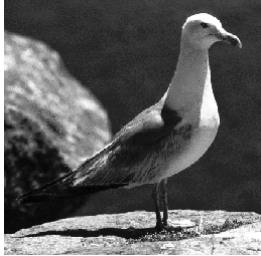


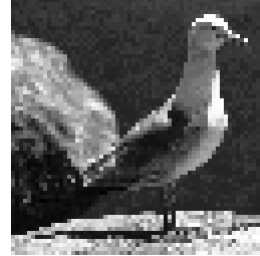
Amostragem



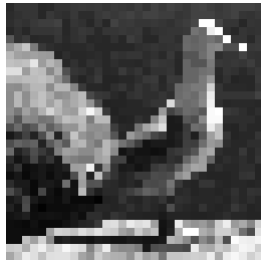
256 x 256



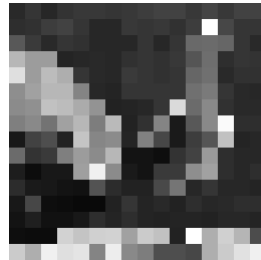
128 x 128



64 x 64



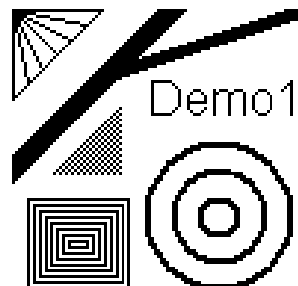
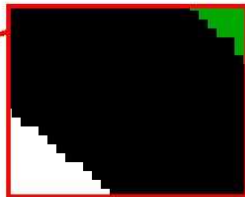
EA978 - 2s2008 - Ting 32 x 32



16 x 16

Amostragem

Efeito de Borda Serrilhada

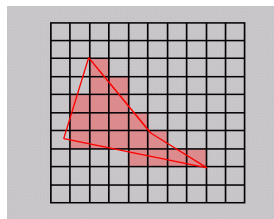
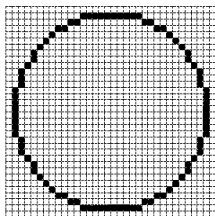


Por quê ocorrem estes efeitos?

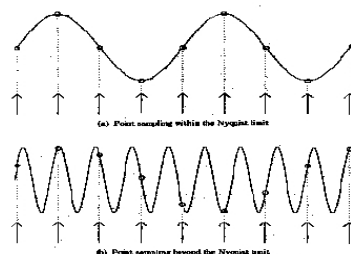
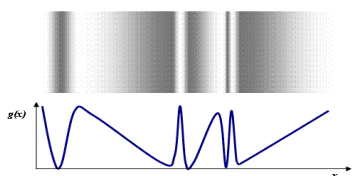
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Duas abordagens

Geométrica (Rasterização): *pixels* que sobrepõem os objetos de interesse



Espectral (Amostragem): amostragem da função de intensidade definida no domínio espacial



