
Table of Contents

.....	1
Problem 2	1
Problem 2 a III	2
Problem 2 a IV	3
Problem 2 b I	4
Problem 2 b II	5

```
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% ECE 486 - HW #4 Problem 2
% February 18th, 2019
```

```
clear variables
```

Problem 2

```
Fig1 = figure('Position', [200, 75, 850, 600]); % set figure size and
location

% Load the image, and convert to doubles for processing.
p1 = double(imread('Cavvy_bw.jpg'));
p2 = p1; % For Gaussian Blur
p3 = p1; % For Edge-detection

% Display the image in a figure: Pixels range from 0 (dark) to 255
(light)
imshow(p1,[0 255]);

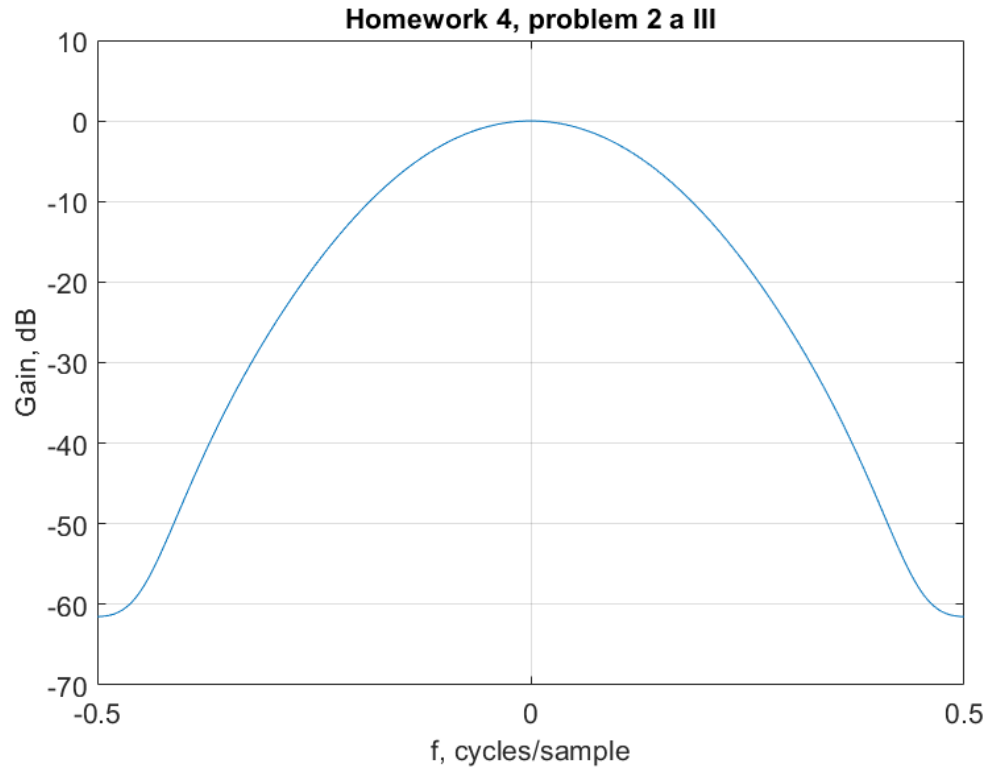
% Constants
Q = 1.3;
M = 4;
G = 0.307;
```



Problem 2 a III

```
f = linspace(-.5,.5,1001); % cycles/sample from -0.5 to 0.5
z = exp(1i .* 2 .* pi .* f); % z = e^(j2pif)
% Crude way of doing the sum from n = -4 to 4 of G*exp(-0.5*(n/
Q)^2)z^(-n)
% and converting to dB to get the Gain
H = 20.*log10(abs(G .* exp(-0.5.*(-4./Q).^2) .* z.^4 + G .*
exp(-0.5.*(-3./Q).^2) .* z.^3 + G .* exp(-0.5.*(-2./Q).^2) .* z.^2 +
G .* exp(-0.5.*(-1./Q).^2) .* z.^1 + G .* exp(-0.5.*(0./Q).^2) + G .*
exp(-0.5.*(1./Q).^2) .* z.^-1 + G .* exp(-0.5.*(2./Q).^2) .* z.^-2
+ G .* exp(-0.5.*(3./Q).^2) .* z.^-3 + G .* exp(-0.5.*(4./Q).^2) .*
z.^-4));

Fig2 = figure('Position', [200, 75, 850, 600]); % set figure size and
location
plot(f,H); % plot
grid on; % add grid
set(gca, 'fontsize', 16); % increase font size
xlabel('f, cycles/sample', 'fontsize', 16); % x label
ylabel('Gain, dB', 'fontsize', 16); % y label
title('Homework 4, problem 2 a III', 'fontsize', 16); % title
```



