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```
%Assignment 2 by Nikeet Pandit
%GS/MATH 6920 Harmonic Analysis and Image Processing

% --- Question List --- %
% 4.7a) Read in "blurry_moon" and sharpen using unsharp masking in
%       FREQUENCY DOMAIN
%
% 4.7b) Improve sharpness using highboost filtering
%
% --- Question List --- %
```

4.7 (a) and (b)

```
close all; clearvars
```

Read the image

```
Im = imread("blurry_moon.tif");
```

Determine image size and calculate padded image size

```
[M, N] = size(Im); P = M*2; Q = N*2;
```

Construct kernel (frequency domain) to be used for filtering

```
D0 = 10; %cut off frequency
H = kernel_construct(D0,P,Q,'Gaussian'); %function is uploaded to GitHub
```

Take DFT of the image with padding specified by P and Q

```
Im_DFT = fft2((Im),P,Q);
```

Filter in frequency domain and isolate real components only

```
Im_Filter = real(ifft2(H.*Im_DFT));
```

Crop Image to remove padding

```
Im_Filter = Im_Filter(1:M, 1:N);
```

Frequency Domain Unsharp Masking (a)

```
mask = double(Im) - Im_Filter;
k = 1;
G_unsharp = (1 + k*(1-H)).*Im_DFT;  %Expression in frequency domain
g_unsharp = real(ifft2(G_unsharp)); %Converting back to spatial domain
```

Frequency Domain Highboost filtering

```
k = 1.5;
G_highboost = (1 + k*(1-H)).*Im_DFT; %Expression in frequency domain
g_highboost = real(ifft2(G_highboost)); %Converting back to spatial domain
```

Plotting

```
figure(1);
subplot(2,2,1);
h = surf(fftshift(H)); title('Centred Gaussian Transfer Func');
set(h,'LineStyle','none');
subplot(2,2,2);
imshow(Im); title('Original Image');
subplot(2,2,3);
imshow(uint8(Im_Filter)); title('Blurred Image');
subplot(2,2,4);
imshow(uint8(mask)); title('Filter Mask');

figure(2);
subplot(1,2,1); imshow(uint8(g_unsharp(1:M,1:N)),[]); title('Unsharp
 Masking');
subplot(1,2,2); imshow(uint8(g_highboost(1:M,1:N)),[]); title('Highboost
 Filter');
```
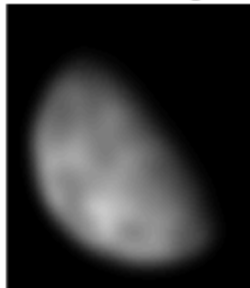
Centred Gaussian Transfer Func
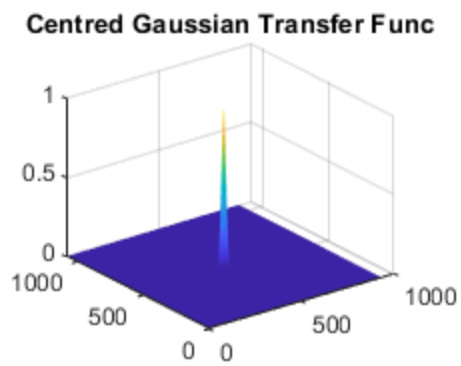
Original Image

Blurred Image

Filter Mask

Unsharp Masking

Highboost Filter

Some Commentary on 4.7

The effect and improved sharpeness is readily apprent in high-boost filtering. Clearly, both unsharp masking and high-boost filtering are sharpened with respect to the original image, where the high frequency edge components of the images are enhanced.

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