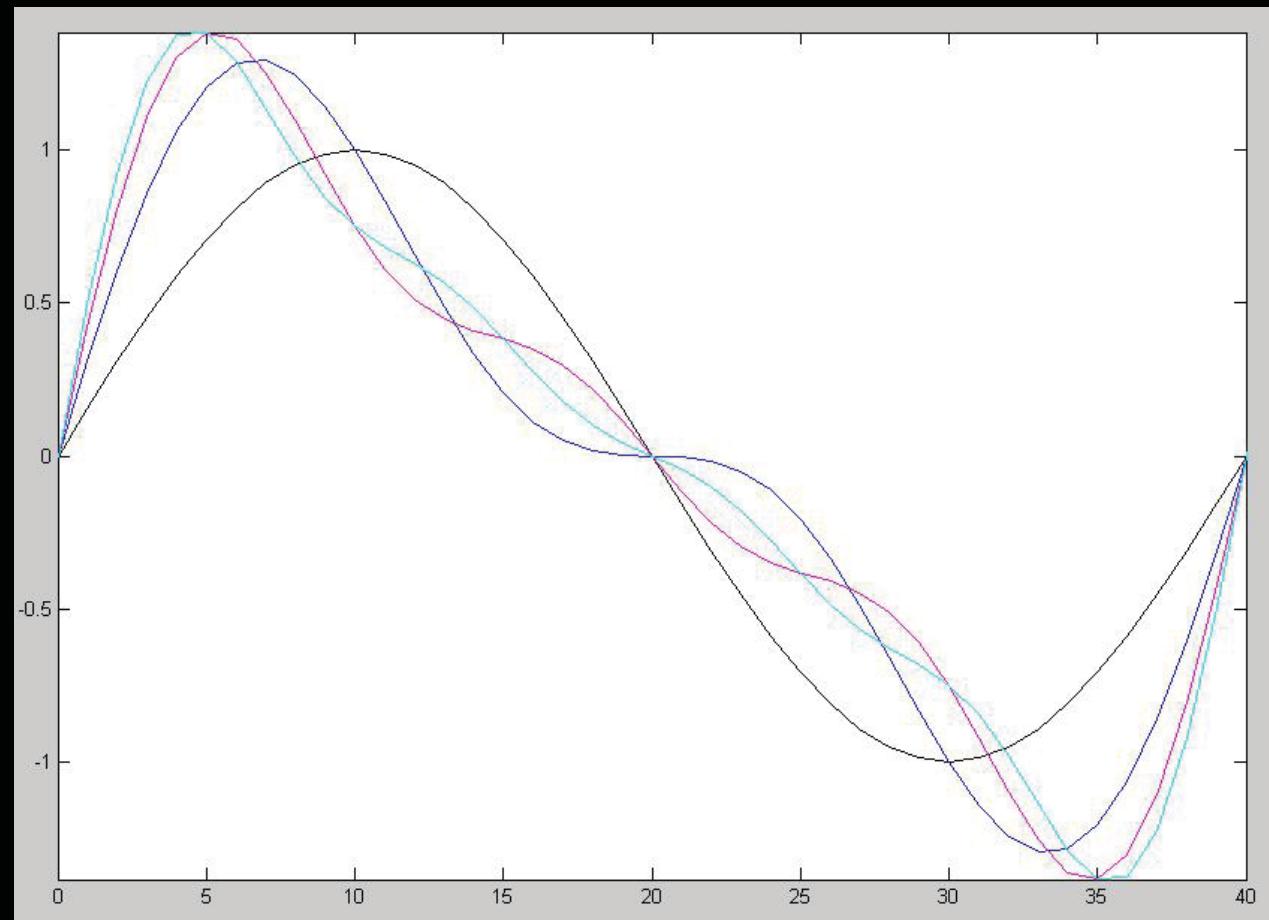
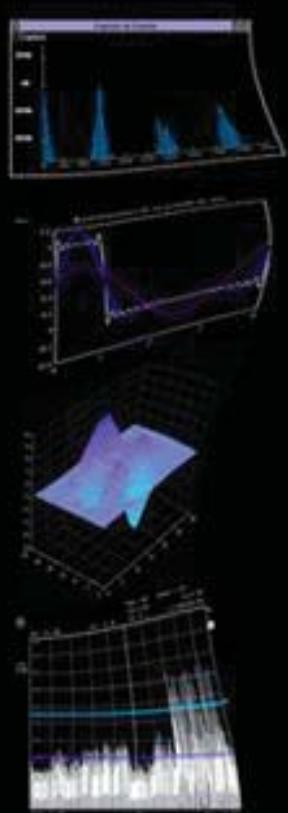
Transformada de Fourier

