

Laplace Transform and Fourier Transform

Signal

```
t = linspace(0,10,200);  
x = (exp(-1*t).*sin(1*t));  
Fs = 1/20;  
plot(t,x)
```

Fourier Transform of Signal

```
Xw = fft(x);  
Ns = size(Xw);  
Ns = Ns(2);  
w = 2*pi*([-Ns/2:(Ns/2)-1])/Ns;  
  
plot(w,Fs*fftshift(abs(Xw)))
```

Laplace Transform of Signal

```
syms t y  
s = (exp(-1*t).*sin(1*t));  
Ls = laplace(s);
```

Ls

Ls =

$$\frac{1}{(s+1)^2+1}$$

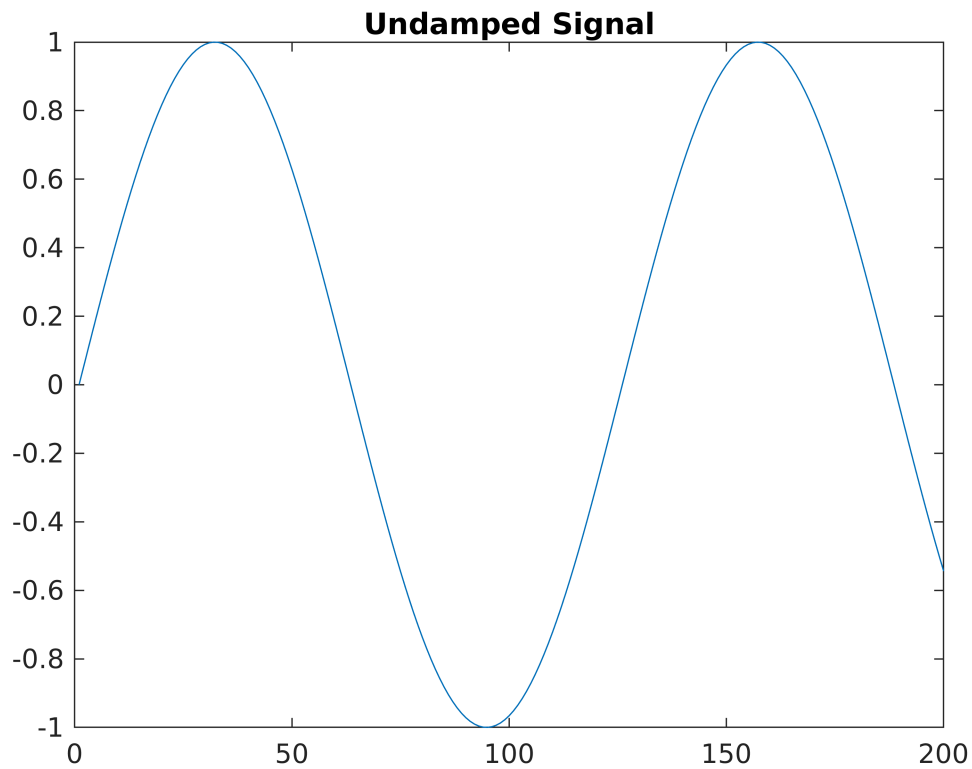
```
s = 1i*w;  
LT = arrayfun(matlabFunction(Ls),s);  
plot(w,abs(LT))
```

```
s = -0.5+1i*w;  
LT = arrayfun(matlabFunction(Ls),s);  
plot(w,abs(LT))
```

```
sigma = linspace(-2,1,30);  
[X,Y] = meshgrid(sigma,w);  
Z = abs(arrayfun(matlabFunction(Ls),X+1j*Y));  
surf1(X,Y,Z)
```

Undamped Signals

```
t = linspace(0,10,200);  
y = sin(t);  
plot(y)  
title('Undamped Signal');
```

