Laboratory Work #03

DIGITAL SIGNAL PROCESSING (DSP)

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1. Using MATLAB determine the second-order factored form of the following z-transforms. And show their pole-zero plots. Then determine all possible ROCs of above z-transform.

$$G(z) = \frac{4z^4 + 15.6z^3 + 6z^2 + 2.4z - 6.4}{3z^4 + 2.4z^3 + 6.3z^2 - 11.4z + 6}$$

2. Writing a MATLAB program to determine the rational form of a z-transform whose zero are at ξ_1= 1.2, ξ_2= 2.3-j0.5, ξ_3= -0.4+j0.2, ξ_4= -0.4-j0.2, ξ_5= 2.3+j0.5; the poles are at λ_1= 0.5, λ_2= -0.75+j0.2, λ_3= 0.6+j0.7, λ_4= 0.6-j0.7, λ_5= -0.75-j0.2; and the gain constant k is 2.1.
3. Using the function fir1 and window of Kaiser, design a linear-phase FIR lowpass filter meeting the following specifications: passband edge frequency = 2 kHz, stopband edge frequency=2.5 kHz, passband ripple δ_p=0.005, stopband ripple δ_s=0.005, and sampling rate of 10 kHz. Plot its gain and phase responses and check if it meets the specifications?

SOLUTION

Question1

```
num=[4 15.6 6 2.4 -6.4];
den=[3 2.4 6.3 -11.4 6];
[sos,G]=tf2sos(num,den)
[z,p,k]=tf2zp(num,den)
zplane(z,p);
```

Question2

```
z=input('input the zeros=');
p=input('input the ploes=');
g=input('input the gain constant=');
[num,den]=zp2tf(z',p',g);
w = 0:pi/(255):pi;
h=freqz(num,den,w);
subplot(2,1,1)
plot(w/pi,abs(h));grid
title('Magnitude Spectrum')
xlabel('\omega/\pi'); ylabel('Magnitude')
subplot(2,1,2)
plot(w/pi,angle(h));grid
title('Phase Spectrum')
xlabel('\omega/\pi'); ylabel('Phase, radians')
```

Question3

```
[n,wn,beta,typ]=kaiserord([2000 2500],[1 0],[0.005 0.005],10000);
b=fir1(n,wn,kaiser(n+1,beta),'noscale');
[h,omega]=freqz(b,1,256);
subplot(2,1,1)
```

```
plot(omega/pi,20*log10(abs(h)));

xlabel('\omega/\pi'); ylabel('Gain, dB');

subplot(2,1,2)

plot(omega/pi,angle(h));grid

title('Phase Spectrum')

xlabel('\omega/\pi'); ylabel('Phase, radians')
```