Universidad
Popular del Cesar

Tratamiento de Señales

Version 2022-I

Impulso en 1D y en 2D

[Capítulo 4]

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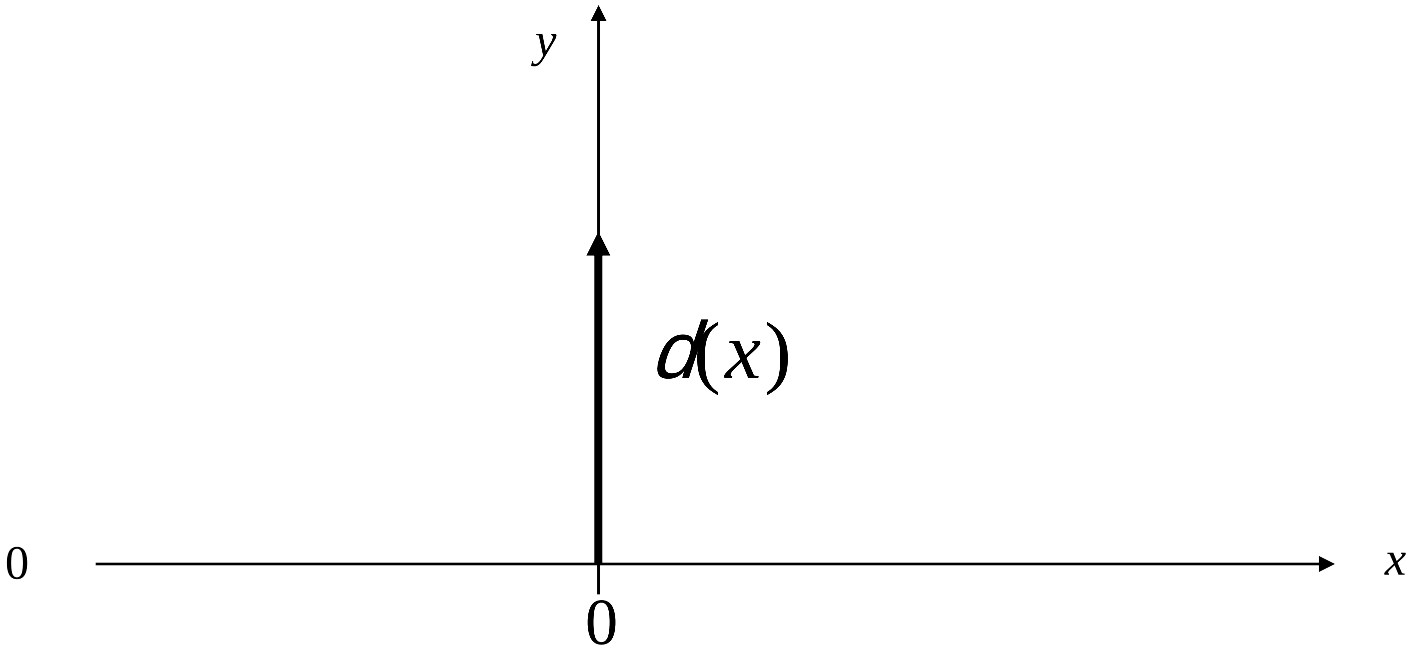
[La función impulso]



$$\int_{-\infty}^{+\infty} \delta(x)\,dx = 1$$

[La función impulso]

Conocida también como la función de Dirac delta:

$$\int_{-\infty}^{+\infty} \delta(x)dx = \int_{-\varepsilon}^{+\varepsilon} \delta(x)dx = 1$$

$$\varepsilon \to 0$$

[La función impulso]

Conocida también como la función de Dirac delta:

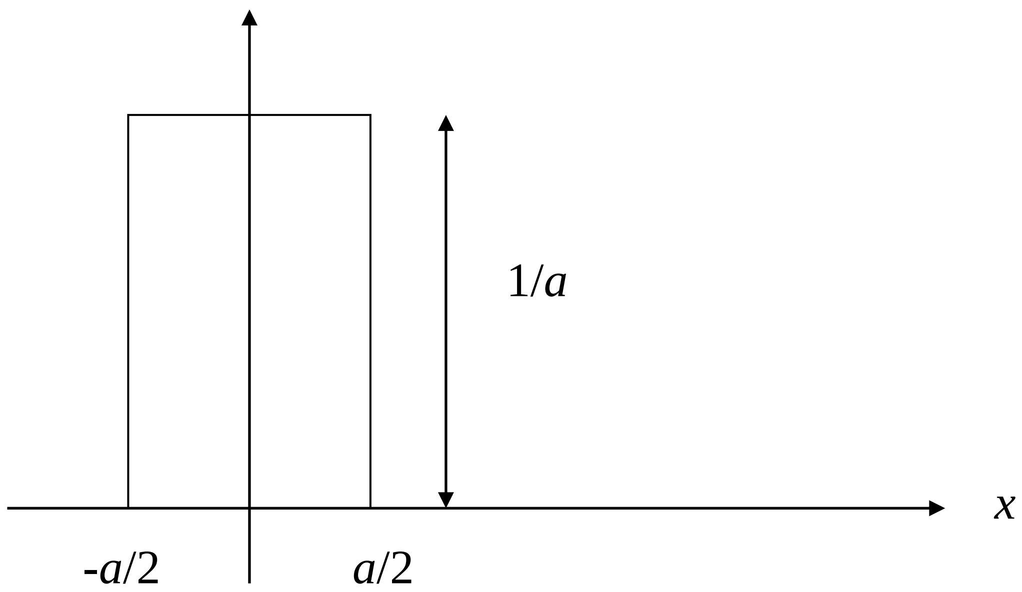
$$\delta(x) = 0 \quad \text{para} \ \ x \neq 0$$

La función de Dirac está indefinida para $x=0$.

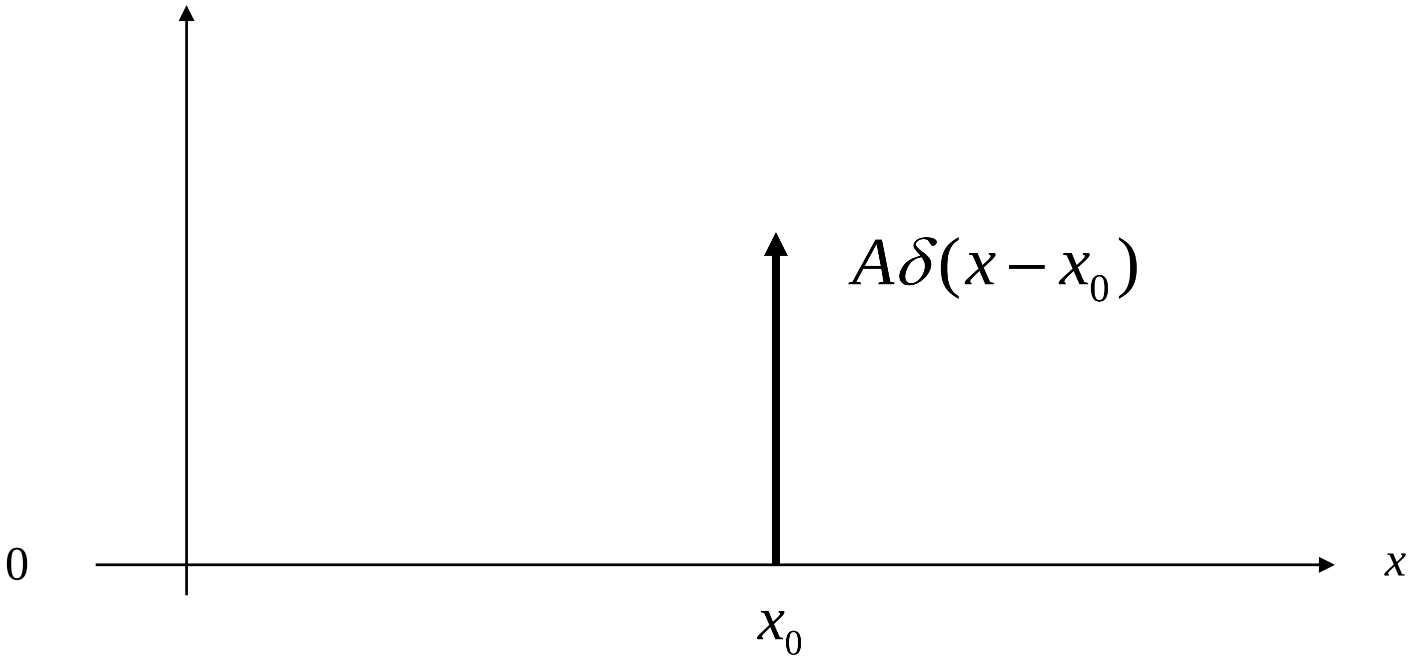
[La función impulso]