Análisis espectral



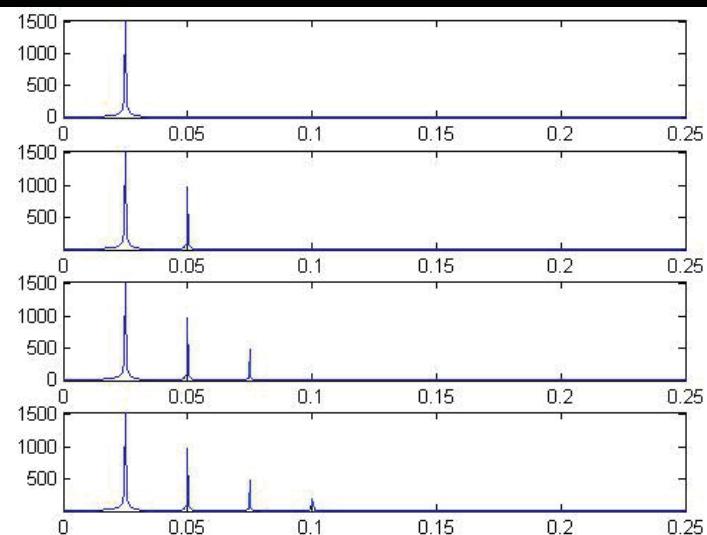
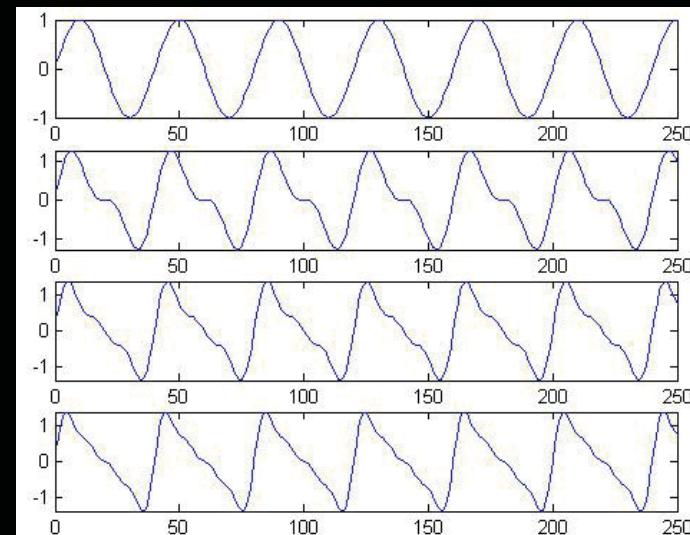
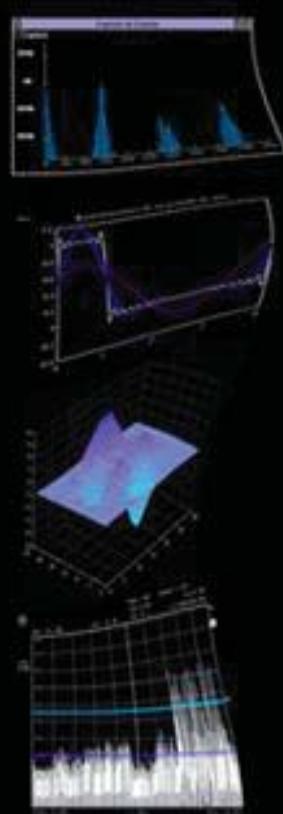
Transformada de Fourier

