An Example Log Report - DSP Labs (David Dorran and Richard Hayes)

This is an example log report for a typical DSP lab problem. It should be used as a guide for producing other log reports submitted to either Richard Hayes or David Dorran.

Log reports should be very concise and written with an expert audience in mind. Marks will be awarded for clear presentation and organisation.

Log reports will assessed online i.e. not printed on A4 paper. It is therefore not necessary to have pages in your document; this means that you do not have to be concerned about headings and figures being positioned neatly on pages. A guide to creating this type of 'non-paged' document using matlab publish is at http://eleceng.dit.e/dorran/matlab/resources

This report was generated using Matlab Publish, it is not required to use this feature. The script used to generate this report will accompany it at http://eleceng.dit.e/dorran/matlab/resources

Contents

Lab problem summary

Analysis of the discrete system with the following coefficients: b = [1] a = [1 -1.2 0.72];

Determine, and plot where appropriate, the following features of the system:

- The difference equation of the system and signal flow diagram
- The system frequency response
- The system transfer function
- The poles and zeros of the system
- The step response
- The impulse response

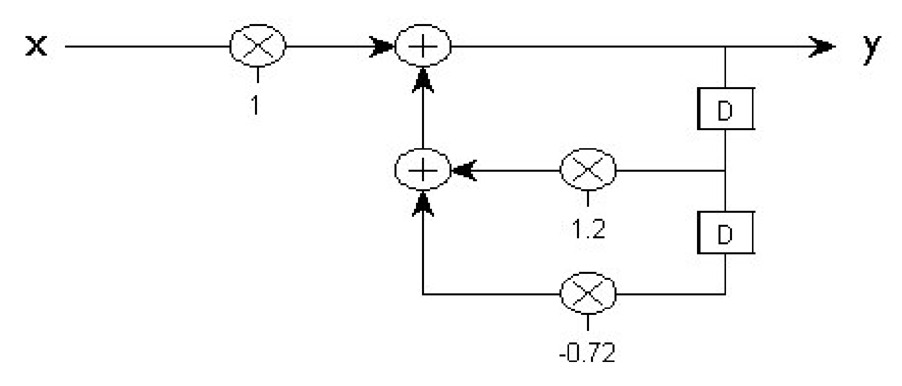
Difference equation and signal flow diagram

System difference equation:

$$y[n] = x[n] + 1.2y[n-1] - 0.72y[n-2]$$

Create the signal flow diagram using a create_signal_flow function available at http://dadorran.wordpress.com

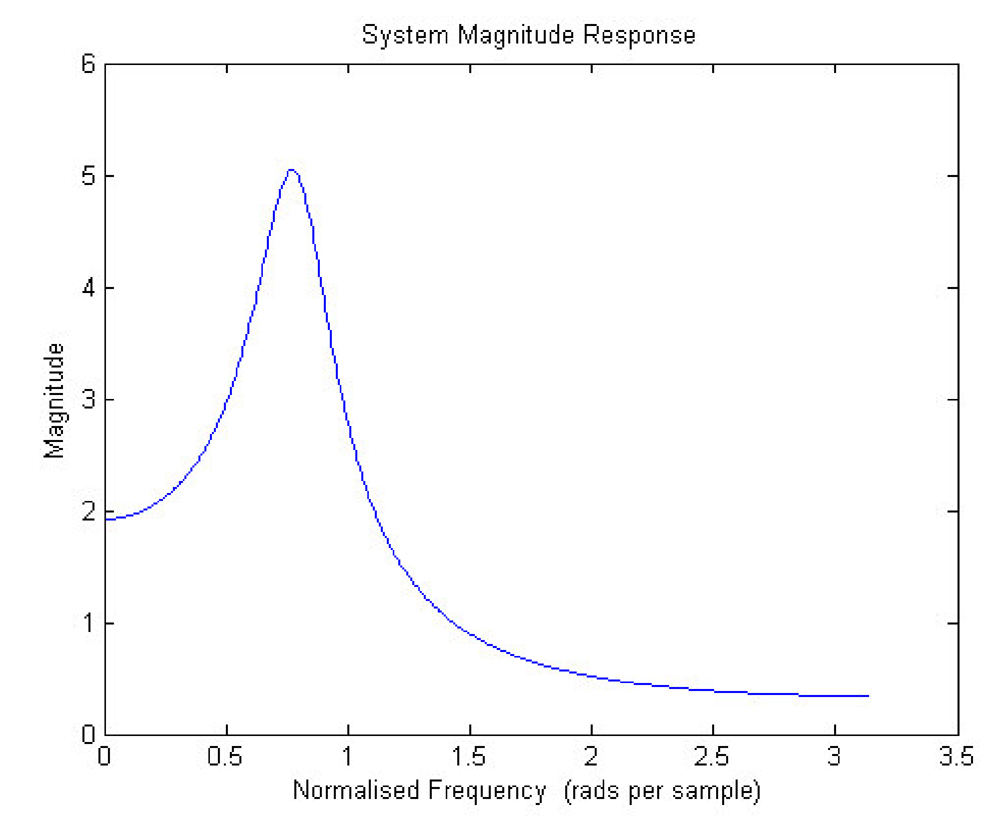
```
b = [1];
a = [1 -1.2 0.72];
create_signal_flow(b,a)
```



