EE387 – Signal Processing

Lab03 - System Functions and Frequency Response

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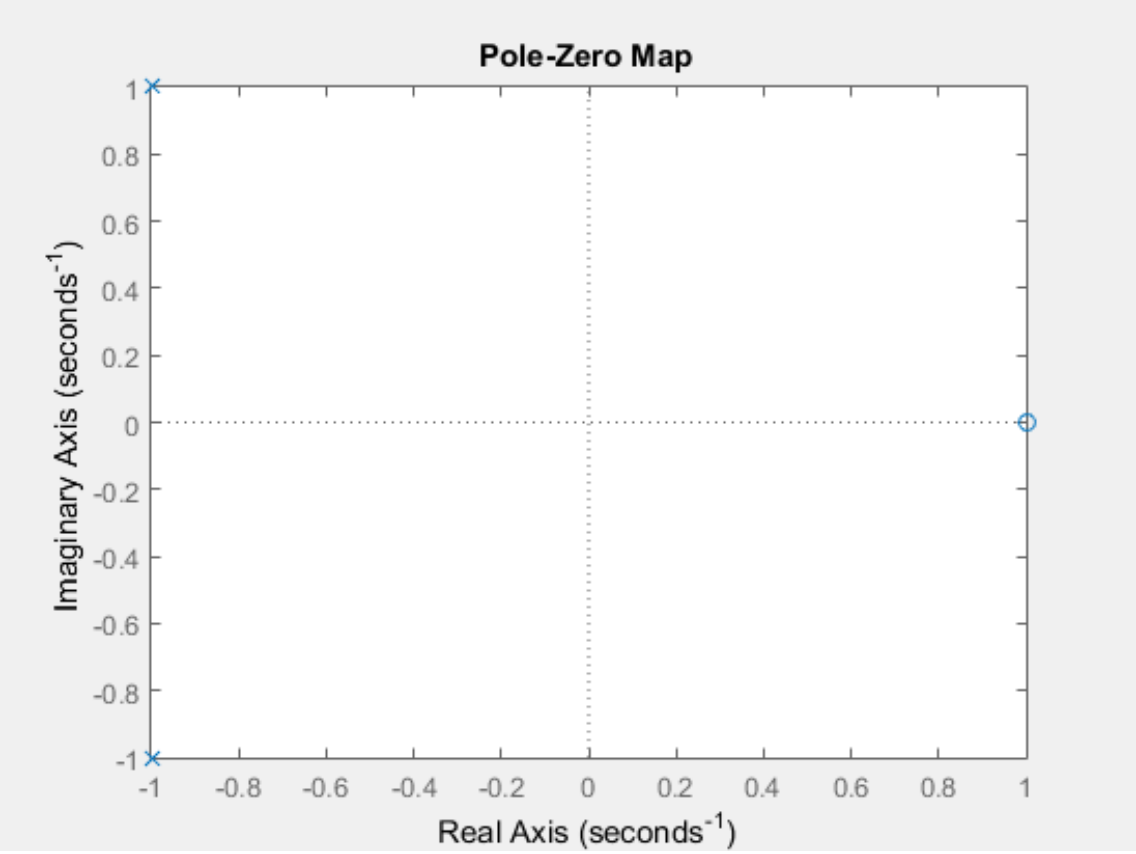
E/15/366

PART 1: Pole-Zero Diagrams in MATLAB.

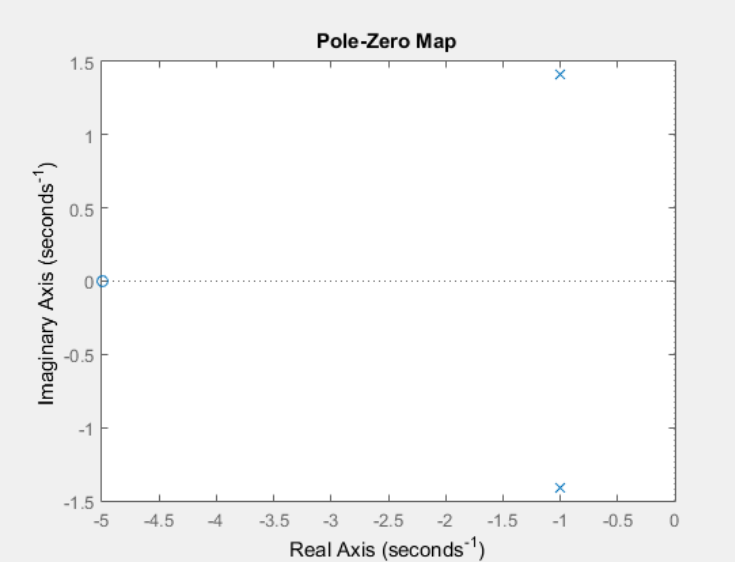
Example

```
clear all;
close all;
b = [1 -1]; % Numerator coefficients
a = [1 2 2]; % Demoninator coefficients
zs = roots(b); % Generetes Zeros
ps = roots(a); % Generetes poles
pzmap(ps,zs); % generates pole-zero diagram
```