Problem 2 a IV

```
% Goes through the pixels and does the convolution to get y[n], which
is
% the output pixels. The convolution is the sum from k = -M to M of
% G*exp(-0.5*(k/Q)^2)*x[n-k]
total = 1;
for i = 1:1024
    for j = 1:768
        for k = -M:M
            if ((i - k) > 0) && ((i - k) < 1025)
                total = total + G .* exp(-0.5.*(k./Q).^2) * p1(j,i -
k);
            end
        end
        p2(j,i) = total;
        total = 1;
    end
end

% displays new image with blur
Fig3 = figure('Position', [200, 75, 850, 600]); % set figure size and
location
imshow(p2,[0 255]);
```

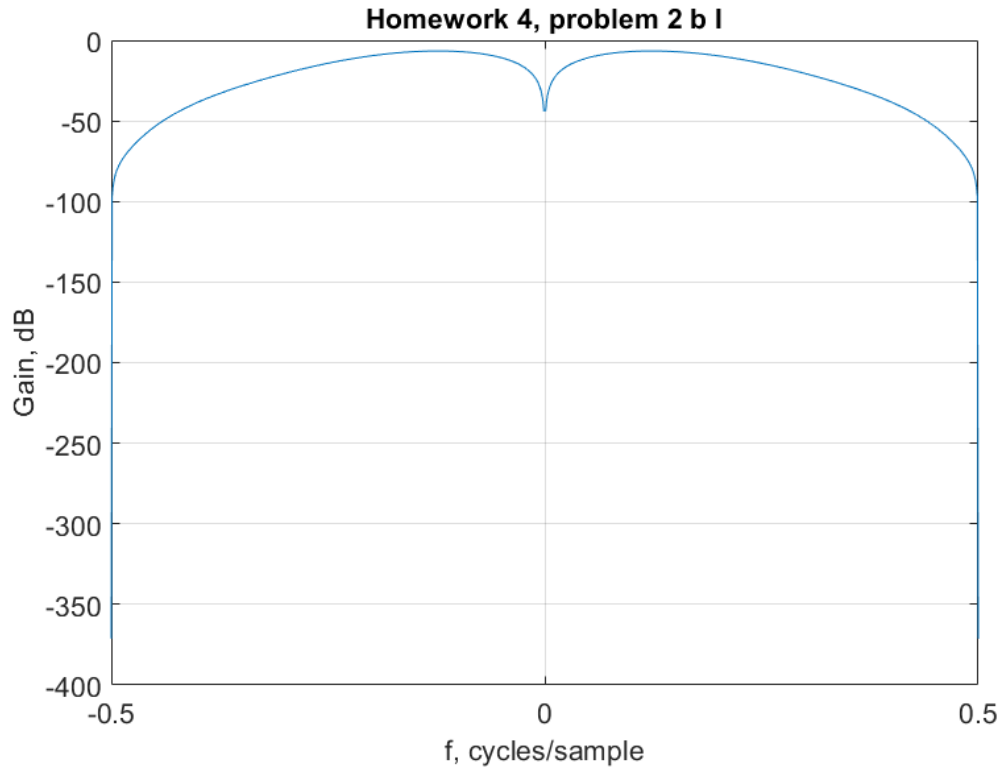


Problem 2 b I

Crude way of doing the sum from $n = -4$ to 4 of $G \cdot (n/Q^2) \cdot \exp(-0.5 \cdot (n/Q)^2) z^{(-n)}$ and converting to dB to get the Gain

```
H = 20.*log10(abs(G .* (-4./Q.^2) .* exp(-0.5.*(-4./Q).^2) .* z.^4 +  
    G .* (-3./Q.^2) .* exp(-0.5.*(-3./Q).^2) .* z.^3 + G .* (-2./Q.^2) .*  
    exp(-0.5.*(-2./Q).^2) .* z.^2 + G .* (-1./Q.^2) .* exp(-0.5.*(-1./  
Q).^2) .* z.^1 + G .* (1./Q.^2) .* exp(-0.5.*(1./Q).^2) .* z.^-1 +  
    G .* (2./Q.^2) .* exp(-0.5.*(2./Q).^2) .* z.^-2 + G .* (3./Q.^2) .*  
