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Homework 8

Solution

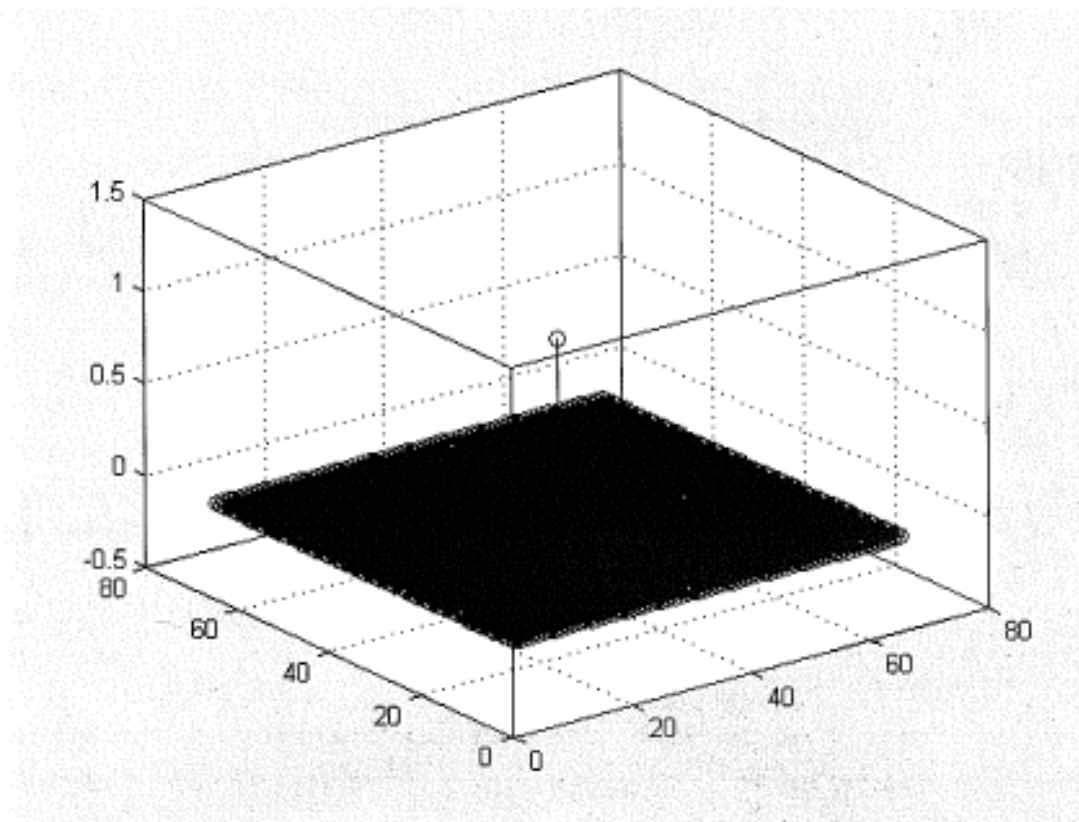
Homework 8 Problem 1

```
clear
close all
clc

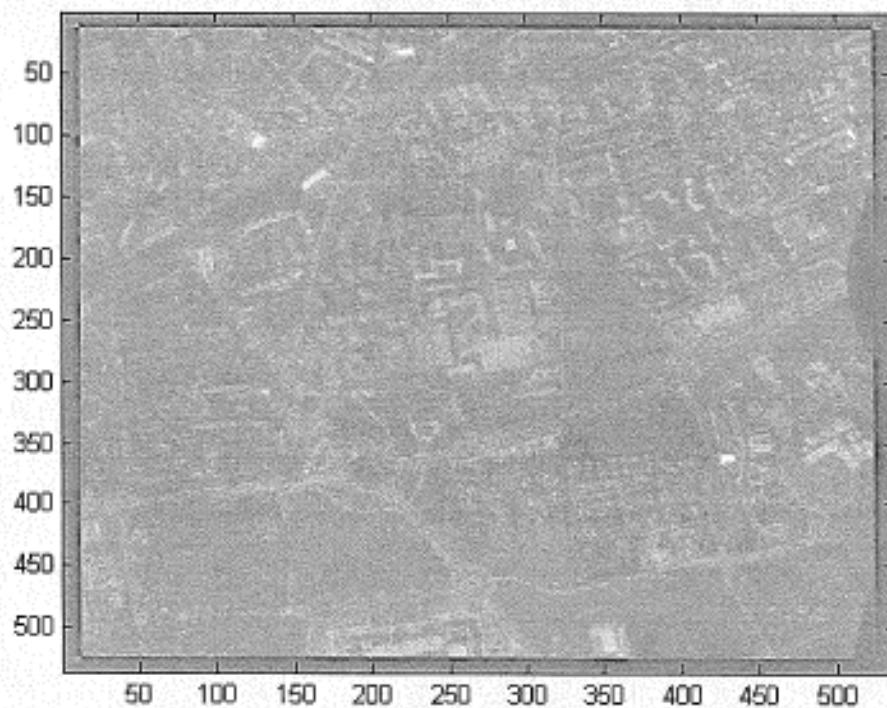
load Hmwk8.mat
```