Puede ser modelada como

$$\delta(x) = \lim_{a \to 0} \frac{1}{a} \prod\left(\frac{x}{a}\right)$$

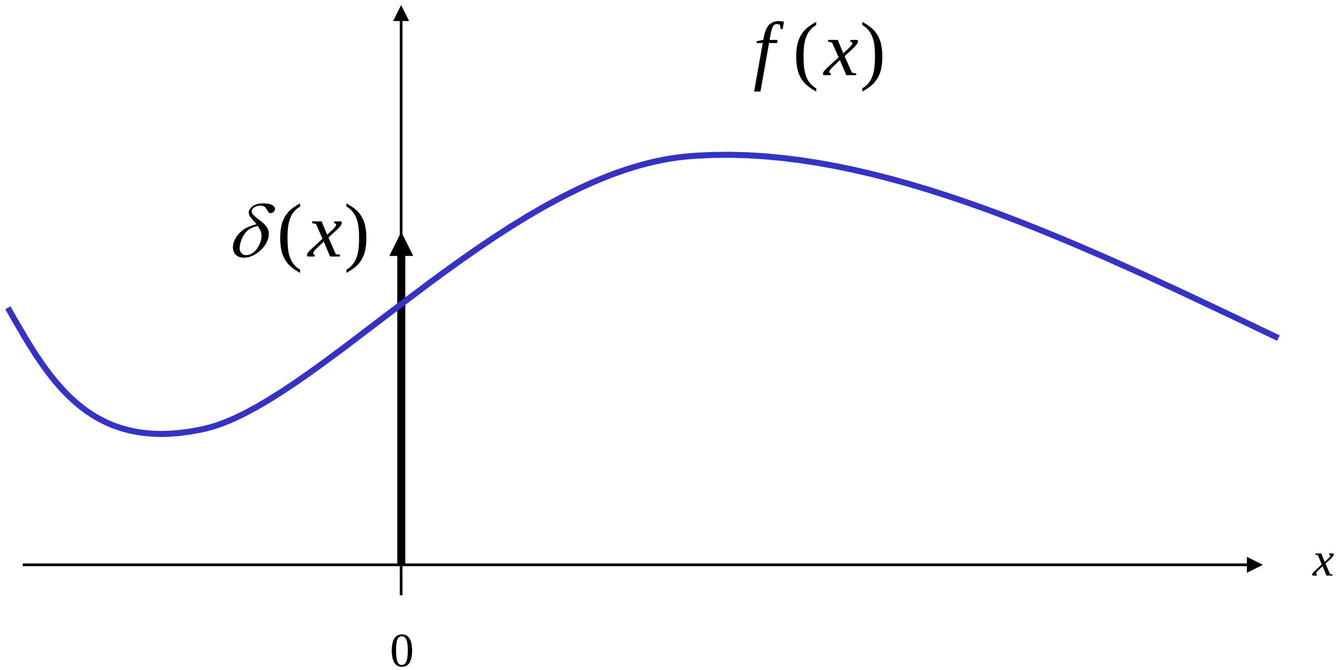


[La función impulso]



