Assignment 01

Computer Vision

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Part 1

Problem Set : Implement a 3 x 3, 7 x 7, 9 x 9 (i) median and (ii) average filters. Apply each one of them to this mage and comment on the results. Also, compare the results obtained by the two filtering methods. Do not use an inbuilt filter function.

Section (i) : *Filter Size : 3*3*

Median Filter

After Applying 3*3 median Filter I got the following results

Original image

Filtered Image

In the above two images, it can be seen that the filtered image has less detail and seems like a smoother image as the median filter removes the white and black dot commonly known as salt and pepper salt.

I have Calculated the eculidian distance of the filtered image from the original image which comes out to be as `27964213 pixels.`

Averaging Filter

After Applying

Original image

Average Filtered Image

Here averaging Filter has smoothen the image.

*Section (ii) Filter Size 7*7*

Median Filter

Here is the output of applying 7*7 median filter on the image

Original Image

Filtered Image

Averaging Filter

Here is the output of applying 7*7 averaging filter

Original Image

Filtered Image

*Section (iii) : Filter Size 9*9*
Median Filter
Here is the output of applying 9*9 median filter

Original Image

Filtered Image

Averaging Filter

Here is the output of applying averaging filter of size 9*9 on the original image

Original Image

Filtered Image

Discussion :

The output of the median filter seems to remove more high frequency details i.e removing salt and pepper noise from the image while the averaging filter smoothen the image by taking the average over all the image pixel as the filter moves across the image.

As the the size of filter image increases, image gets more and more blur in the case of averaging filter and median filter starts behaving like averaging filter as the size of the filter increase which can be seen in the above images.

Part-2

Problem Statement : For this image, perform the following transformations by defining the appropriate transformation matrix.

a) Translation by 2 pixels in any direction.
b) Scaling by a factor of 2 in the x-direction.
c) Rotation by 30 degrees in the anti-clockwise direction.
d) A combination of the above three operations.

a) Translation by 2 pixels in any direction.

Following results have been obtained after applying translation by 2 pixels in x direction

Original Image

Translated Image

b) Scaling by a factor of 2 in the x-direction.

Following image has been obtained after scaling the original image by the factor of 2 in x direction

Original Image

Scaled Image

As the intermediate value has not been interpolated, image contains alternate dark pixel where no information has been obtained.

c) Rotation by 30 degrees in the anti-clockwise direction.

Following image has been obtained after applying a rotation of 30 degree anti-clockwise direction.

Original Image

Roasted Image Image

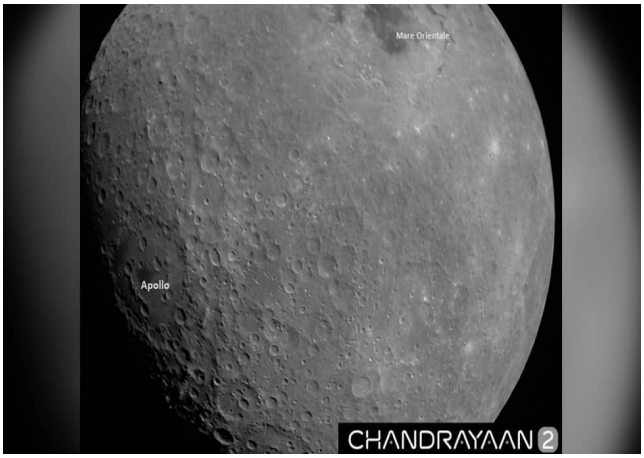
Part 3

Problem Statement : For this image, save the Laplacian image separately and add it to the input image to sharpen it. Now, compare it with the sharpening filter - as discussed in the class. Do not use the inbuilt

Laplacian Filter : I have used 3*3 laplacian filter to sharpen the image. The laplasian filter is given as following :

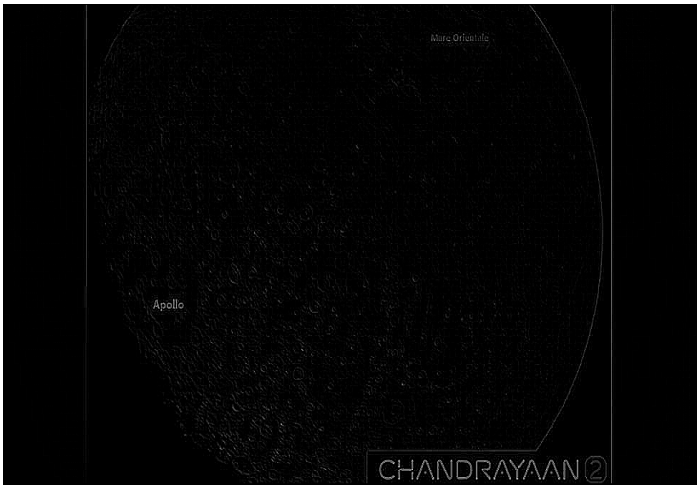
0	-1	0
-1	4	-1
0	-1	0

Results : Following Results have been produced after applying the laplacian filter on the given image.