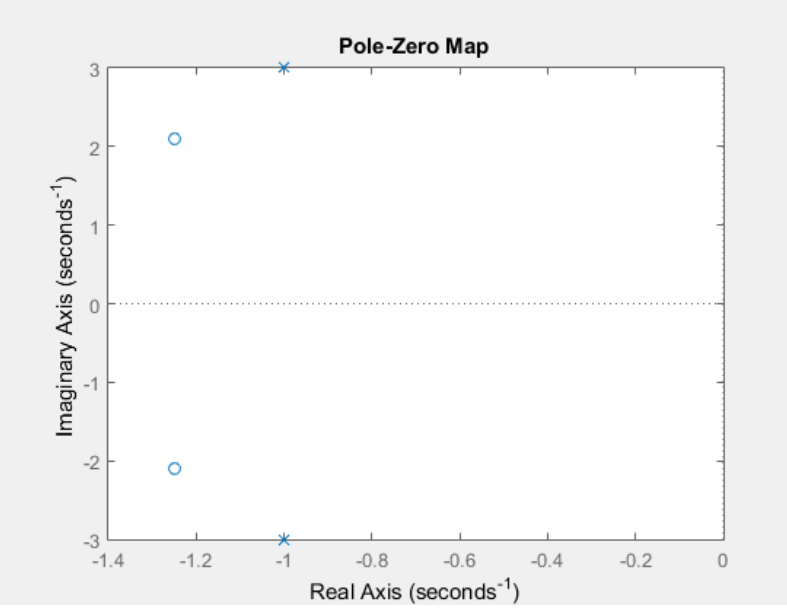
1.

```
a = [1 5];
b = [1 2 3];
z = roots(a);
p = roots(b);
pzmap(p,z);
```



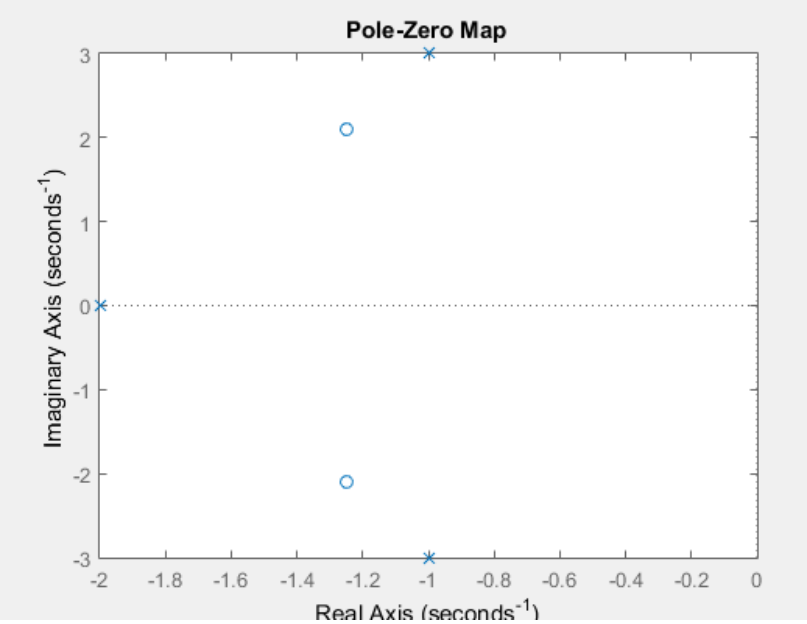
2.

```
a = [2 5 12];
b = [1 2 10];
z = roots(a);
p = roots(b);
pzmap(p,z);
```



