ECE 310 Recitation 3

Thursday Mar 03, 2021

Concept check

1. Linear Constant Coefficient Difference Equations (LCCDE)
   a. Delay form:

$$y[n] + \sum_{k=1}^{N} a_k\, y[n-k] = \sum_{k=0}^{N} b_k\, x[n-k]$$

   b. Advance form:

$$y[n] + \sum_{k=1}^{N} a_k\, y[n+k] = \sum_{k=0}^{N} b_k\, x[n+k]$$

   c. Zero-state response & Zero-input response
      i. Zero-state: solution to the LCCDE with zero initial conditions
      ii. Zero-input: solution to the LCCDE with zero input

2. Z-transform
   a. Definition:

$$X(z) = \sum_{n=-\infty}^{\infty} x[n]\, z^{-n}$$

   b. ROC: regions where the z-transform converges
   c. Properties
      i. Linearity:

$$Z\{ax[n] + by[n]\} = aX(z) + bY(z), ROC = ROC_x \cap ROC_y$$

      ii. Shifting

$$Z\{x[n \pm k]\} = z^{\pm k}\, X(z), ROC = ROC_x$$

      iii. Convolution

$$y[n] = h[n] * x[n] \rightarrow Y(z) = H(z)X(z), ROC_Y = ROC_H \cap ROC_X$$

Exercise

1. Given the z-transform pair $x[n] \leftrightarrow X(z) = 1/(1 - 2z^{-1})$ with ROC: $|z| < 2$, use the z-transform properties to determine the z-transform of the following sequences:

    a. $y[n] = x[n-3]$
    b. $y[n] = (\frac{1}{3})^n \, x[n]$
    c. $y[n] = x[n] * x[-n]$
    d. $y[n] = nx[n]$
    e. $y[n] = x[n-1] + x[n+2]$
    f. $y[n] = x[n] * x[n-2]$