

Fifth Lecture

What

linearity + time invariance

Represent each signal as a weighted sum of scaled and shifted impulses

- We only need to know the impulse response to know the system output

Discrete-time LTI Systems:

The Convolution Sum

Sifting Property

$$\cancel{x[-1] \times \delta[n+1]} = \begin{cases} x[-1] & , n=-1 \\ 0 & , n \neq -1 \end{cases}$$

$$x[0] \delta[n], \begin{cases} x[0] & , n=0 \\ 0 & , n \neq 0 \end{cases}$$

$$x[1] \delta[n-1] = \begin{cases} x[1] & , n=1 \\ 0 & , n \neq 1 \end{cases}$$

$$x[n] = \sum_{k=-\infty}^{\infty} x[k] \delta[n-k]$$

$$u[n] = \sum_{k=0}^{\infty} s[n-k]$$

linear time varying

$$y[n] = \sum_{k=-\infty}^{\infty} x[k] h_k[n]$$

↑
Response to $\delta[n-k]$

Figure 2.2

Time invariance

$$h_k[n] = h_0[n-k]$$

$$h[n] \triangleq h_0[n] \quad \text{defn}$$

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

Convolution Sum

Superposition

$$y[n] = x[n] * h[n]$$

Example 2.1

Example 2.2 Same $h[n]$

Figure 2.4

Example 2.3

$$E[n](W[k]) = \sum_{n=0}^{\infty} w[n]e^{-jn\omega k}$$

$$= \frac{1}{1 - e^{-j\omega}} \left(w[0] + j\omega w[1] + \dots \right)$$

is slanted
so it looks similar to your
(without loss)