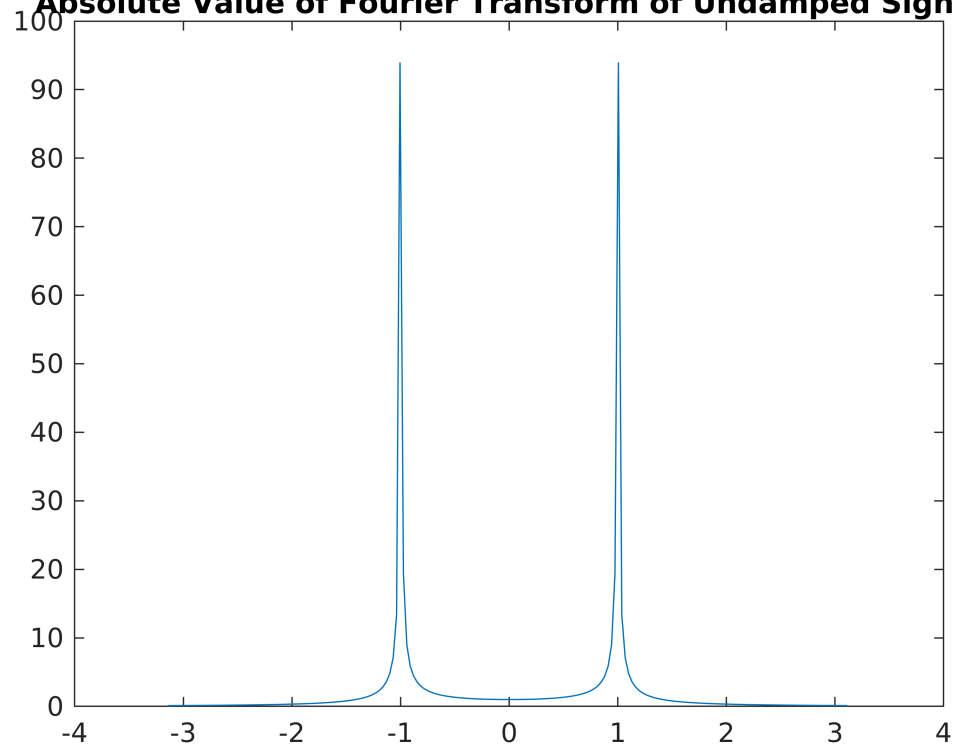


```
syms t Ls  
s = sin(t);  
Ls = laplace(s);  
Ls
```

Ls =
$$\frac{1}{s^2 + 1}$$

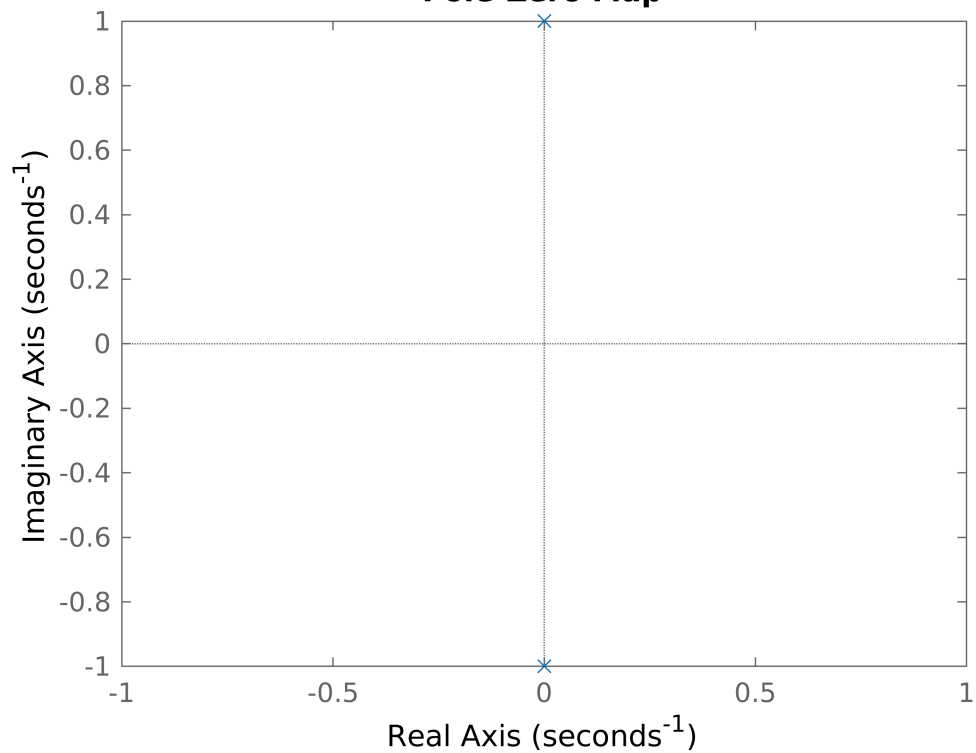
```
w = 2*pi*([-Ns/2:(Ns/2)-1])/Ns;  
s = li*w;  
LT = arrayfun(matlabFunction(Ls),s);  
plot(w,abs(LT))  
title('Absolute Value of Fourier Transform of Undamped Signal')
```