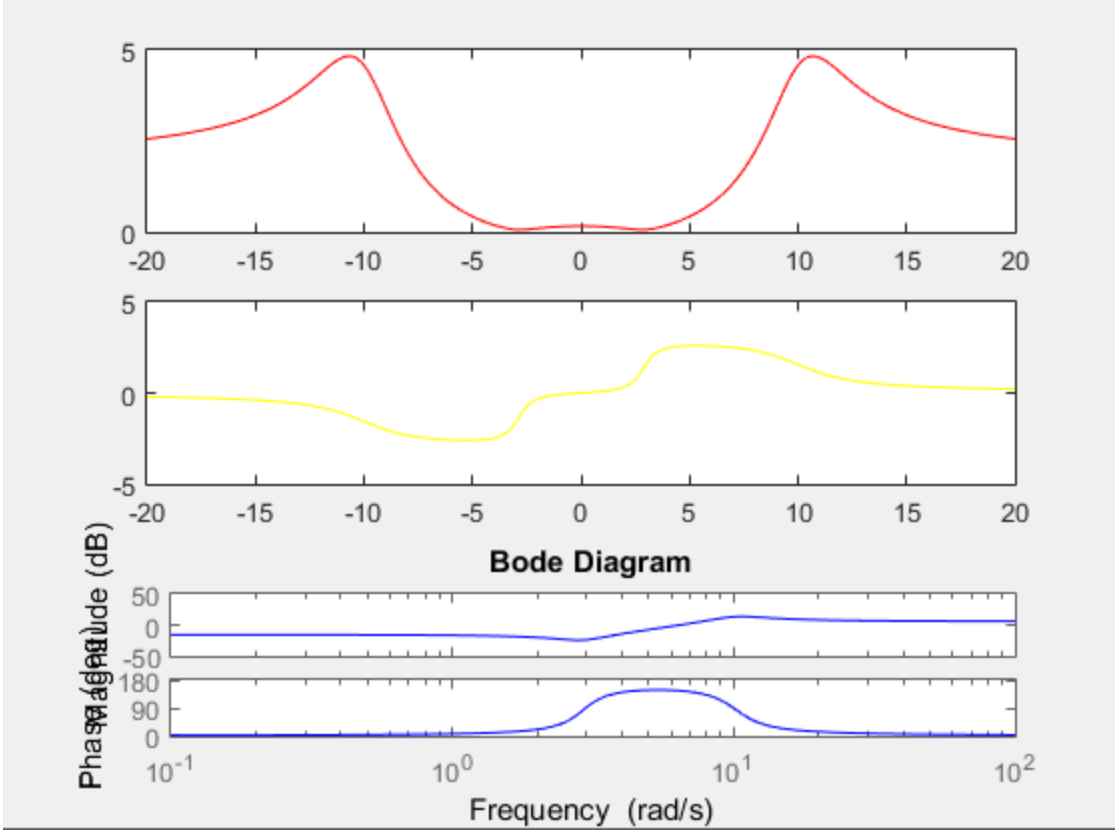
3.

```
a = [2 5 12];
b = [1 4 14 20];
z = roots(a);
p = roots(b);
pzmap(p,z);
```



