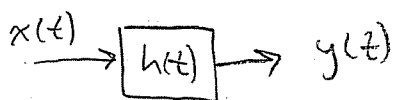


We have shown that if a system is LTI then the output can be described by convolution. We will now show that if a system can be described by convolution then it is LTI

Notation

$$y(t) = \int_{-\infty}^{\infty} x(t-\tau)h(\tau)d\tau$$



$x(t) \rightarrow y(t)$

can be repeated for discrete time

Let $x_1(t) = g(t) \rightarrow y_1(t) = \int_{-\infty}^{\infty} g(t-\tau)h(\tau)d\tau$

Let $x_2(t) = w(t) \rightarrow y_2(t) = \int_{-\infty}^{\infty} w(t-\tau)h(\tau)d\tau$

Let $x_3(t) = \alpha x_1(t) + \beta x_2(t)$

$\rightarrow y_3(t) = \int_{-\infty}^{\infty} (\alpha g(t-\tau) + \beta w(t-\tau))h(\tau)d\tau$

$= \alpha y_1(t) + \beta y_2(t)$

The system is additive and homogeneous and is therefore Linear

Notation

$$y[n] = \sum_{m=-\infty}^{\infty} x[n-m]h[m]$$



$x[n] \rightarrow y[n]$

Can be repeated for continuous time

Let $x_1[n] = g[n] \rightarrow y_1[n] = \sum_{m=-\infty}^{\infty} g[n-m]h[m]$

Let $x_2[n] = g[n-n_0] = x_1[n-n_0]$

$\rightarrow y_2[n] = \sum_{m=-\infty}^{\infty} g[n-n_0-m]h[m]$

$= y_1[n-n_0]$

The system is time invariant