Absolute Value of Fourier Transform of Undamped Signal



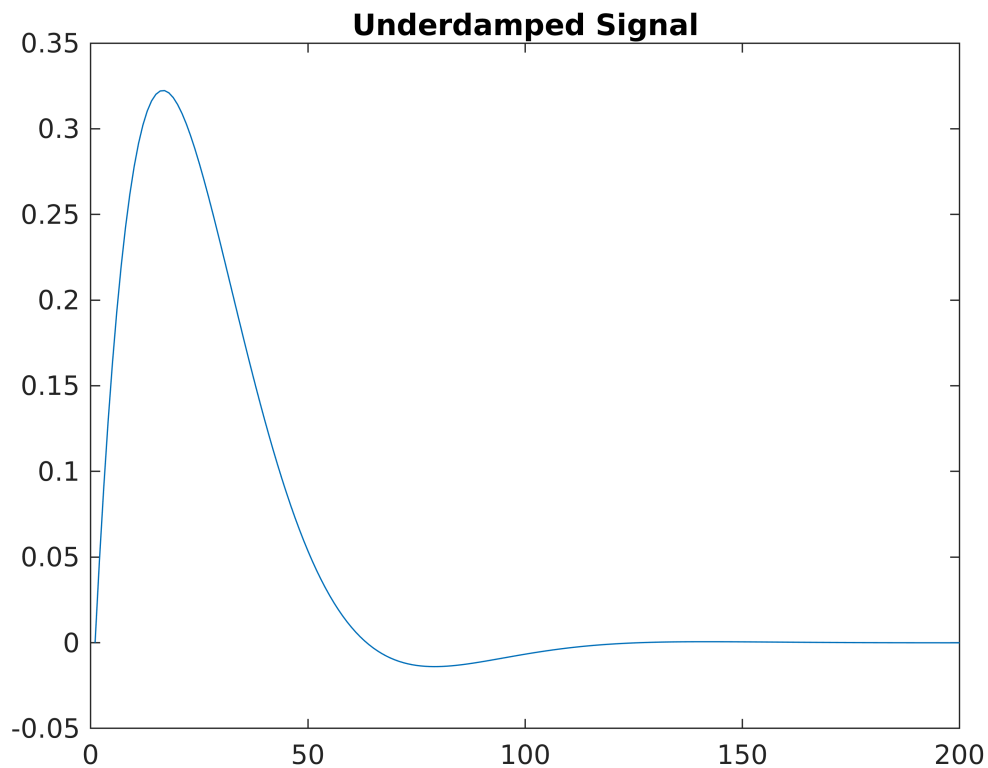
```
h = pzplot(sym2tf(Ls));
```

Pole-Zero Map



Underdamped Signals

```
t = linspace(0,10,200);  
y = exp(-t).*sin(t);  
plot(y)  
title('Underdamped Signal')
```



