Birzeit University

Faculty of Engineering and Technology

Electrical and Computer Engineering

Digital Signal Processing (DSP)

Assignment No (4)

Fall semeter 2015

Submission deadline: Wednesday 28/11/2015 (23:55 PM) only through Moodle (itc.birzeit.edu)

Some useful MATLAB functions: The M-file *factorize* (found on Moodle under chapter 3) can be used to factorize the denominator polynomial of the rational *z*-transform in order to determine its possible ROCs. The pole-zero plot of a rational *z*-transform can also be plotted using the M-file *zplane*. The z-transform can be described either in terms of its zeros and poles given as vectors zeros and poles or in terms of numerator and denominator polynomials entered as vectors *num* and *den* containing coefficients in descending powers of z:

Zplane(zeros, poles), zplane(num, den)

Note that the argument zeros and poles must be entered as column vectors, whereas arguments *num* and *den* need to be entered as row vectors.

The M-file *residuez* can be used to develop the partial-fraction expansion of a rational *z*-transform and to convert a z-transform expressed in partial-fraction form to its rational form. For the former case, the statement is:

[r,p,k] = residuez(num, den);

Where, *num* and *den* are numerator and denominator vectors expressed in descending power of z. vector *r* contains residues and numerator constants, vector *p* contains the corresponding poles and the vector *k* contains the constants.

The inverse of a rational z-transform of causal sequences can be calculated using MATLAB. Both the M-file *impz* and *filter* can be used.

The M-file *tf2zp* can also be used to obtain (*z*), poles (*p*) and constant (*k*) of a rational z-transform.

[z, p, k] = tf2zp(num, den);

MATLAB EXERCISES:

(1) Using MATLAB, determine the factored form of the following z-transforms:

(a)

$$G1(z) = \frac{2Z^4 - 5Z^3 + 13.48Z^2 - 7.78Z + 9}{4Z^4 + 7.2Z^3 + 20Z^2 - 0.8Z + 8}$$

(b)

$$G1(z) = \frac{5Z^4 + 3.5Z^3 + 21.58Z^2 - 4.6Z + 18}{5Z^4 + 15.5Z^3 + 31.7Z^2 + 22.52Z + 4.8}$$

And show their pole-zero plots. Determine all possible ROCs of each of the above z-transforms, and describe of their inverse z-transforms (left-sided, right-sided, or two-sided sequences) associated with each of the ROCs.

(2) Use M-file *residues* to determine the z-transform as a ratio of two polynomials in Z^{-1}

From each of the partial-fraction expansions listed below:

(a) $X1(Z) = 3 - \frac{4}{5+Z^{-1}} - \frac{7}{6-Z^{-1}}, |Z| > 0.2$

(b) $X2(Z) = \frac{-4}{(4+2Z^{-1})^2} + \frac{6}{4+2Z^{-1}} + \frac{5}{1+0.64Z^{-2}}, |Z| > 0.8$

(3) A causal stable LTI system is characterized by an impulse response h1(n) = $1.2\delta(n)+0.5(-0.5)^n u(n)-0.6(0.2)^n u(n)$. Use MATLAB to determine the impulse response h2(n) of its inverse system, which is causal and stable.