    exp(-0.5.*(3./Q).^2) .* z.^-3 + G .* (4./Q.^2) .* exp(-0.5.*(4./  
Q).^2) .* z.^-4));
```

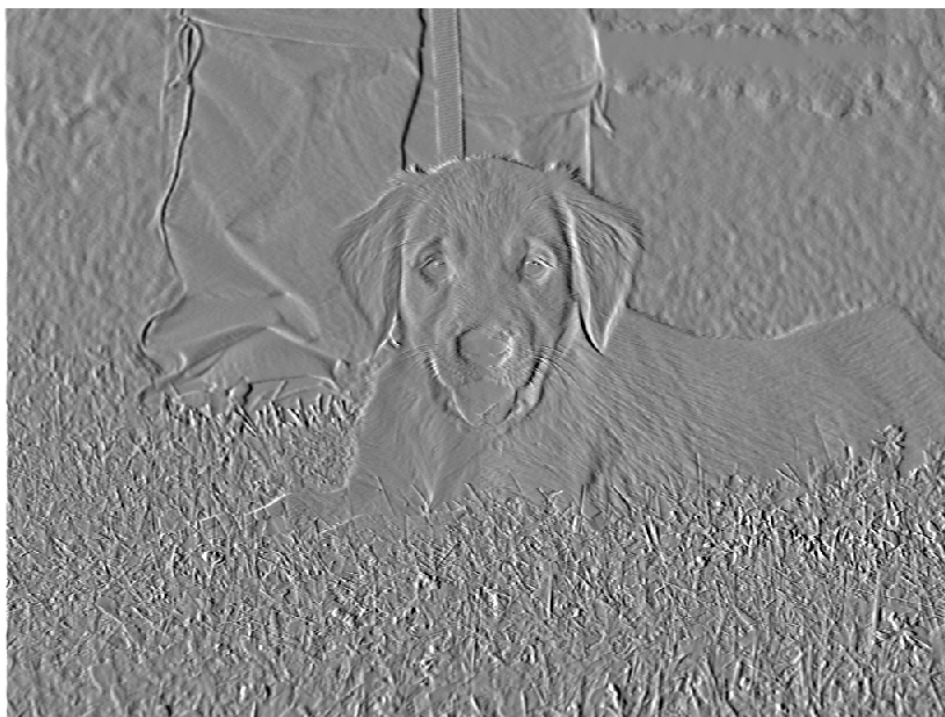
```
Fig4 = figure('Position', [200, 75, 850, 600]); % set figure size and  
    location  
plot(f,H); % plot  
grid on; % add grid  
set(gca, 'fontsize', 16); % increase font size  
xlabel('f, cycles/sample', 'fontsize', 16); % x label  
ylabel('Gain, dB', 'fontsize', 16); % y label  
title('Homework 4, problem 2 b I', 'fontsize', 16); % title
```



Problem 2 b II

```
% Goes through the pixels and does the convolution to get y[n], which
% is
% the output pixels. The convolution is the sum from k = -M to M of
% G*(n/Q^2)*exp(-0.5*(k/Q)^2)*x[n-k]
total = 1;
for i = 1:1024
    for j = 1:768
        for k = -M:M
            if ((i - k) > 0) && ((i - k) < 1025)
                total = total - G .* (k ./ Q^2) .* exp(-0.5.*(k./
Q).^2) * p1(j,i - k);
            end
        end
        p3(j,i) = total;
        total = 1;
    end
end

% displays new image with edge-detection
Fig5 = figure('Position', [200, 75, 850, 600]); % set figure size and
location
imshow(p3,[-20 20]);
```



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