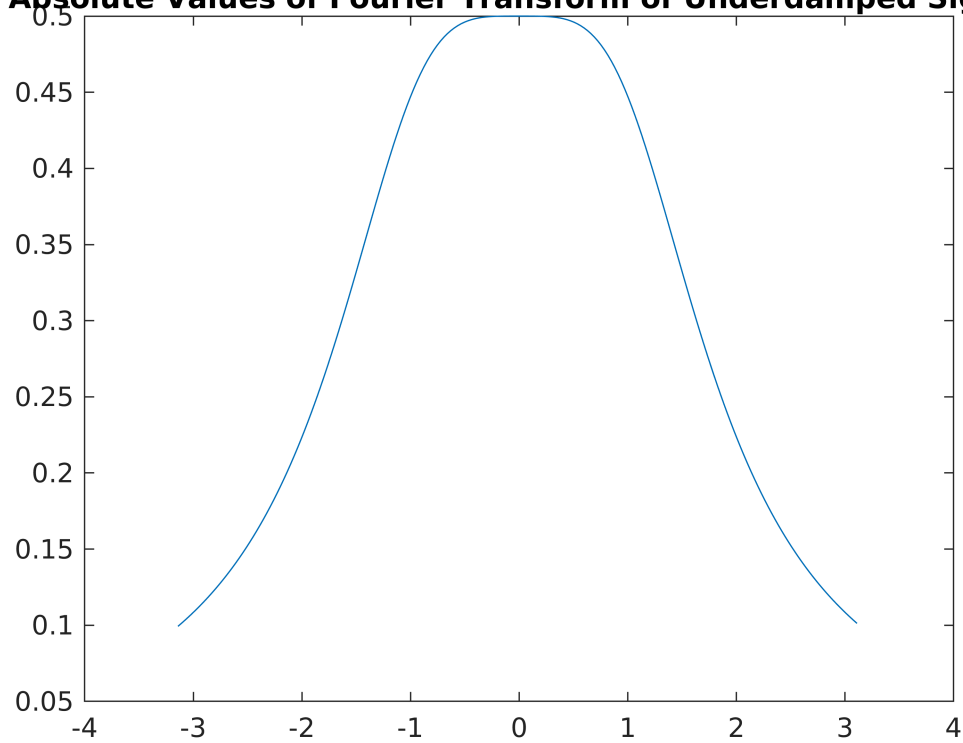
```
syms t Ls  
s = exp(-t).*sin(t);  
Ls = laplace(s);  
Ls
```

Ls =

$$\frac{1}{(s+1)^2+1}$$

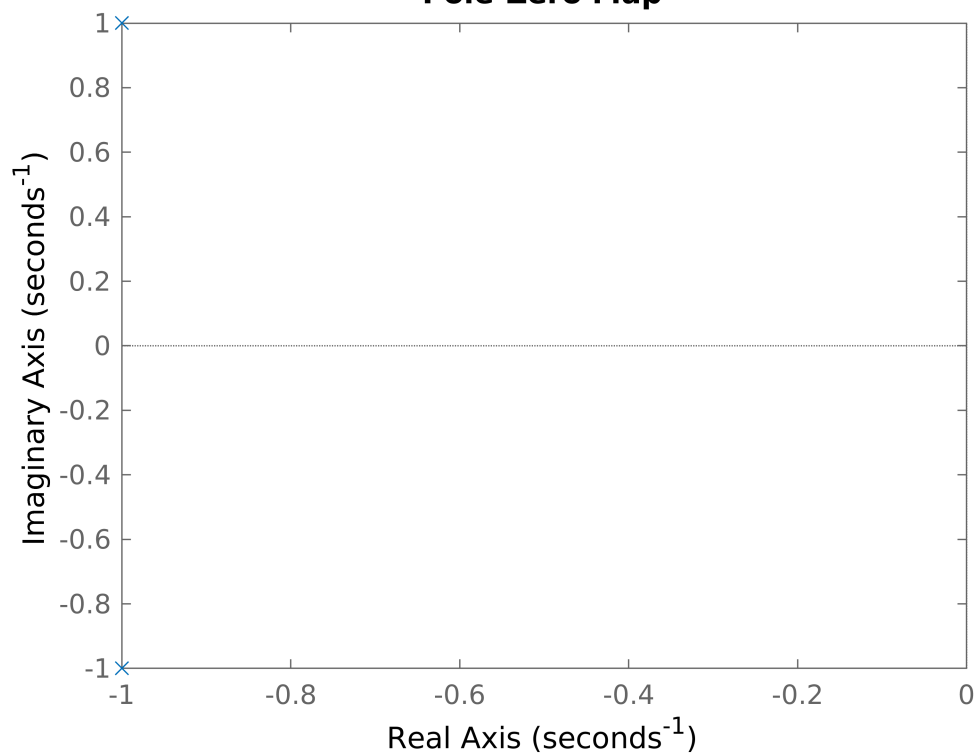
```
w = 2*pi*([-Ns/2:(Ns/2)-1])/Ns;  
s = 1i*w;  
LT = arrayfun(matlabFunction(Ls),s);  
plot(w,abs(LT))  
title('Absolute Values of Fourier Transform of Underdamped Signal')
```