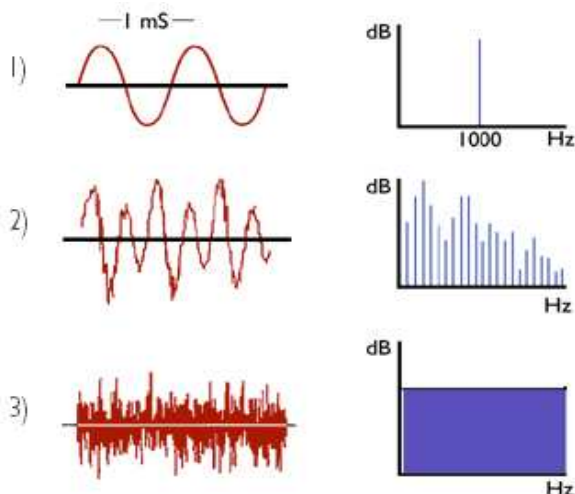
Transformada de Fourier

$$F(\nu) = \int_{-\infty}^{\infty} f(t) e^{-2\pi i \nu t} dt,$$

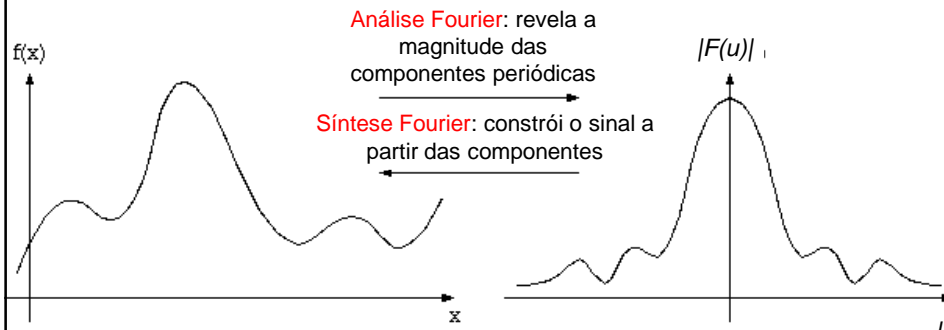
Transformada mapeia funções em funções

Transformada de Fourier mapeia funções $f(t)$ definidas no domínio t em integrais de funções senos e cossenos $F(\nu)$, no domínio de frequência ν .

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Transformada de Fourier 1D



Par de transformadas:

$$F(u) = \int_{-\infty}^{\infty} f(x) e^{-j2\pi ux} dx \quad (\text{Análise})$$

$$f(x) = \int_{-\infty}^{\infty} F(u) e^{j2\pi ux} du \quad (\text{Síntese})$$

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Transformada de Fourier 1D Espectro de Freqüência e Ângulo de Fase

$$F(u) = \int_{-\infty}^{\infty} f(x) e^{-j2\pi ux} dx$$

$F(u)$ é uma função complexa: $F(u) = R(u) + jI(u)$

$$P(u) = R^2(u) + I^2(u) \quad \text{Espectro de Potência}$$

$$|F(u)| = (R^2(u) + I^2(u))^{1/2} \quad \text{Espectro de Fourier}$$

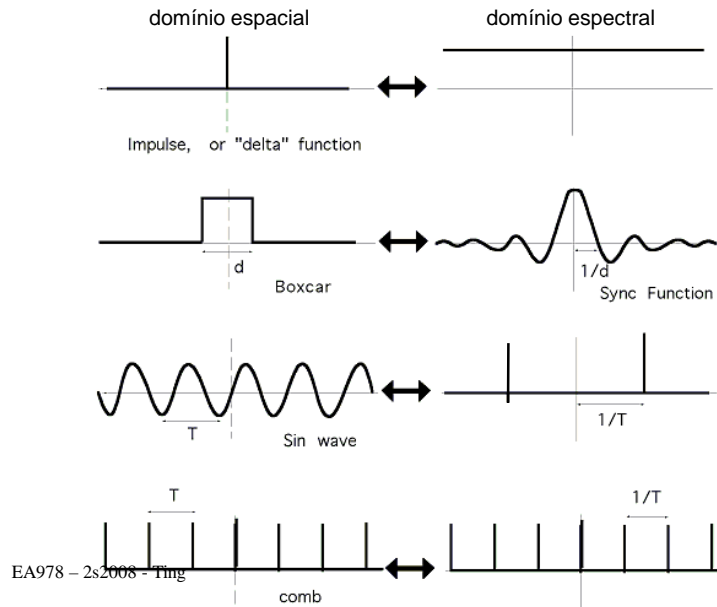
$$\varphi(u) = \text{tg}^{-1} (I(u)/R(u)) \quad \text{Ângulo de fase}$$

$$F(u) = |F(u)| e^{j\varphi(u)}$$

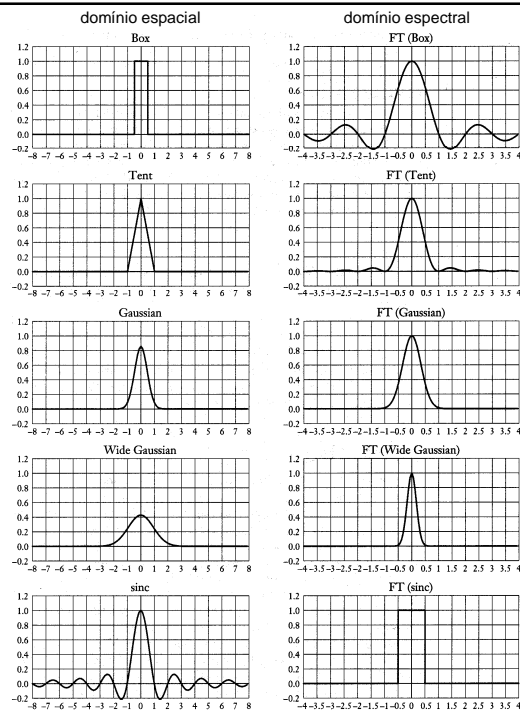
$$f(x) = \int_{-\infty}^{\infty} F(u) e^{j2\pi ux} du$$