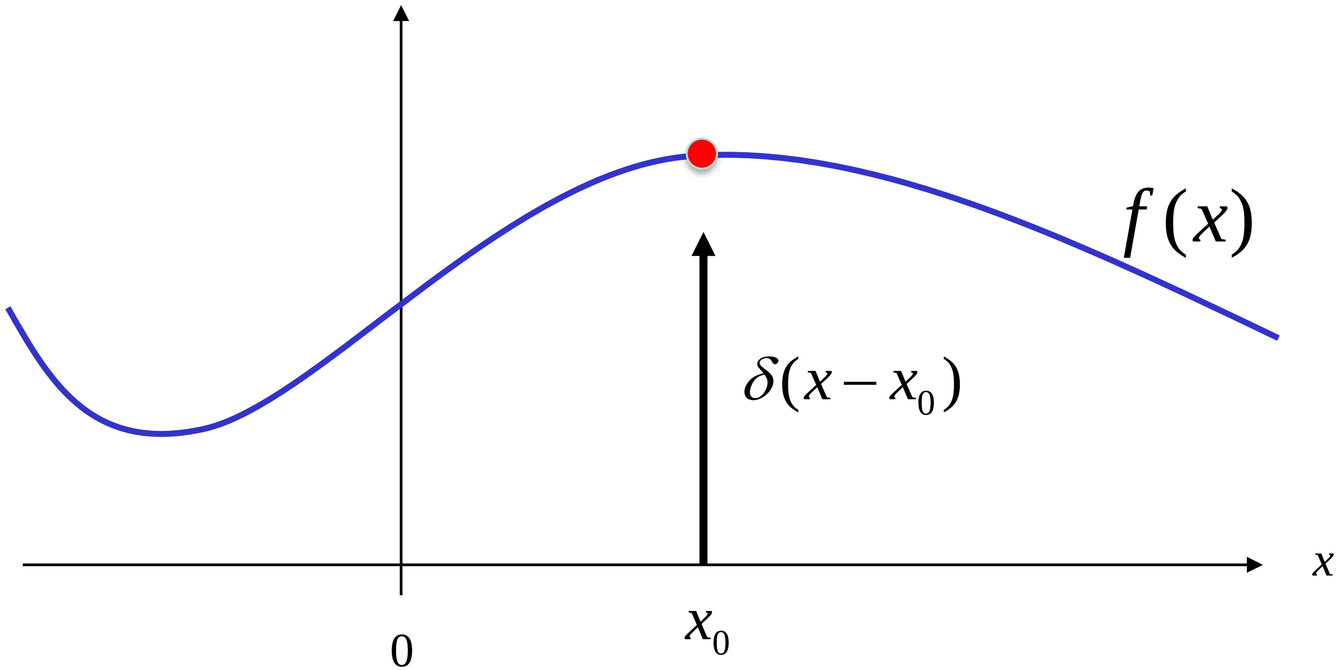
$$\boxed{\int_{-\infty}^{+\infty} A\delta(x)\,dx = A}$$

[La función impulso]



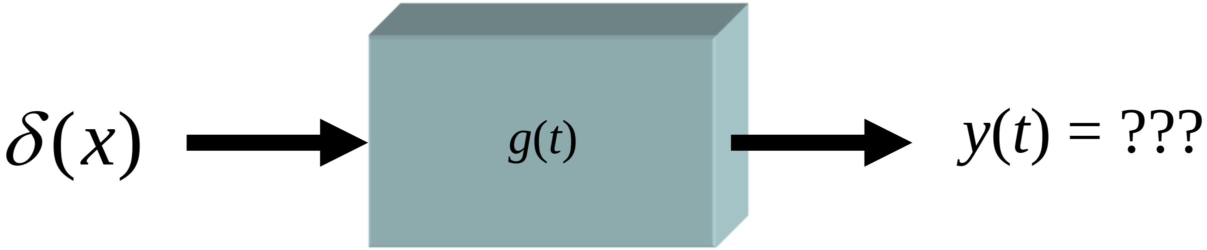
$$\boxed{\int_{-\infty}^{+\infty} f(x)\delta(x)dx = f(0)}$$

[La función impulso]



$$\boxed{\int_{-\infty}^{+\infty} f(x)\delta(x-x_0)dx = \int_{-\infty}^{+\infty} f(\tau+x_0)\delta(\tau)d\tau = f(x_0)}$$

[La función impulso]

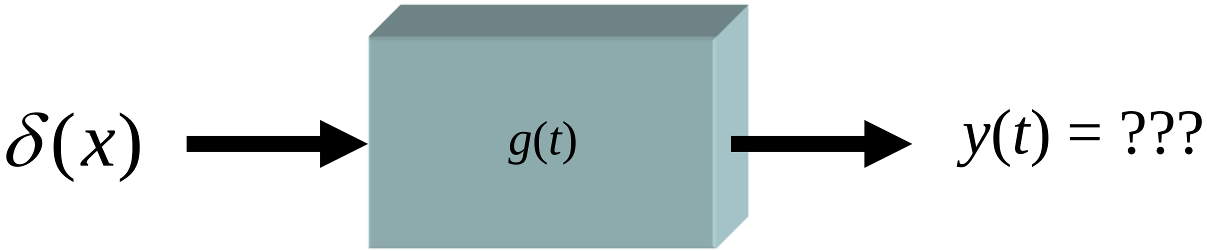


[La función impulso]

