MAS160: Signals, Systems & Information for Media Technology

Problem Set 7

Instructor : V. Michael Bove, Jr.

Problem 1: z-Transforms, Poles, and Zeros

Determine the z-transforms of the following signals. Sketch the corresponding pole-zero patterns.

(a) $x[n] = \delta[n-5]$
(b) $x[n] = nu[n]$
(c) $x[n] = \left(-\frac{1}{3}\right)^n u[n]$
(d) $x[n] = (a^n + a^{-n})u[n], a$ real
(e) $x[n] = (na^n \cos\omega_0 n)u[n], a$ real
(f) $x[n] = \left(\frac{1}{2}\right)^n (u[n-1] - u[n-10])$

Problem 2: z-Transform Properties

Given $x[n]$ below, use the properties of the z-transform to derive the transform of the following signals.

$$x[n] \rightarrow X(z) = \frac{z^{-1}}{(1-z^{-1})^2}$$

(a) $x[n-3]$
(b) $x[n] * \delta[n-3]$
(c) $x[n] - x[n-1]$
(d) $x[n] * (\delta[n] - \delta[n-1])$
(e) $5x[n-1] + 4\left(-\frac{1}{3}\right)^n u[n]$

Problem 3: Relating pole-zero plots to frequency- and impulse-response

(a) *DSP First* 8.16
(b) *DSP First* 8.17

Problem 4: *DSP First* Lab 10

Items to be turned in:

(a) Answers to questions from C.10.4.
(b) Answers to questions from C.10.5.
(c) Plots and answers to questions from C.10.6.