Problem 1a)

```
stem3(conv2(invblur,blur))
%check to see that this is an impulse by looking at stem plot, or any other
%method
```

**Problem 1b)**

```
i_nimes_b = conv2(invblur,nimes_b);
figure
imagesc(i_nimes_b)
colormap(gray)
```

**Problem 1c)**

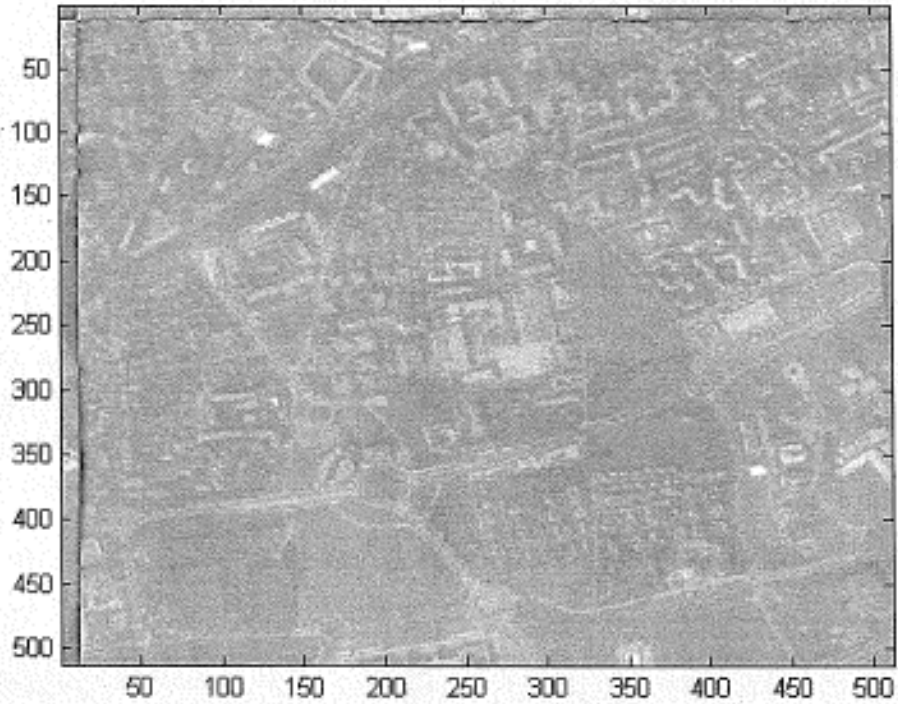
```
[n m] = size(nimes_b)
%zero pad invblur to make it same size as nimes
i_nimes_b_dft = ifft2(fft2(nimes_b).*fft2(invblur,n,m));
figure
imagesc(real(i_nimes_b_dft))
colormap(gray)
```