Análisis espectral



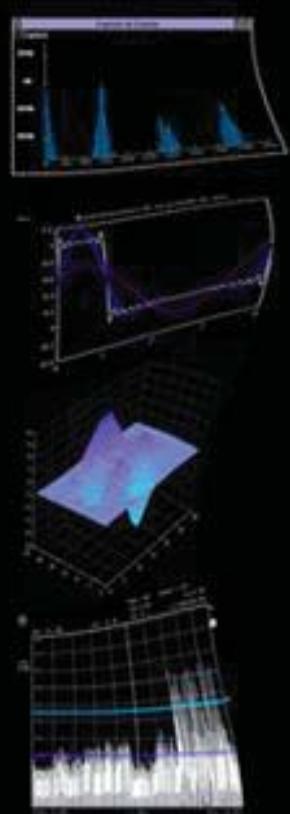
Transformada de Fourier

Análisispectral



Transformada de Fourier

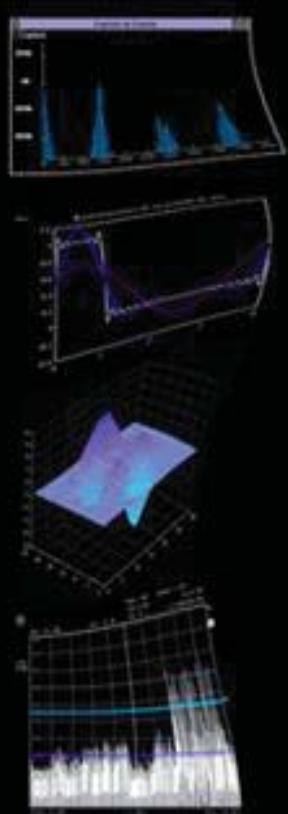
Señales y espectros



Señal	$x(t)$ Continua periódica	$x(t)$ Continua aperiódica	$x[n]$ Discreta periódica	$x[n]$ Discreta aperiódica
Espectro	$X(k)$ Discreto aperiódico	$X(\Omega)$ Continuo aperiódico	$X(k)$ Discreto periódico	$X(e^{j\omega})$ Continua periódica

Transformada de Fourier

Serie Discreta de Fourier



Transformada

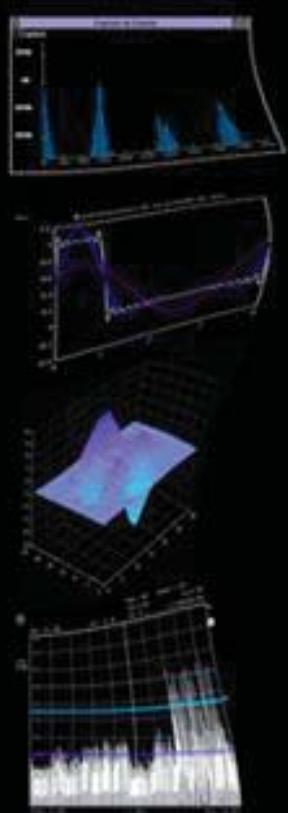
$$X[k] = \sum_{n=0}^{N-1} x[n] e^{-j \frac{2\pi k n}{N}}$$

Antitransformada

$$x[n] = \frac{1}{N} \sum_{k=0}^{N-1} X[k] e^{\frac{j 2\pi k n}{N}}$$

Transformada de Fourier

Transformada de Fourier de Tiempo Discreto



Transformada

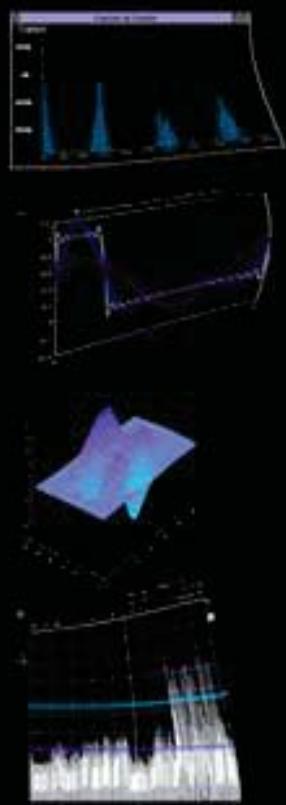
$$TFTD\{x[n]\} = X(e^{j\omega}) = \sum_{n=-\infty}^{+\infty} x[n]e^{-j\omega n}$$

Antitransformada

$$TFTD^{-1}\{X(e^{j\omega})\} = x[n] = \frac{1}{2\pi} \int_{-\pi}^{\pi} X(e^{j\omega})e^{jn\omega} d\omega$$

Transformada de Fourier

Serie Geométrica



$$\sum_{n=0}^{\infty} a^n = \frac{1}{1-a} = 1 + a + a^2 + \dots \quad \text{si } |a| < 1$$

$$\sum_{n=1}^{\infty} a^n = a + a^2 + \dots = \frac{1}{1-a} - 1 = \frac{a}{1-a} \quad \text{si } |a| < 1$$