PART 2: Frequency Response and Bode Plots in MATLAB

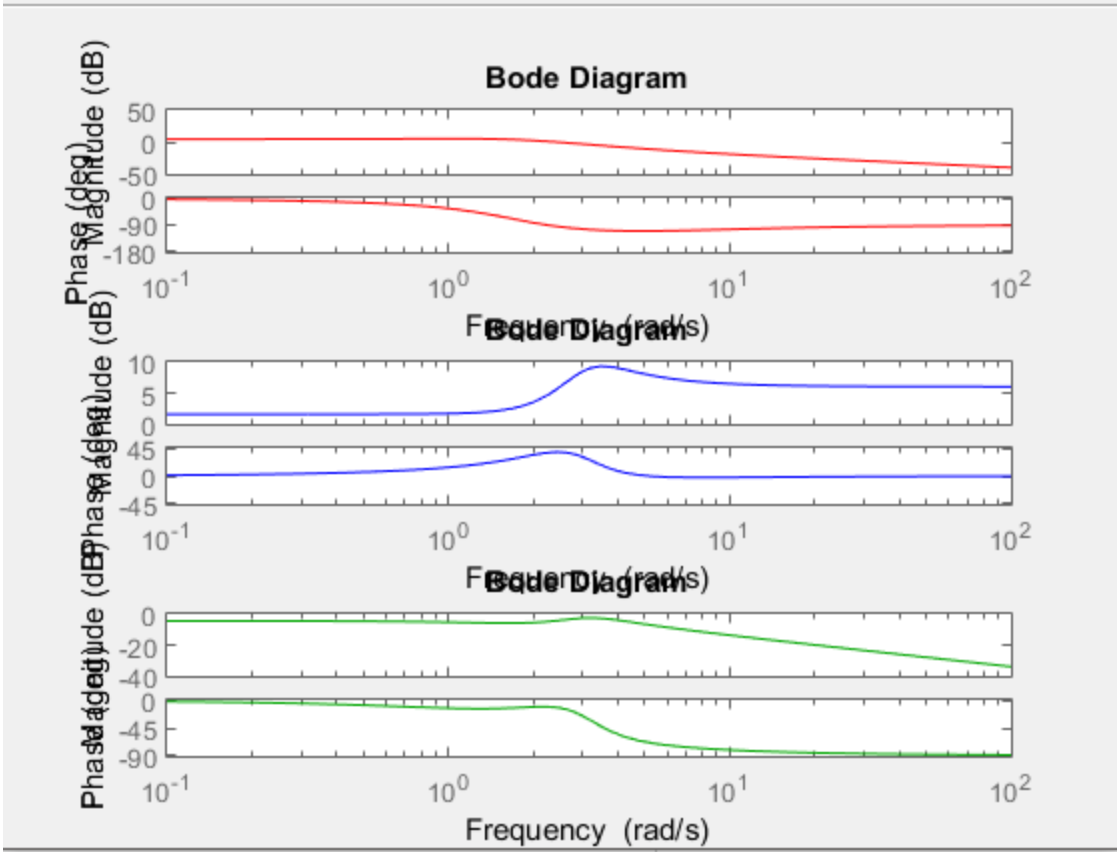
```
a = [2 2 17];
b = [1 4 104];
omega = linspace(-20,20,200);

x = freqs(a,b,omega);
subplot(3,1,1);
plot(omega, abs(x),'r');

subplot(3,1,2)
plot(omega, angle(x),'y');

x1=tf(a,b);
subplot(3,1,3)
bode(x1,'b');
```



Exercise

1.

```
a1 = [1 5];
b1 = [1 2 3];

a2 = [2 5 12];
b2 = [1 2 10];

a3 = [2 5 12];
b3 = [1 4 14 20];

x2=tf(a1,b1);
subplot(3,1,1)
bode(x2,'r');

x3=tf(a2,b2);
subplot(3,1,2)
bode(x3,'b');

x4=tf(a3,b3);
subplot(3,1,3)
bode(x4,'g');
```



2.