n =

512

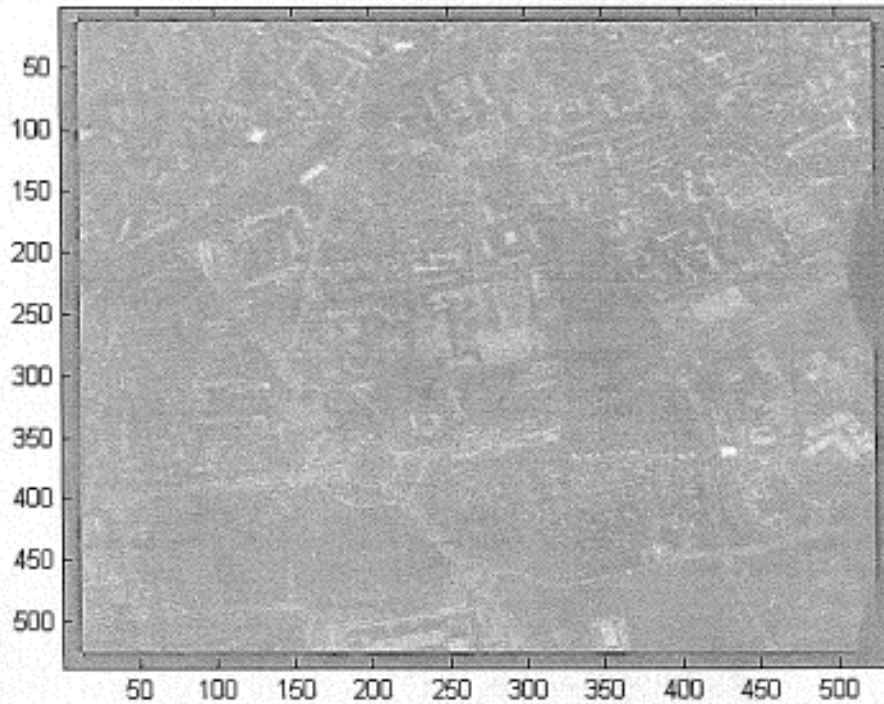
m =

512

**Problem 1d)**

We have to zero pad so that each dimension is $N+L-1$ (where N is size of nimes, L is size of filter).

```
[m1,n1] = size(nimes_b);  
[m2,n2] = size(invblur);  
  
i_nimes_b_dft = ifft2(fft2(nimes_b,m1+m2-1,n1+n2-1).*fft2(invblur,m1+m2-1,n1+n2-1));  
figure  
imagesc(real(i_nimes_b_dft))  
colormap(gray)
```