$$\delta(x) \longrightarrow \boxed{g(t)} \longrightarrow y(t) = ???$$

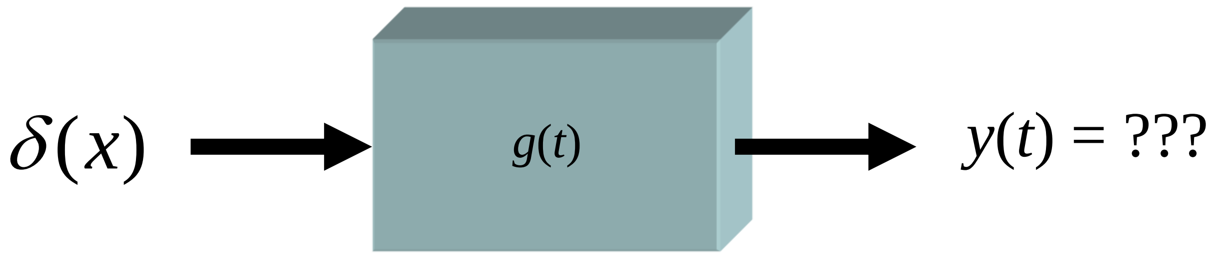
$$y(t) = \delta(t) * g(t)$$

[La función impulso]



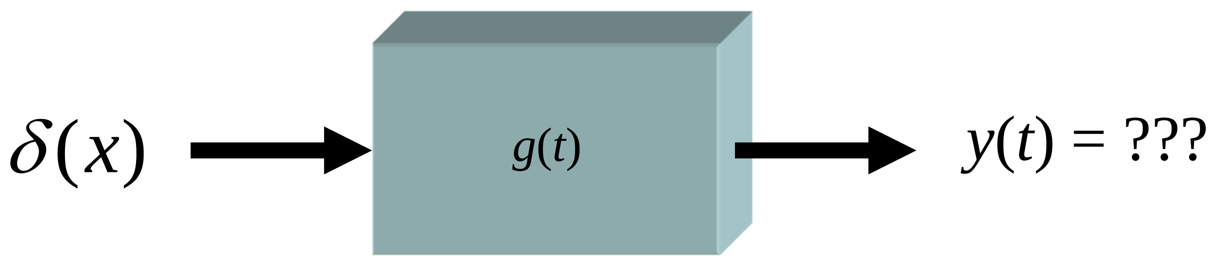
$$y(t) = \delta(t) * g(t) = \int_{-\infty}^{+\infty} g(t-\tau)\delta(\tau)\,d\tau$$

[La función impulso]



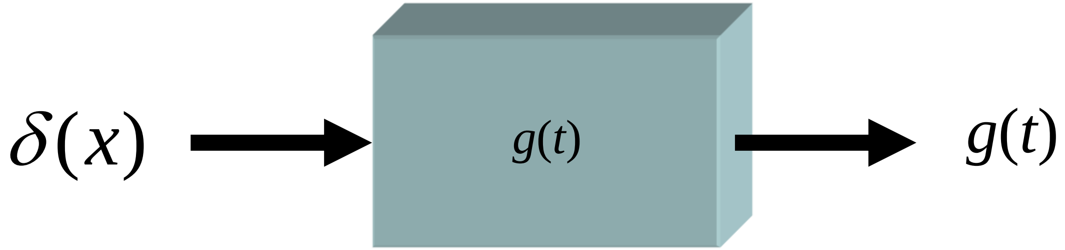
$$y(t) = \delta(t) * g(t) = \int_{-\infty}^{+\infty} g(t-\tau)\delta(\tau)d\tau = g(t-\tau)\Big|_{\tau=0}$$

[La función impulso]



$$y(t) = \delta(t) * g(t) = \int_{-\infty}^{+\infty} g(t-\tau)\delta(\tau)\,d\tau = g(t-\tau)\Big|_{\tau=0} = g(t)$$