Absolute Values of Fourier Transform of Underdamped Signal



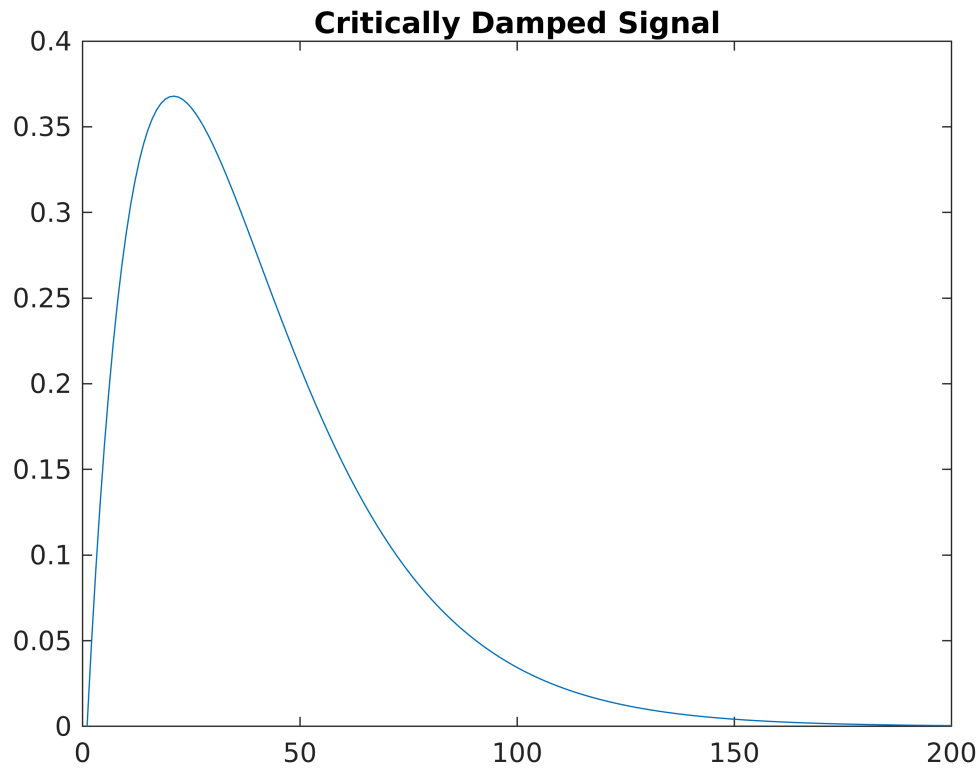
```
h = pzplot(sym2tf(Ls));
```

Pole-Zero Map



Critically Damped Signals

```
t = linspace(0,10,200);  
y = (t).*exp(-t);  
plot(y)  
title('Critically Damped Signal')
```

