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EECE5356_DSP

FIR System Identification

You need to model an unknown FIR system. You have placed a random noise signal, **x**, at the input of the system and observed the resulting signal, **y**. All that is known about the FIR system is that it is **9 points long**. This means the **order Q is 8.**

Since it is an FIR system, A(z) = 1 and the order of **A(z) is P = 0**. This also means you will need to modify the **system identification code** so that D is now **D = X** and the estimate of the **B coefficients** is the **thetls** result.

Estimate the **impulse response**, **h**, of this system.

The signals, x and y, are in the file FIRSystemIDHwk.

Turn in your Matlab code and your estimated h values (numbers, not a plot).

Solution:

Since $H(z) = \frac{B(z)}{A(z)}$ *and* $A(z) = 1, H(z) = B(z)$.

We also have

$$\sum_{n=-inf}^{inf} h[n]z^{-n} = h[0] + h[1]z^{-1} + \cdots + h[n]z^{-n} = B(z) = b_0 + b_1 z^{-1} + \cdots + b_n z^{-n}$$

Then impulse response h[n] coefficients are simply coefficients of B(z), we don't have to do the Inverse Z-transform of the system's frequency response H(z).

Matlab Code:

```
% This is similar to AR signal but we observe both the input x (Q-order) and
% output y (P-order)
load('FIRSystemIDHwkData.mat')
N=length(x);
P = 0; % A has 0 order
Q = 8;
L = max(P,Q);
yvec= y((L+1):N);
xFirstCol = x((L+1):N);
xFirstRow = x((L+1):(-1):(L-Q+1));
X=toeplitz(xFirstCol,xFirstRow);
% since we are dong FIR system ID, we ignore
Y=toeplitz(yFirstCol,yFirstRow);
D=X;
theta = pinv(D)*yvec;
A=1;
B=theta
```

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```
>> FIRSystemID

B =

    1.0000
   -2.0000
    3.0000
   -4.0000
    5.0000
    4.0000
    3.0000
    2.0000
    1.0000

fx >>
```