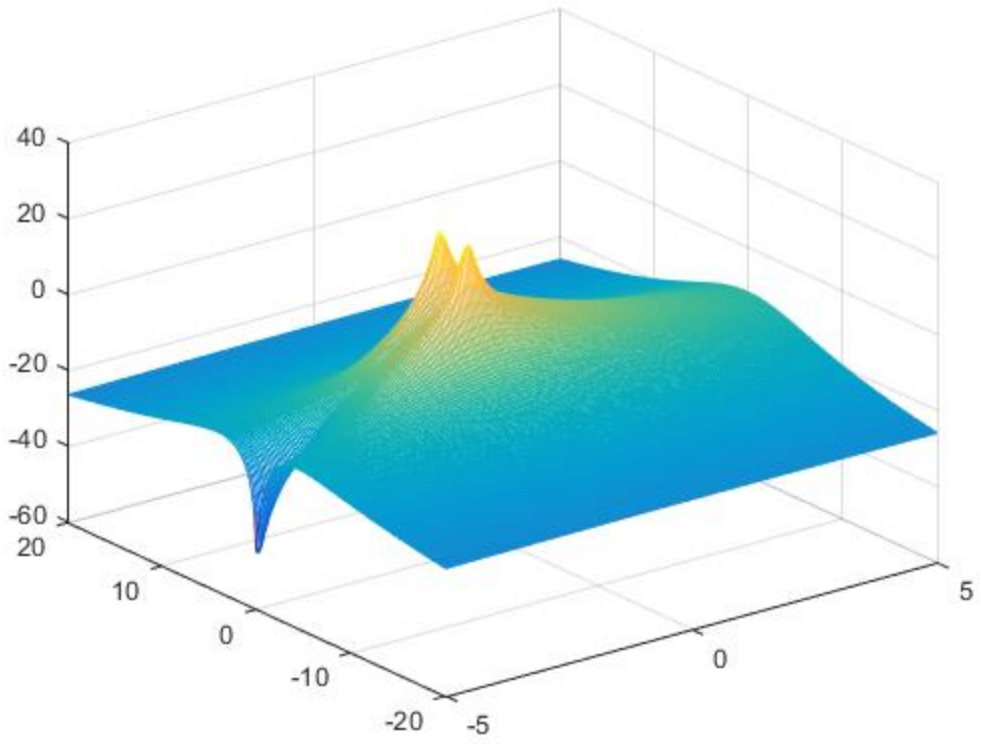
```
syms s;
omega = linspace(-20,20,200);

lh1 = (s+5)./(s*s+2*s+3);
lh2 = (2*s*s+5*s+12)./(s*s+2*s+10);
lh3 = (2*s*s+5*s+12)./(s.^3+4*s*s+14*s+20);

% Registration Number = 366
w1 = 2*pi*366*1;
w2 = 2*pi*366*2;
w3 = 2*pi*366*3;

lx1 = sin(w1*omega);
lx2 = sin(w2*omega);
lx3 = sin(w3*omega);

%give signal lx1 to all the systems
y12 = ilaplace(lx1.*lh1)
y13 = ilaplace(lx1.*lh2)
y14 = ilaplace(lx1.*lh3)
```

```
%give signal lx2 to all the systems
y22 = ilaplace(lx2.*lh1)
y23 = ilaplace(lx2.*lh2)
y24 = ilaplace(lx2.*lh3)

%give signal lx3 to all the systems
y32 = ilaplace(lx3.*lh1)
y33 = ilaplace(lx3.*lh2)
y34 = ilaplace(lx3.*lh3)
```

```
y12 =

[ (7957400298746171*exp(-t)*(cos(2^(1/2)*t) + 2*2^(1/2)*sin(2^(1/2)*t)))/247588007857076054979824844 8, -(931019769184731*exp(-t)*(cos(2^(1/2)*t) + 2*2^(1/2)*

y13 =

[ (7957400298746171*dirac(t))/123794003928538027489912422 4 + (7957400298746171*exp(-t)*(cos(3*t) - 3*sin(3*t)))/247588007857076054979824844 8, - (931019769184

y14 =

[ (7957400298746171*exp(-2*t))/247588007857076054979824844 8 + (7957400298746171*cos(3*t)*exp(-t))/247588007857076054979824844 8, - (931019769184731*exp(-2*t)).

y22 =

[ (7957400298746171*exp(-t)*(cos(2^(1/2)*t) + 2*2^(1/2)*sin(2^(1/2)*t)))/123794003928538027489912422 4, (3390864029718003*exp(-t)*(cos(2^(1/2)*t) + 2*2^(1/2)*

y23 =

[ (7957400298746171*dirac(t))/618970019642690137449562112 + (7957400298746171*exp(-t)*(cos(3*t) - 3*sin(3*t)))/123794003928538027489912422 4, (339086402971800
```

PART 3: Surface Plots of a System Function in MATLAB

```
%consider the system in part1 exercise 1help
b = [1 5];
a = [1 2 3];

omega = linspace(-20,20,200);
sigma = linspace(-5,5,200);

%system response matrix
[sigmagrid,omegagrid] = meshgrid(sigma,omega);

sgrid = sigmagrid+1i*omegagrid;

%evaluate the numerator and denominator polynomials
H1 = polyval(b,sgrid)./polyval(a,sgrid);

%surface graph of the magnitude of H(s)
mesh(sigma,omega,20*log10(abs(H1)));
```



Zeros and poles are in the XY horizontal plane. Poles are same in two bode plot and the surface plot.