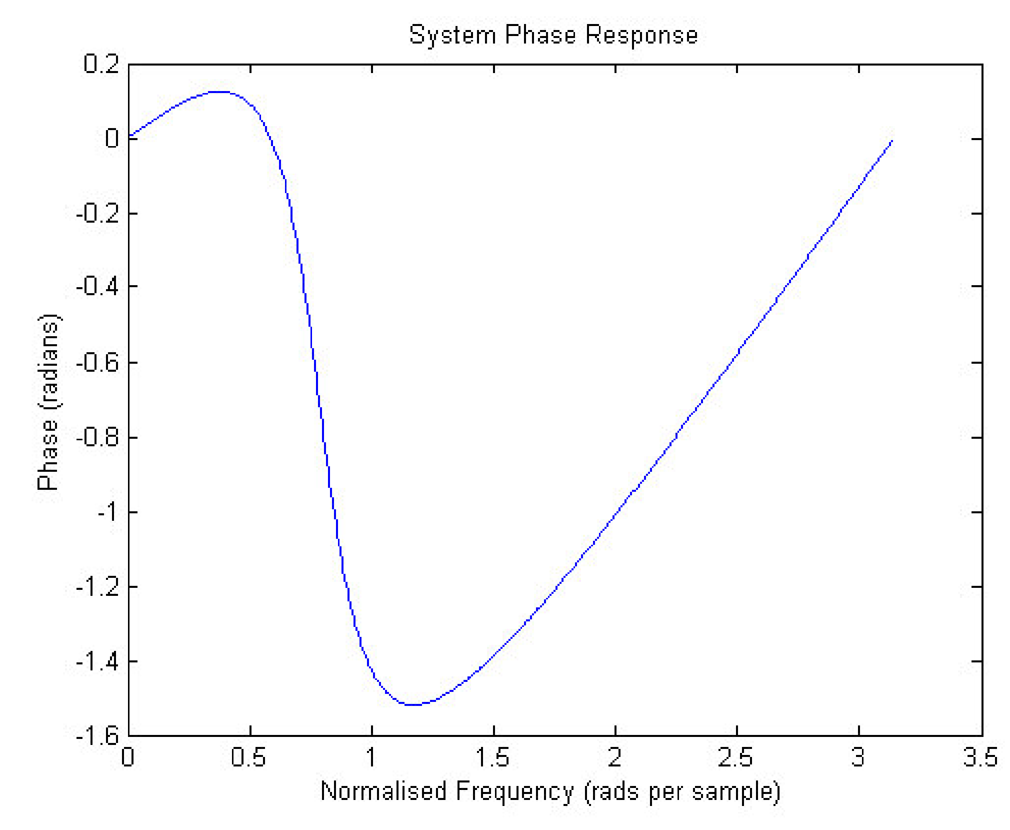

```
%Note: The large amount whitespace after the signal flow diagram isn't
%ideal but results from the create_signal_flow function. I'll try to sort
%out this problem with the function at some stage.
```

System frequency response

```
[H w] = freqz(b,a);

figure
plot(w, abs(H))
xlabel('Normalised Frequency  (rads per sample)');
ylabel('Magnitude');
title('System Magnitude Response');
```




```
plot(w, angle(H))
xlabel('Normalised Frequency (rads per sample)');
ylabel('Phase (radians)');
title('System Phase Response');
```