**Problem 1e)**

```

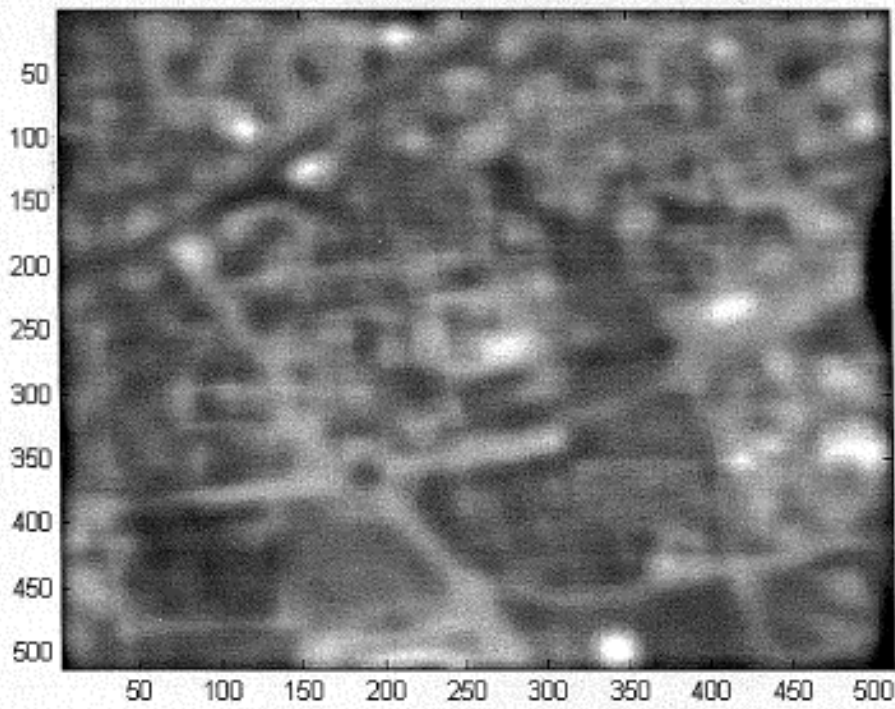
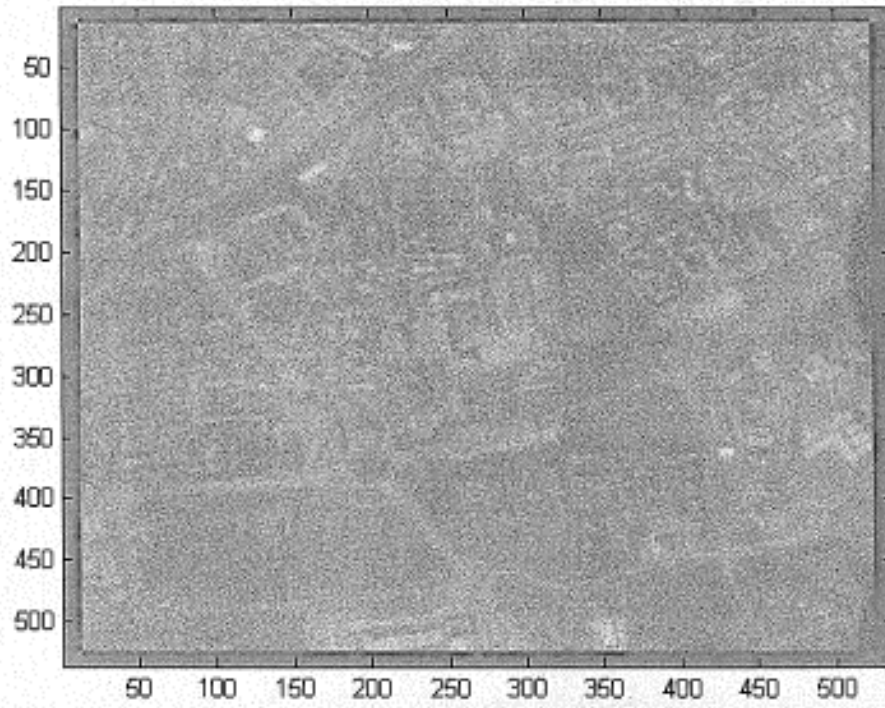
[m1,n1] = size(nimes_bn);
[m2,n2] = size(invblur);

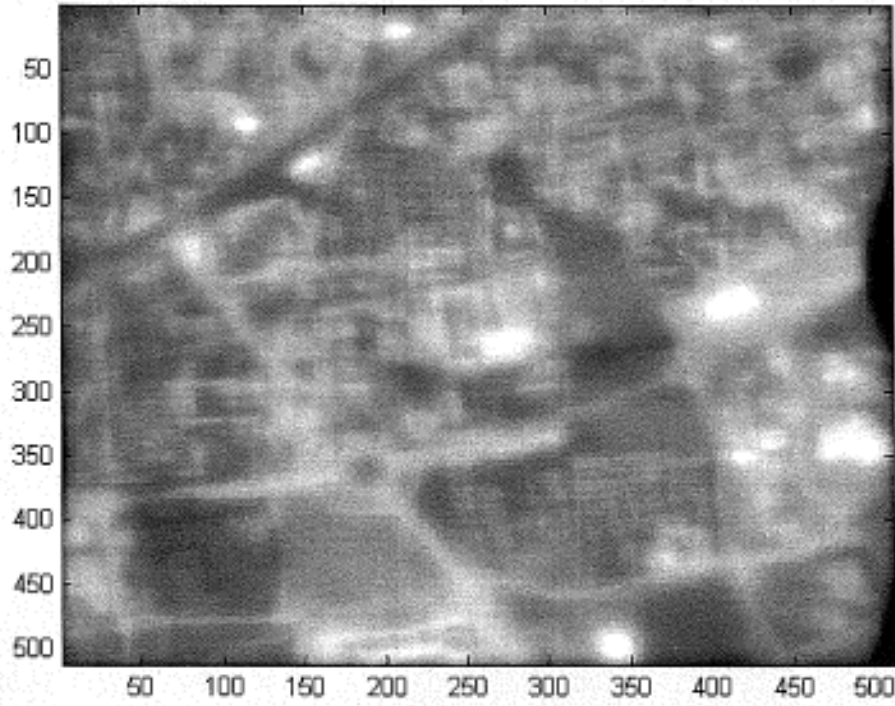
i_nimes_bn_dft = ifft2(fft2(nimes_bn,m1+m2-1,n1+n2-1).*fft2(invblur,m1+m2-1,n1+n2-1));
figure
imagesc(real(i_nimes_bn_dft))
colormap(gray)

%Do not grade second question of 1e)
%- you could do any number of things - one
%be use the deconvwnr (deconvolve using weiner filter) built-in matlab
%command

J = deconvwnr(nimes_bn, blur);
figure
imagesc(J)
colormap(gray)
figure
imagesc(nimes_bn)
colormap(gray)

