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Bonus Project

Introduction:

This report will showcase the plot and frequency response of the following band pass filter:

$$|H[e^{j\Omega}]| = \frac{|e^{j2\Omega} - 1|}{|e^{j\Omega} - |\gamma|e^{j\pi/4}||e^{j\Omega} - |\gamma|e^{-j\pi/4}|}$$

$$|H[e^{j\Omega}]|^2 = \frac{2(1 - \cos 2\Omega)}{\left[1 + |\gamma|^2 - 2|\gamma|\cos\left(\Omega - \frac{\pi}{4}\right)\right]\left[1 + |\gamma|^2 - 2|\gamma|\cos\left(\Omega + \frac{\pi}{4}\right)\right]} \quad (5.67)$$

For the following values:

a. $|\gamma| = 0.83$
b. $|\gamma| = 0.96$
c. $|\gamma| = 0.99$

These calculations were done utilizing MATLAB. Once we calculate the system response, we also utilized MATLAB to get the plots of each system response. This was all done based on the example showcased in C5.2.

Process:

The main task was implementing the function shown in equation 5.67 above in Matlab. Once this was successfully completed, graphing the functions were easy. Below is the implementation of this equation in Matlab.

```
Omega = linspace(-pi,pi,4097); %range of omega
g_mag = [0.83 0.96 0.99]; %g magnitude, values we are testing
H = zeros(length(g_mag),length(Omega)); %setting them to H

%for loop utilizing formula 5.67
for m = 1:length(g_mag),
H(m,:) = freqz ( [1 0 -1], [1 -sqrt(2) *g_mag (m) g_mag (m) ^2], Omega);
end
```

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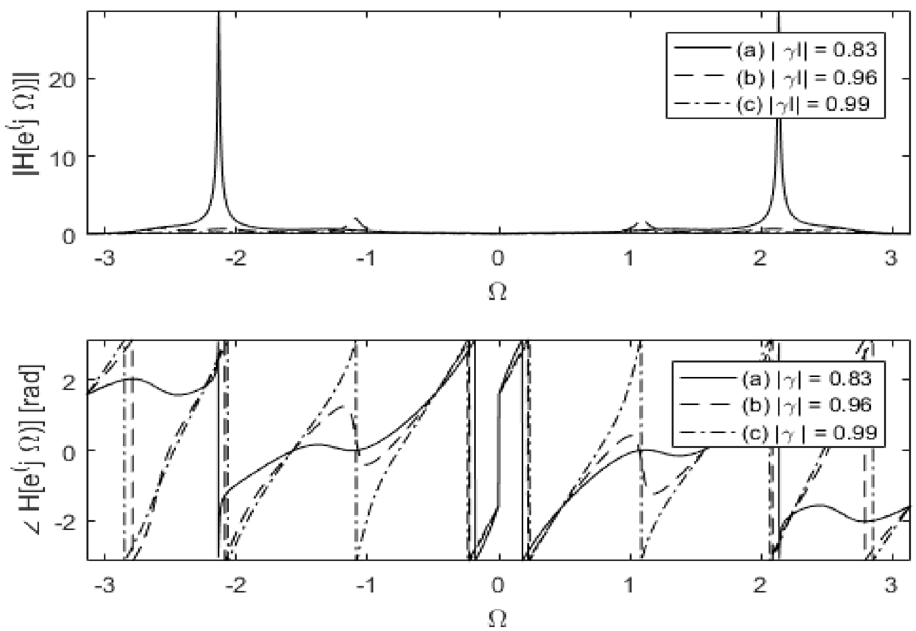
From this code we can see the implementation of the transfer function, H, below with its respective amplitude and phase response. From these graphs we can draw the overall frequency response.



To graph the frequency response in this such way, we used the following code:

```
%Plot 1
subplot(2,1,1);
plot(Omega,abs(H(1,:)),'k-',...
Omega,abs(H(2,:)),'k--',Omega,abs(H(3,:)),'k-.');
axis tight;
xlabel('\Omega');
ylabel('|H[e^(j \Omega)]|');
legend('(a)  | \gammal| = 0.83','(b)  | \gammal| = 0.96','(c)  |\gammal| = 0.99',0)

%plot 2
subplot(2,1,2);
plot(Omega,angle(H(1,:)),'k-',...
Omega,angle(H(2,:)),'k--',Omega,angle(H(3,:)),'k-.');
axis tight;
xlabel('\Omega');
ylabel('\angle H[e^(j \Omega)] [rad]');
legend('(a)  |\gamma| = 0.83','(b)  |\gamma| = 0.96','(c)  |\gamma | = 0.99',0)
```

From this, we can draw that the greater the gamma value, the sharper the phase and amplitude response will be, leading it to be more ideal.