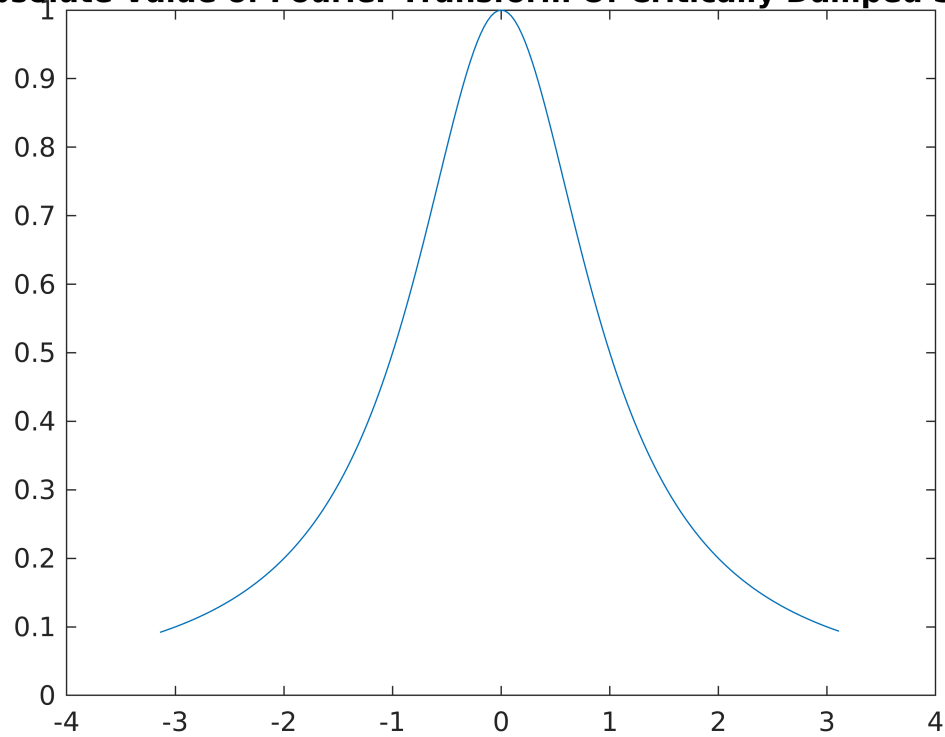


```
syms t Ls  
s = (t).*exp(-t);  
Ls = laplace(s);  
Ls
```

Ls =
$$\frac{1}{(s+1)^2}$$

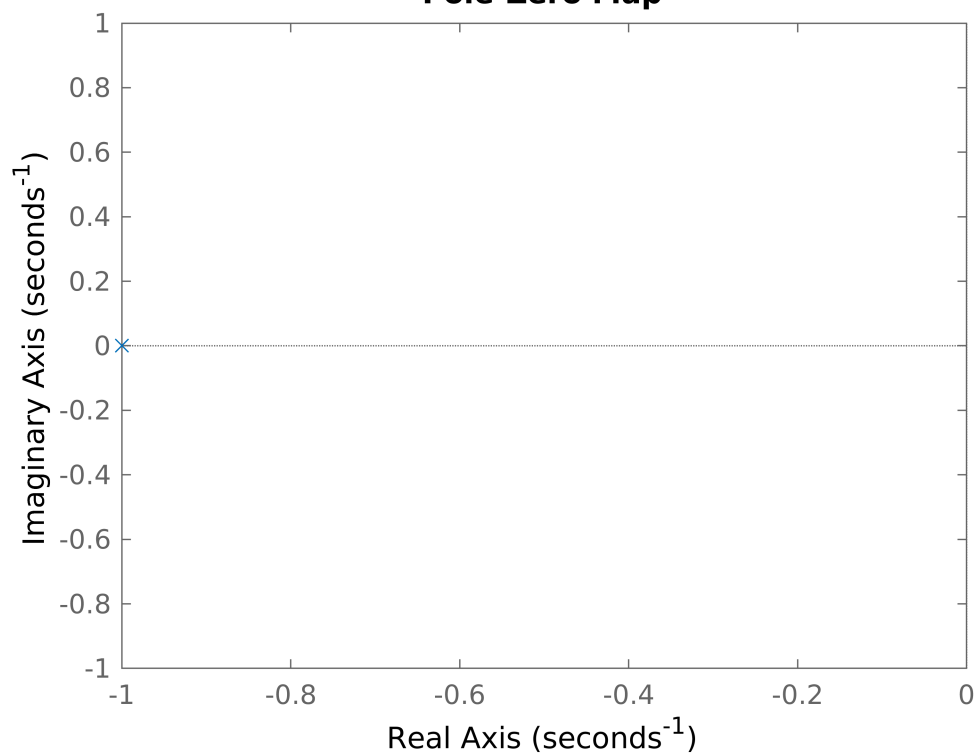
```
w = 2*pi*([-Ns/2:(Ns/2)-1])/Ns;  
s = 1i*w;  
LT = arrayfun(matlabFunction(Ls),s);  
plot(w,abs(LT))  
title('Absolute Value of Fourier Transform Of Critically Damped Signal')
```