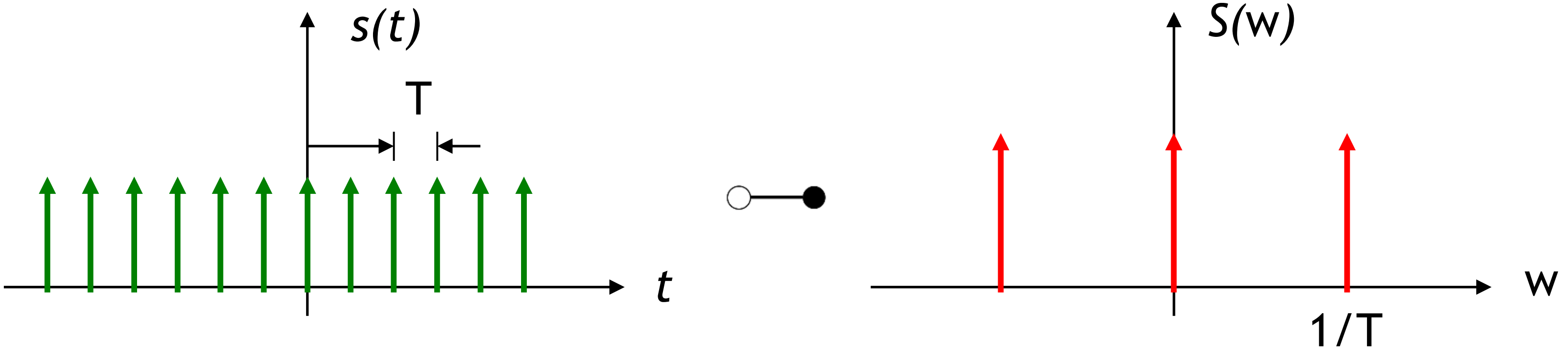
[La función impulso]



$$y(t) = \delta(t) * g(t) = \int_{-\infty}^{+\infty} g(t-\tau)\delta(\tau)\,d\tau = g(t-\tau)\big|_{\tau=0} = g(t)$$

$$\boxed{\delta(t) * g(t) = g(t)}$$

Transformada de Fourier de un Tren de Impulsos



[La función impulso en 2D]