```

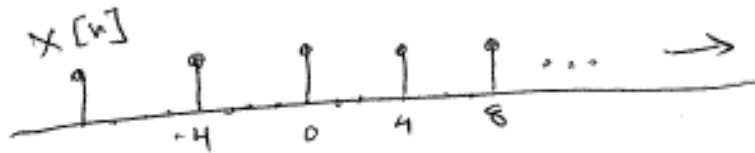




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3.25

$$a) \sum_{k=-\infty}^{\infty} \delta[n-4k]$$



$$X(z) = \sum_{n=-\infty}^{\infty} X[n] z^{-n}$$

$$= \sum_{n=-\infty}^{\infty} \sum_{k=-\infty}^{\infty} \delta[n-4k] z^{-n}$$

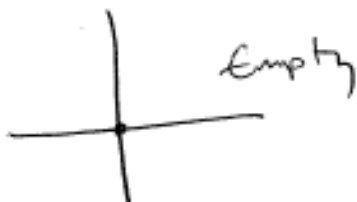
$$= \sum_{n=-\infty}^{\infty} z^{-n} \underbrace{\sum_{k=-\infty}^{\infty} \delta[n-4k]}$$

0 unless n is multiple of 4.

$$= \sum_{n=-\infty}^{\infty} z^{-4n}$$

Does NOT converge for $z \neq 0$.

ROC



3.25 b

$$\frac{1}{2} \left[e^{j\pi n} + \cos\left(\frac{\pi}{2}n\right) + \sin\left(\frac{\pi}{2} + 2\pi n\right) \right] u[n]$$

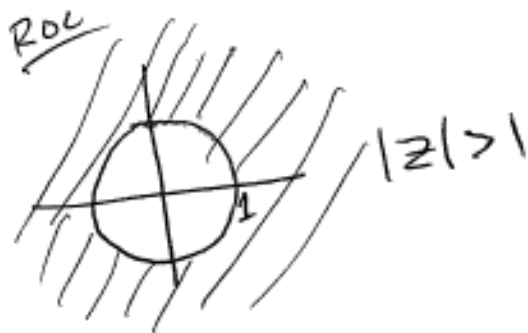
$\underbrace{\cos(-2\pi n)} = 1 \text{ all } n$

Use tables

$$X(z) = \frac{1}{2} \left[\frac{1}{1 - e^{j\pi} z^{-1}} + \frac{1 - \cos\left(\frac{\pi}{2}\right) z^{-1}}{1 - 2\cos\left(\frac{\pi}{2}\right) z^{-1} + z^{-2}} + \frac{1}{1 - z^{-1}} \right]$$

$|z| > 1 \qquad |z| > 1 \qquad |z| > 1$

$$= \frac{1}{2} \left[\frac{1}{1 + z^{-1}} + \frac{1}{1 + z^{-2}} + \frac{1}{1 - z^{-1}} \right]$$



Sketch