Absolute Value of Fourier Transform Of Critically Damped Signal



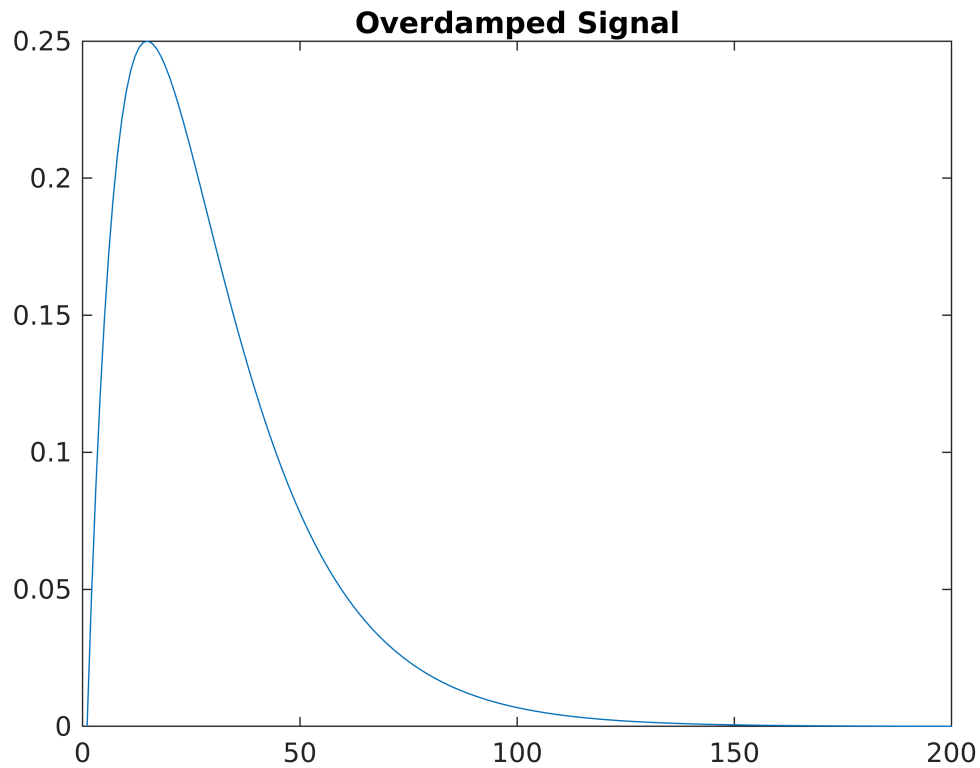
```
h = pzplot(sym2tf(Ls));
```

Pole-Zero Map



Overdamped Signals

```
t = linspace(0,10,200);  
y = exp(-t) - exp(-2*t);  
plot(y)  
title('Overdamped Signal')
```



```
syms t Ls  
s = exp(-t) - exp(-2*t);  
Ls = laplace(s);
```