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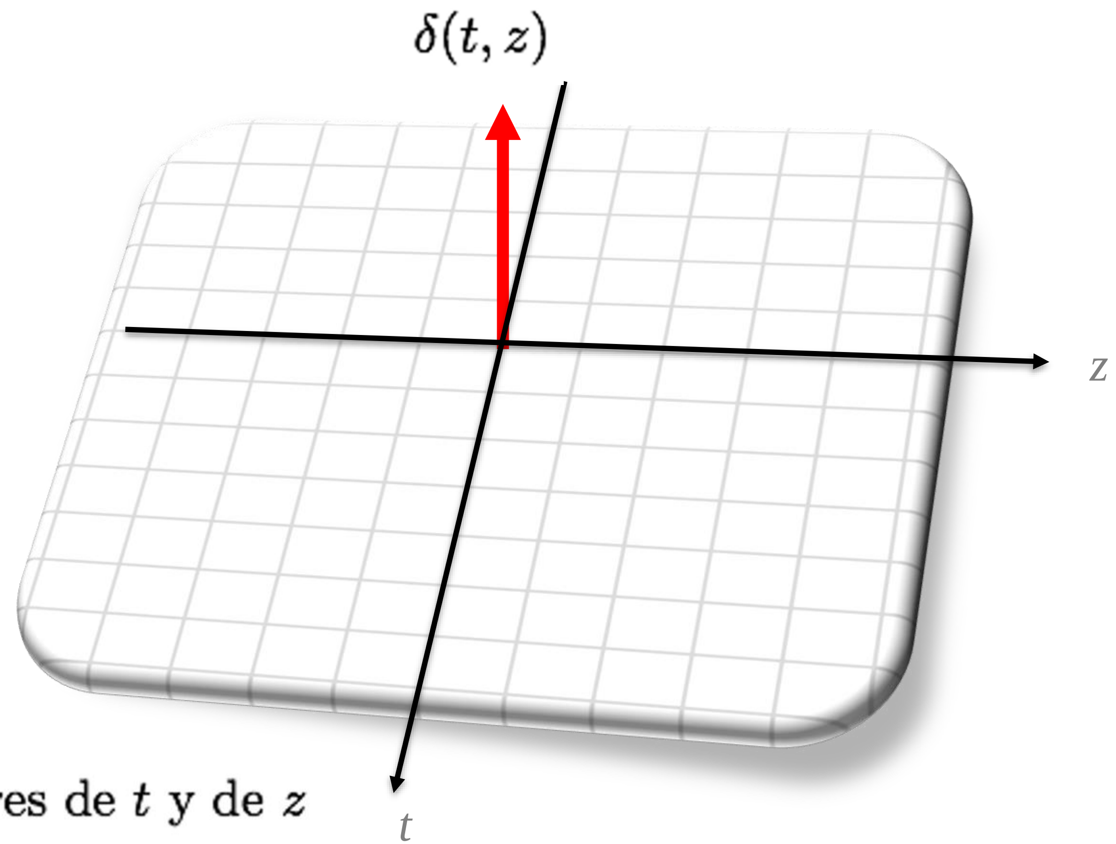
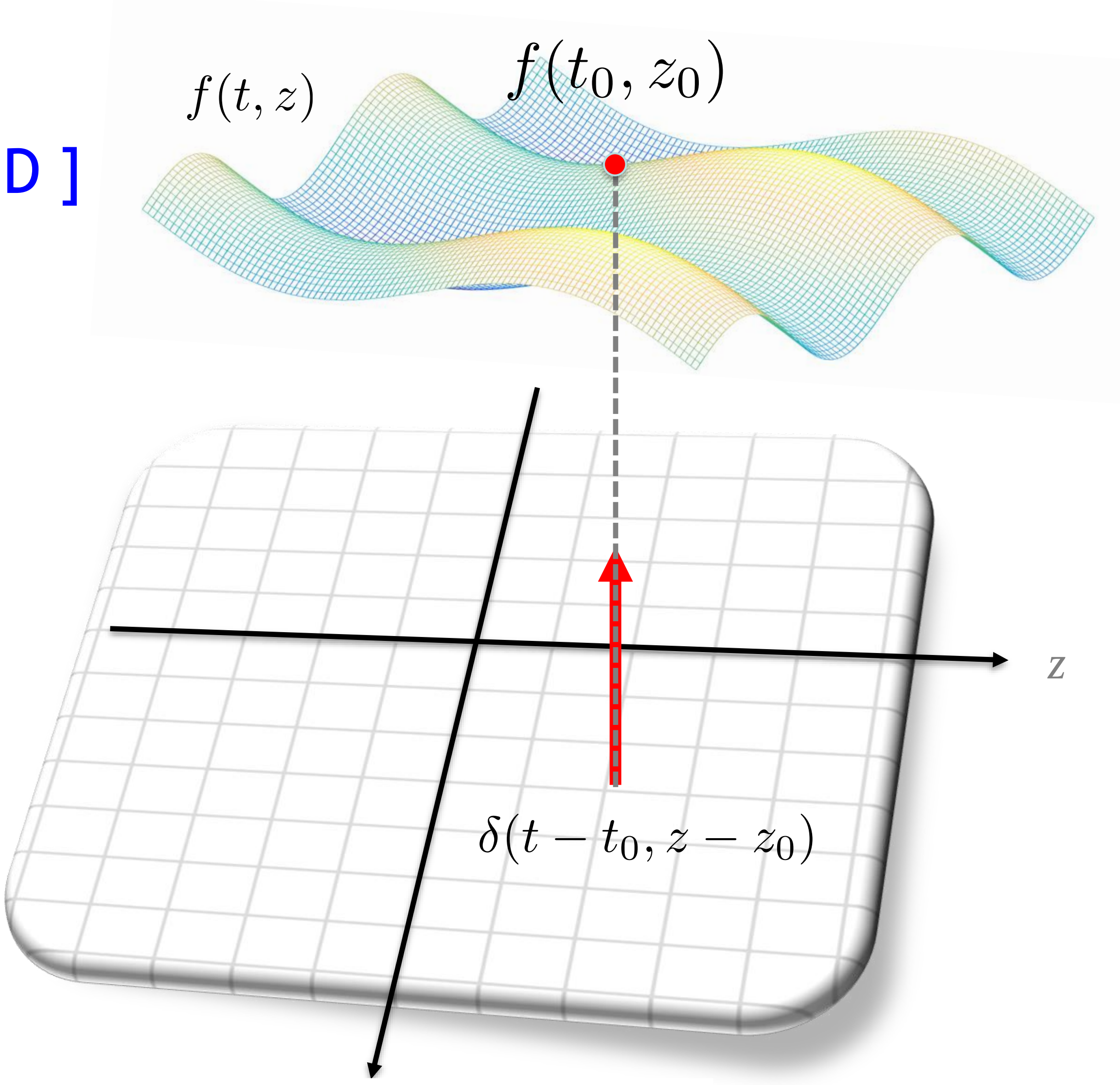