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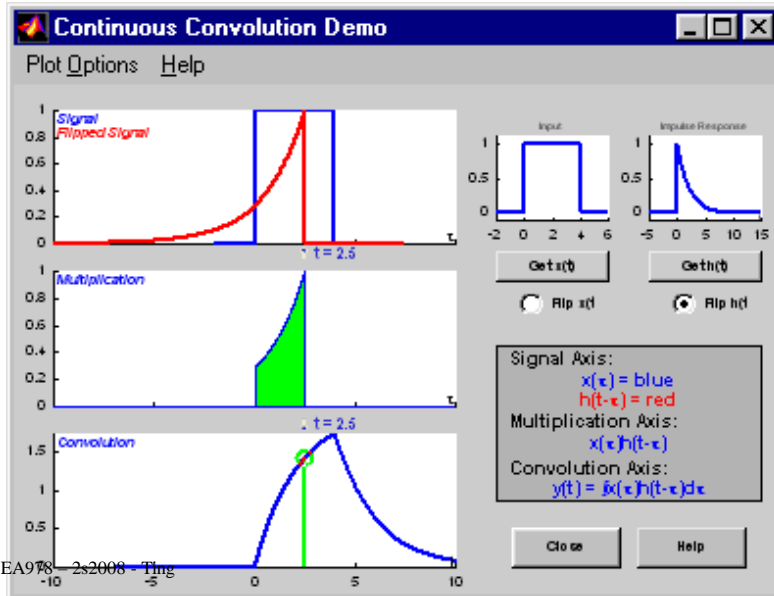
Transformada de Fourier 1D: Exemplos