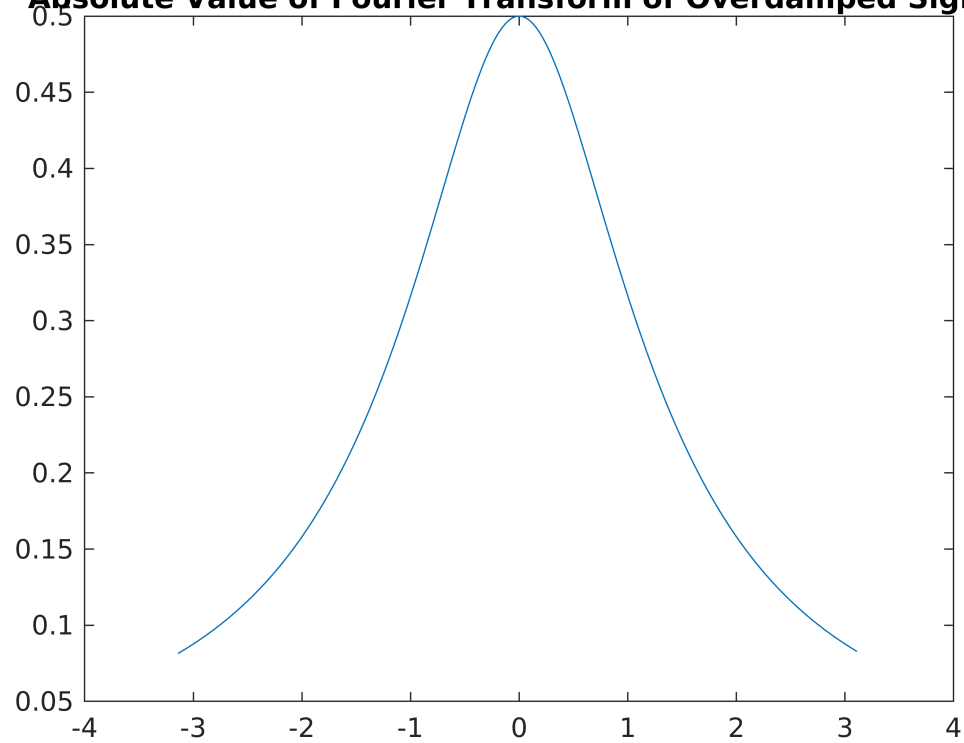
Ls

Ls =

$$\frac{1}{s+1} - \frac{1}{s+2}$$

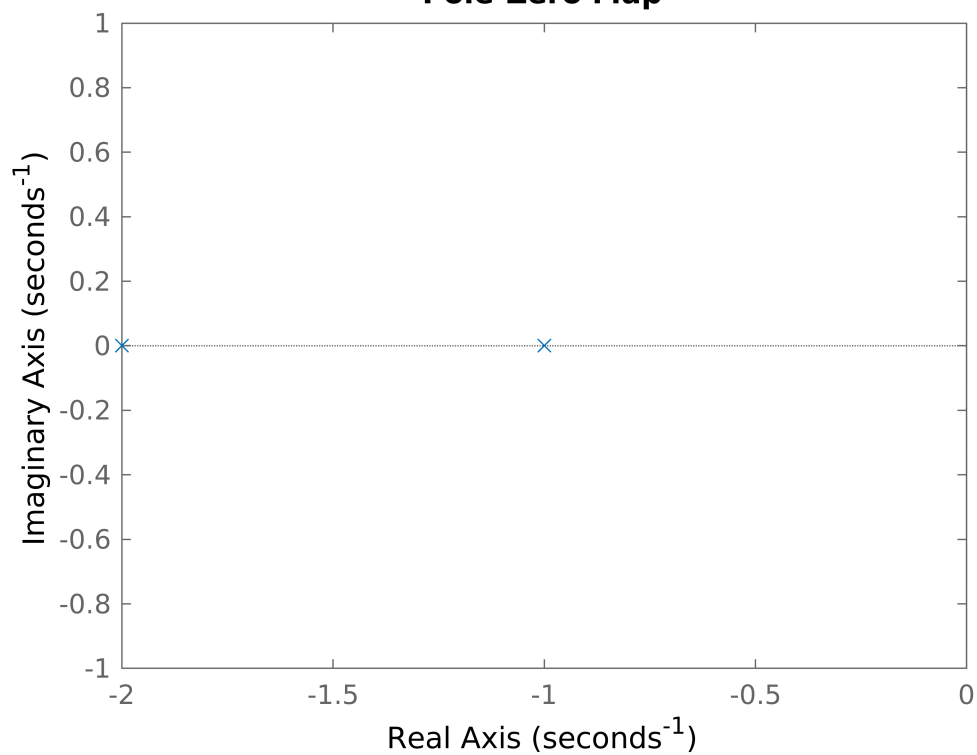
```
w = 2*pi*([-Ns/2:(Ns/2)-1])/Ns;  
s = 1i*w;  
LT = arrayfun(matlabFunction(Ls),s);  
plot(w,abs(LT))  
title('Absolute Value of Fourier Transform of Overdamped Signal')
```


Absolute Value of Fourier Transform of Overdamped Signal



```
h = pzplot(sym2tf(Ls));
```

Pole-Zero Map



Function to convert System Function to tf -----> Matlab Formats

```
function G = sym2tf(g)
[n,m]=size(g);
for i=1:n
    for j=1:m
        [num,den]=numden(g(i,j));
        num_n=sym2poly(num);
        den_n=sym2poly(den);
        G(i,j)=tf(num_n,den_n);
    end
end
end
```