$$\sum_{n=2}^{\infty} a^n = \frac{a^2}{1-a} \quad \text{si } |a| < 1$$

⋮

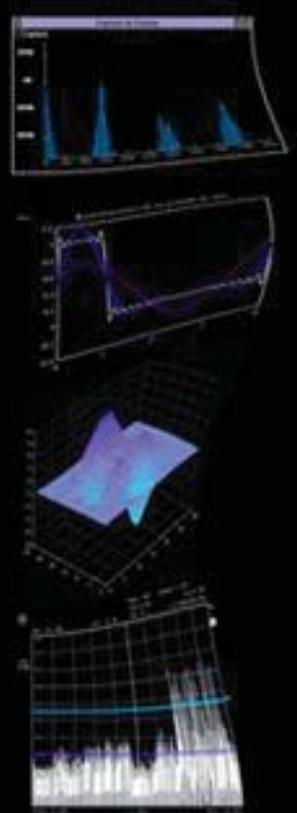
$$\sum_{n=L}^{\infty} a^n = \frac{a^L}{1-a} \quad \text{si } |a| < 1$$

⋮

$$\sum_{n=0}^{L-1} a^n = \sum_{n=0}^{\infty} a^n - \sum_{n=L}^{\infty} a^n = \frac{1-a^L}{1-a} \quad \text{si } |a| < 1$$

Transformada de Fourier

Propiedades



Periodicidad

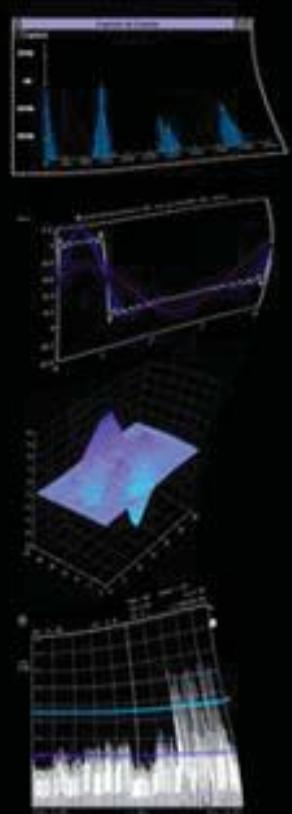
$$x[n] \xrightarrow{TFTD} X(e^{j\omega}) \Rightarrow X(e^{j\omega}) = X(e^{j(\omega+2m\pi)}) \quad m \in \mathbb{Z}$$

Simetría

$$\Re\{X(e^{j\omega})\} \text{ es par} \wedge \Im\{X(e^{j\omega})\} \text{ es impar}$$

Transformada de Fourier

Propiedades



Linealidad

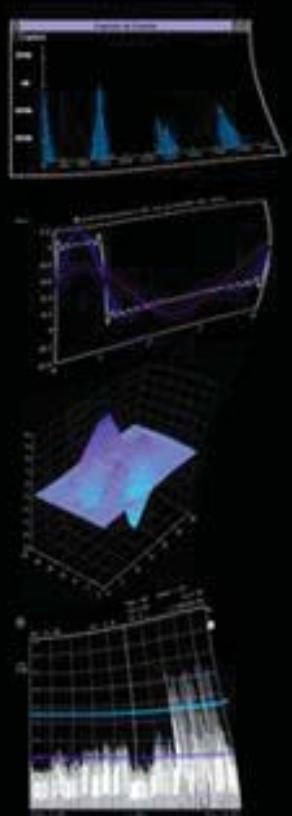
$$c_1x_1[n] + c_2x_2[n] \xrightarrow{TFTD} c_1X_1(e^{j\omega}) + c_2X_2(e^{j\omega})$$

Similaridad

$$x[an] \xrightarrow{TFTD} \frac{1}{|a|} X\left(e^{-j\frac{\omega}{a}}\right)$$

Transformada de Fourier

Propiedades



Desplazamiento Temporal

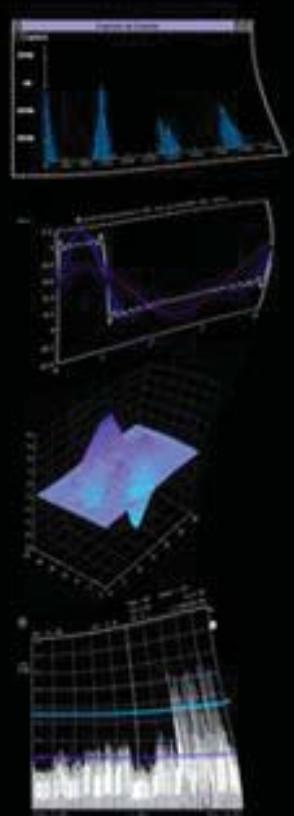
$$x[n - k] \stackrel{TFTD}{\leftrightarrow} X(e^{j\omega}) e^{-j\omega k}$$