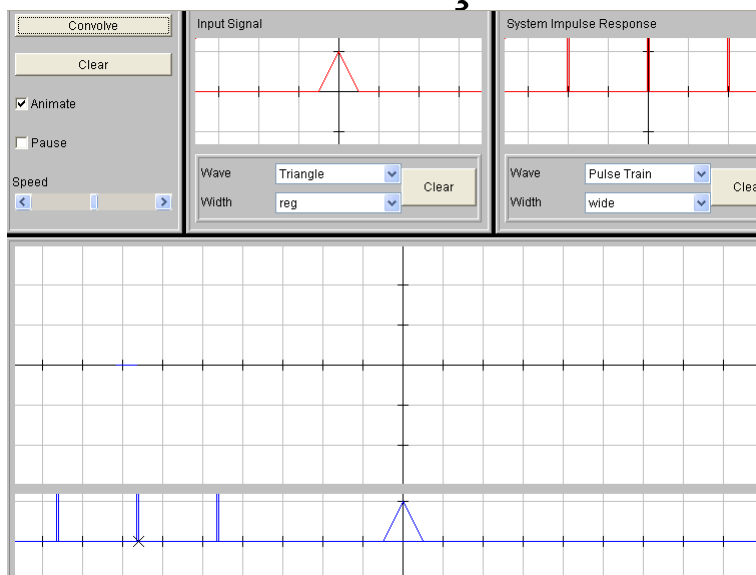
Transformada de Fourier 1D: Exemplos



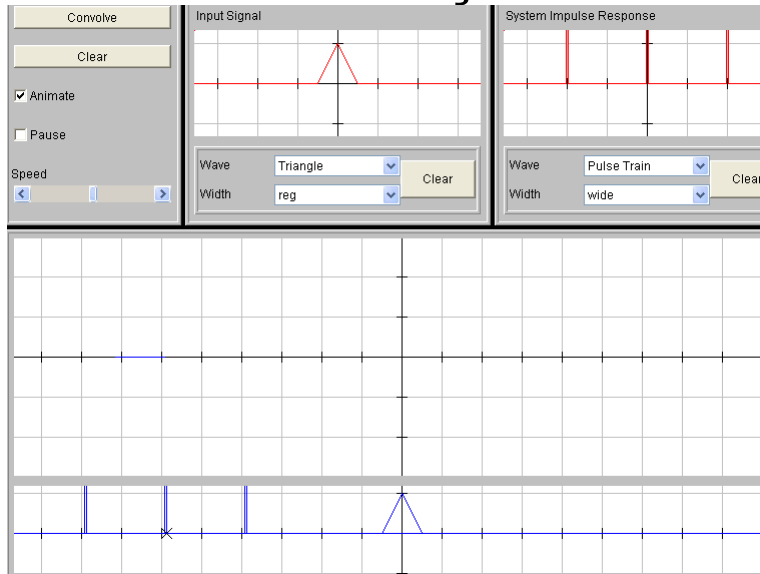
Convolução



Convolução

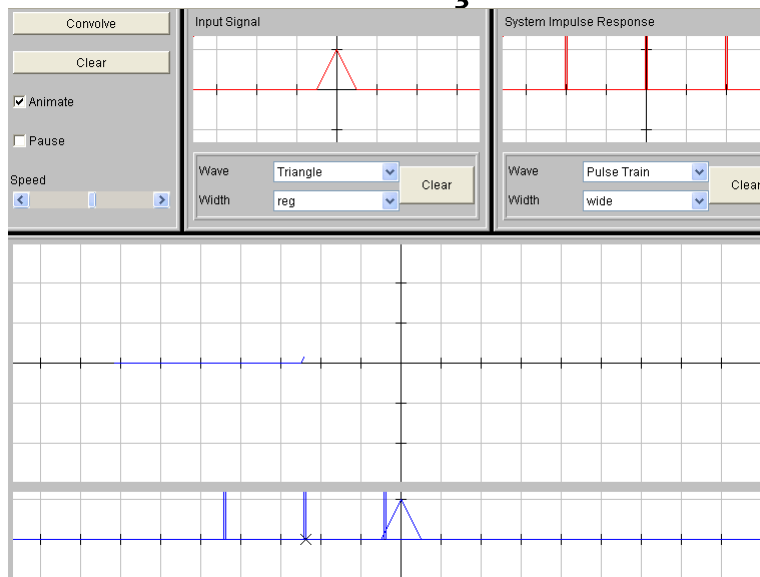


Convolução



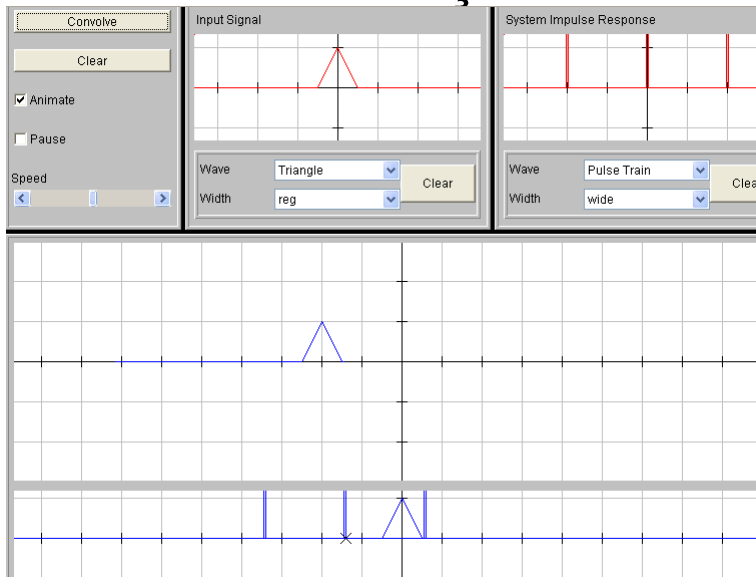
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Convolução



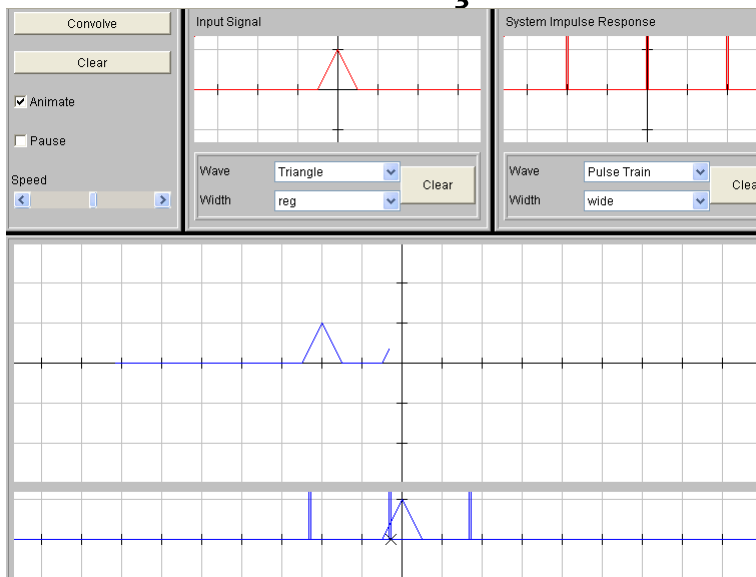
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Convolução