$$\delta(t, z) = \begin{cases} \infty & \text{si } t = z = 0 \\ 0 & \text{para otros valores de } t \text{ y de } z \end{cases}$$

$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \delta(t, z) dt\, dz = 1$$

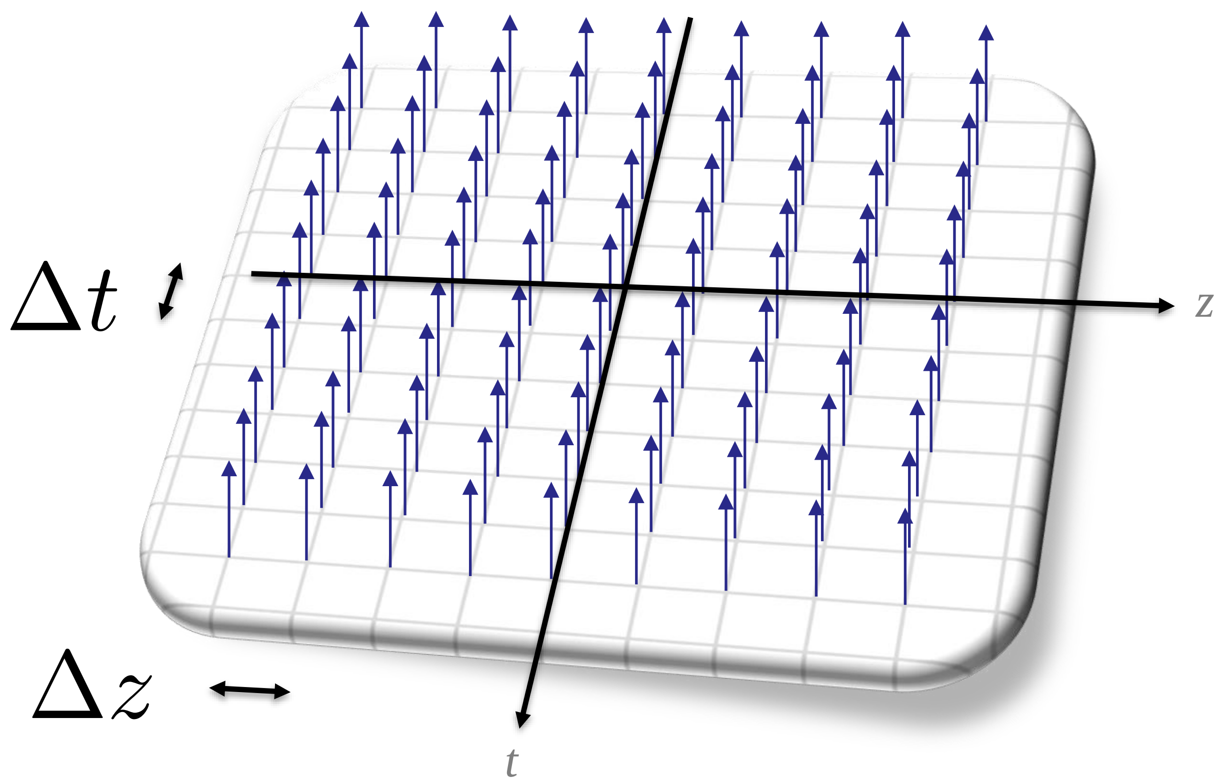
[La función impulso en 2D]



$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(t, z)\delta(t - t_0, z - z_0)dt\, dz = f(t_0, z_0)$$

[Transformada de un tren de impulsos en 2D]

Dominio del espacio:



[Transformada de un tren de impulsos en 2D]

Dominio de la frecuencia: