L.EEC025 - FUNDAMENTALS OF SIGNAL PROCESSING

Academic year 2024-2025, week 6
TP (Recitation) problems

Topics: the inverse Z-Transform

Problem 1

Consider the discrete-time and causal system that is described by the following difference equation:

$$y[n] = x[n] + 2x[n-1] + x[n-2] + 0.5y[n-1] + 0.5y[n-2].$$

a) Obtain its transfer function $H(z)$.

b) Create in Matlab vectors `a[]` and `b[]` and obtain in vector `y1[]` the first 30 coefficients of the impulse response of the system and represent it graphically.

c) Find the impulse response of the discrete-time system using partial fraction expansion of $H(z)$.

d) Find the impulse response of the discrete-time system using the contour line integral method.

e) Add Matlab commands to a `.m` file implementing the signal obtained in **c)**, or **d)**, and find (and represent graphically) the difference relative to the values obtained in **b)**.

Problem 2

Consider a discrete-time and causal system described by the difference equation: $y[n] = x[n] - 0.4x[n-1] + 0.8y[n-1] - 0.64y[n-2]$. Write a `.m` Matlab command file executing the following steps:

a) defines in vectors `num` and `den` the polynomials numerator and denominator of the discrete-time system,

b) represents the zero-pole diagram of the system,

c) uses command `roots()` to find the poles and zeros (which should be compared to the result of the "by hand" computation),

d) uses command

```
[resid, poles, dire]=residuez(num, den);
```

which returns vectors `resid`, `poles` and `dire` whose content you should interpret and compare to the result of the "by hand" partial fraction expansion of $H(z)$,

e) uses command `impz()` to represent the first 40 samples of the impulse response of the system, which you should compare to the "by hand" computation of the impulse response (vector `h`)