Desplazamiento Espectral

$$X(e^{j(\omega-\psi)}) \stackrel{TFTD}{\leftrightarrow} x[n] e^{j\psi n}$$

Transformada de Fourier

Propiedades



Convolución

$$x_1[n] * x_2[n] \xleftrightarrow{TFTD} X_1(e^{j\omega}) X_2(e^{j\omega})$$

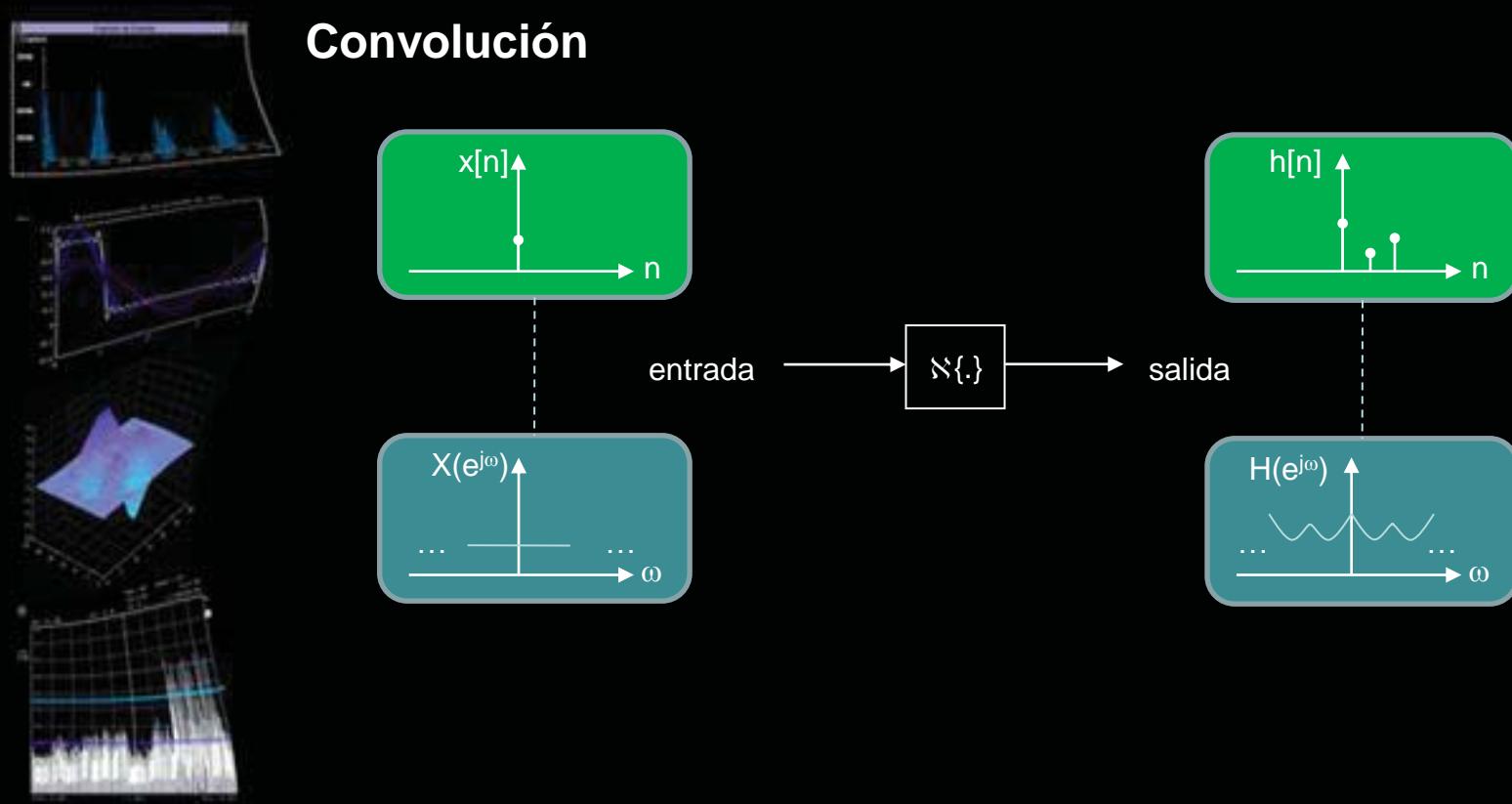
Modulación

$$X_1(e^{j\omega}) * X_2(e^{j\omega}) \xleftrightarrow{TFTD} x_1[n] x_2[n]$$

Transformada de Fourier

Propiedades

Convolución



Transformada de Fourier

Propiedades

Convolución