System transfer function

The system transfer function is given by either of the following expressions:

$$H(z) = \frac{1}{1 - 1.2z^{-1} + 0.72z^{-2}}$$

or

$$H(z) = \frac{z^2}{z^2 - 1.2z + 0.72}$$

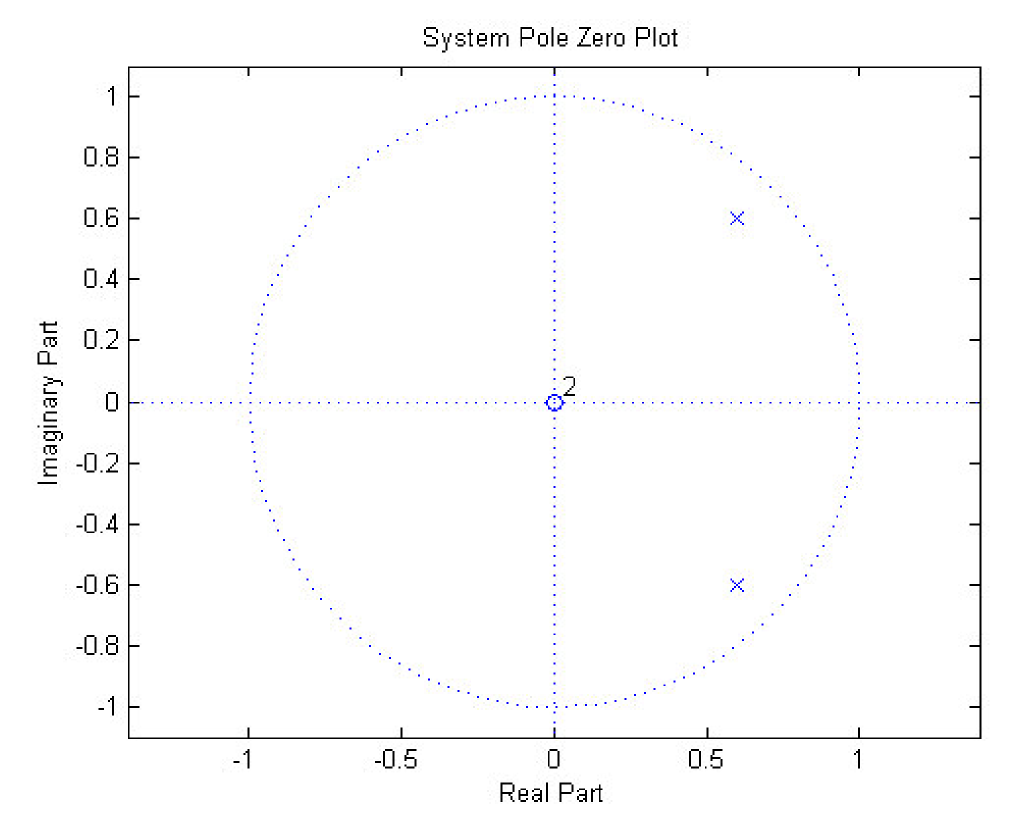
System poles and zeros

Poles are located by finding roots of the denominator of H(z) above.

```
pole_locations = roots(a)


pole_locations =

   0.6000 + 0.6000i
   0.6000 - 0.6000i
```

Zeros are located by finding roots of the numerator of H(z) above.

```
zero_locations = roots([1 0 0 ])


zero_locations =

     0
     0



zplane(b,a)
title('System Pole Zero Plot')
```

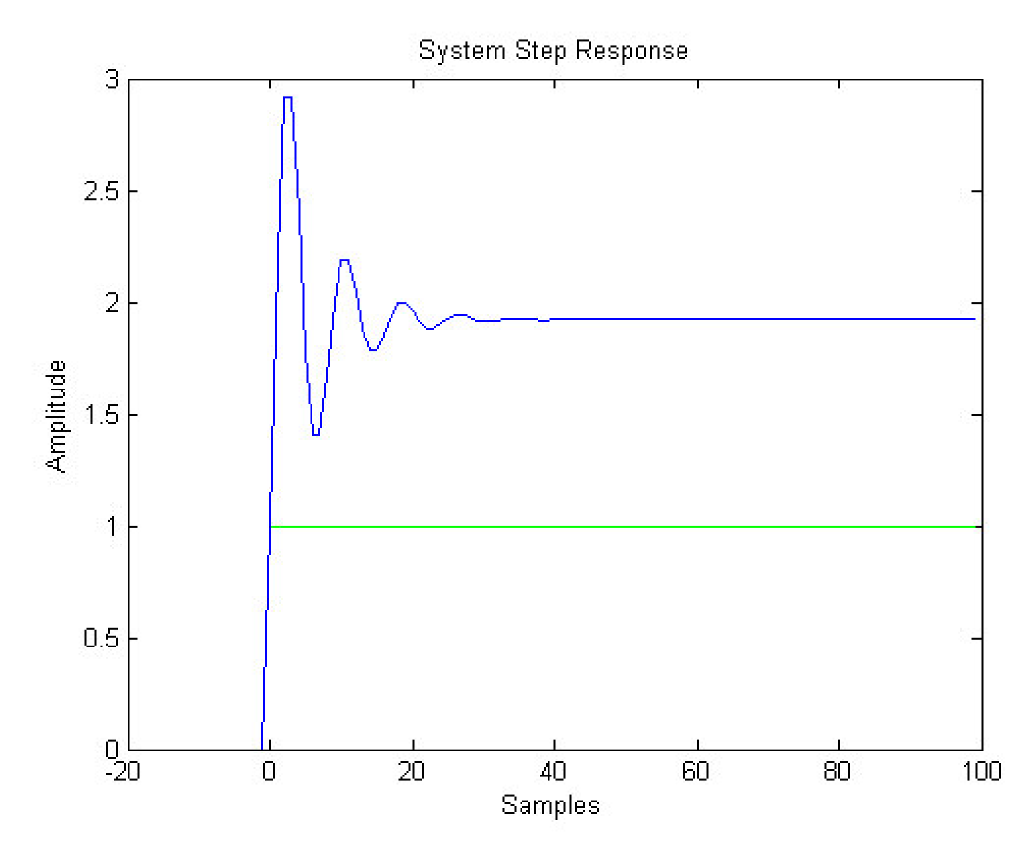



```
%Note: The system is stable as the poles are inside the unit circle
```