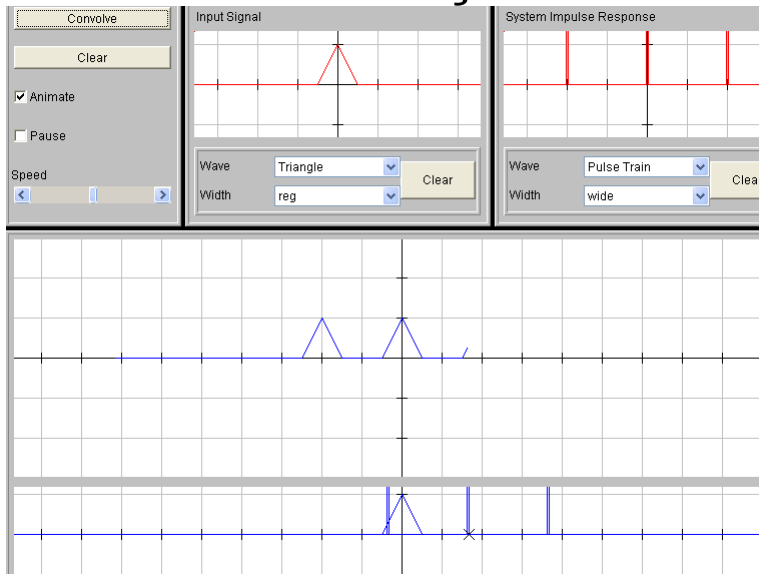
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Convolução



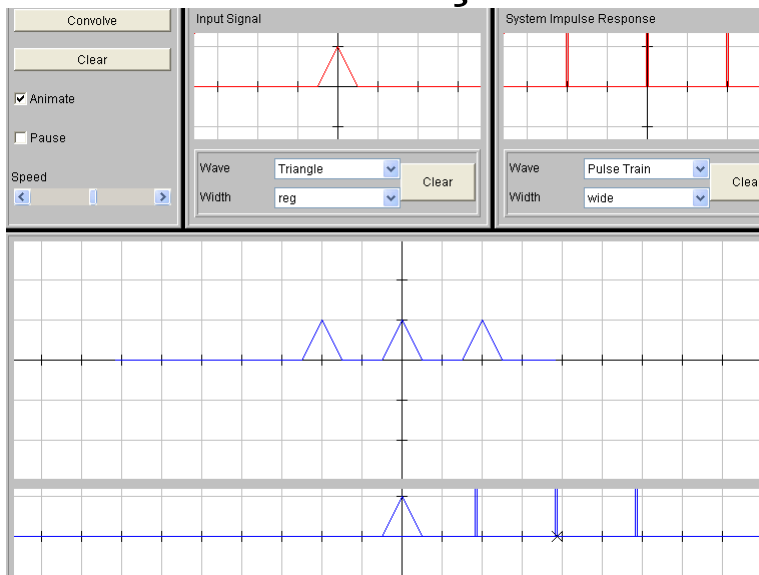
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Convolução



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Convolução



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Transformada de Fourier 1D

Algumas Propriedades

Linearidade

$$a \cdot f(t) + b \cdot g(t) \xleftrightarrow{\mathcal{F}} a \cdot F(\nu) + b \cdot G(\nu)$$

Multiplicação

$$f(t) \cdot g(t) \xleftrightarrow{\mathcal{F}} (F * G)(\nu)$$

Convolução

$$(f * g)(t) \xleftrightarrow{\mathcal{F}} F(\nu) \cdot G(\nu)$$

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Transformada de Fourier 1D

Algumas Propriedades

Deslocamento

$$f(t - t_0) \xleftrightarrow{\mathcal{F}} e^{-j2\pi\nu t_0} \cdot F(\nu)$$

(magnitude da transformada não altera)

Mudança de Escala

$$f(at) \xleftrightarrow{\mathcal{F}} \frac{1}{|a|} F\left(\frac{\nu}{a}\right), \quad a \in \mathbb{R}, a \neq 0$$

Rotação

$$f(r, \theta + \theta_0) \xleftrightarrow{\mathcal{F}} F(\nu, \varphi + \theta_0)$$

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