System step response

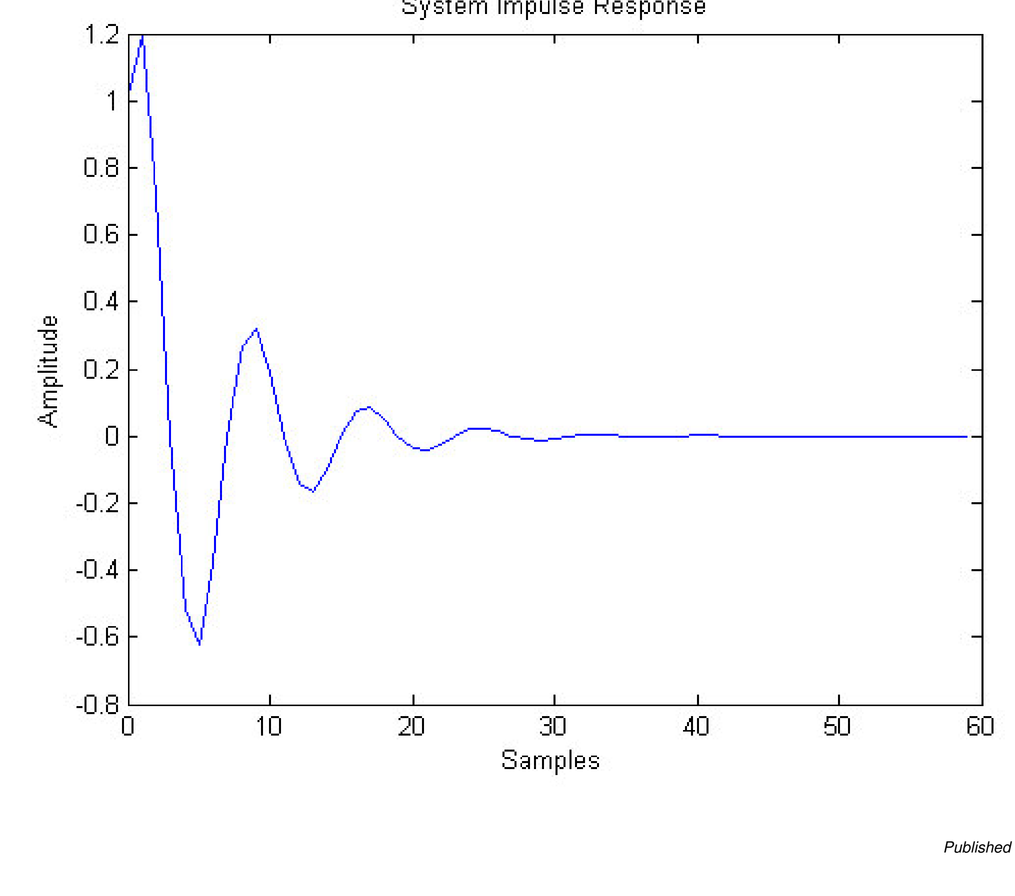
Create a step signal and pass it through the system

```
step_sig = [zeros(1, 10) ones(1, 100)];
n = [-10 : 99];
%Determine the step response
step_response = filter(b,a,step_sig);

plot(n, step_sig, 'g')
hold on
plot(n, step_response)
hold off
xlabel('Samples')
ylabel('Amplitude');
title('System Step Response')
```



System impulse response

```
h = impz(b,a);
n = 0 : length(h)-1;
plot(n, h)

xlabel('Samples')
ylabel('Amplitude');
title('System Impulse Response')
```



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