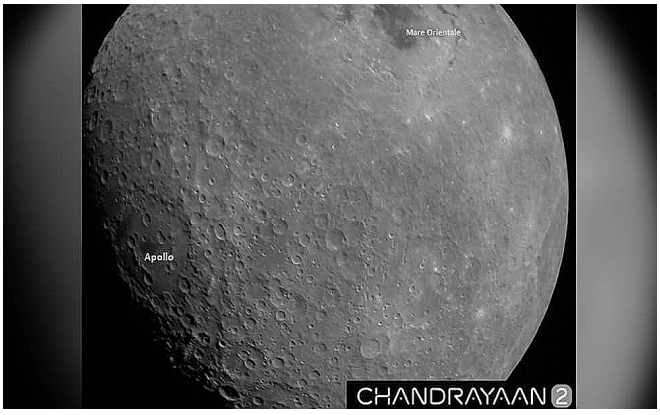
Original Image

Laplacian Output :



Laplacian Output

After adding this obtained laplacian image to the original image, we get the sharpen image as following.



Sharpened Image

There are several other sharping filter that can be used to sharpen the image, here in this assignment I have used double derivative of gaussian filter to do the same. The double derivative of gaussian filter of size 3*3 is given as

-1	2	-1
2	-4	2
-1	2	-1

Here is the output of the double derivative of gaussian filter

Filtered image

After adding this image to the original image, I got the following output

Sharpened Image

Discussion : From the above sharpened figure obtained from two different filters, it can be clearly seen that laplacian is performing better in this case than double derivative of gaussian filter which does not enhance the object details as much as the laplacian filter does.

Part 4

Problem Statement : a) Perform DWT on this image using Haar and db 9/7 (individually)
b) Perform smoothing operation on each component
c) Perform Inverse DWT and obtain the smoothed image
d) On the original image, apply Gaussian smoothing filter (you can use an inbuilt function here)

a) Perform DWT on this image using Haar and db 9/7

Haar Transformation

Haar low pass filter and high pass filter (mother wavelet) is given by the following matrix

Low Pass Filter : [0.7071067811865476 ,0.7071067811865476]

High Pass FIlter : [0.7071067811865476 , - 0.7071067811865476]

After performing haar transformation for the first label, we get the following results.

Original Image

The approximated image after the transformation is given by the following image.

Approximated Image

The other details like diagonal, horizontal and vertical details are as follows.

Horizontal Detail

Vertical Details

Diagonal Details

Reconstructed image are as follows.

Reconstructed Image using Haar Transformation

Similarly, the same can be performed for db1 transformation

Db1 Transformation
Haar low pass filter and high pass filter (mother wavelet) is given by the following matrix

Low Pass Filter : [0.7071067811865476 ,0.7071067811865476]

High Pass FIlter : [0.7071067811865476 , - 0.7071067811865476]

After performing haar transformation for the first label, we get the following results.

Approximated Image

The other details like diagonal, horizontal and vertical details are as follows.

Horizontal Detail Vertical Details Diagonal Details

Reconstructed Image using db1 Transformation

b) Perform smoothing operation on each component

I have applied averaging filter in order to smooth the component obtained from the dwt transformation.

Following are the results obtained from smoothing operation.

Smoothing operation on Haar transformation output




Approximate image Horizontal Detail Vertical Details Diagonal Details

c) Perform Inverse DWT and obtain the smoothed image

Reconstructed image after smoothing operation

d) On the original image, apply Gaussian smoothing filter (you can use an inbuilt function here)

Below are the image obtained from gaussian smoothing on the original image.

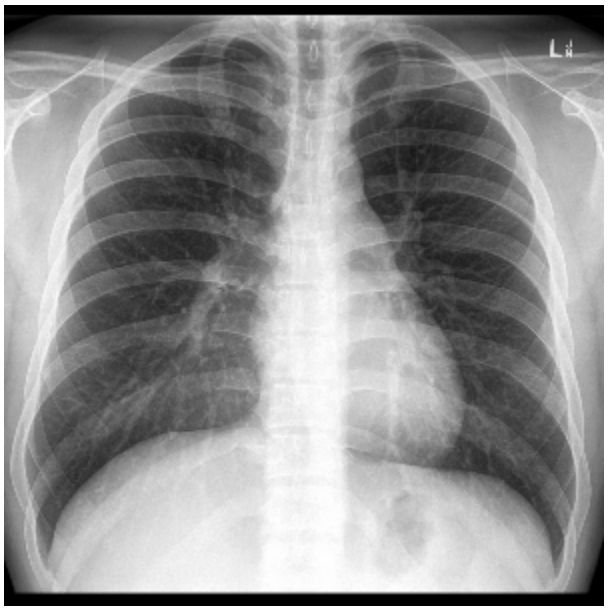
Gaussian Smoothing

Discussion : Performing smoothing operation on each component of dwt decomposition and then reconstructing the original image from the smoothen component gives more blur image than that of gaussian smoothing performed on original image.
Here averaging filter is being used in order to perform the smoothing operation

Part 5

Problem Statement : For this image, perform the invisible watermarking using any technique. Use this image as a watermark. You are allowed to use inbuilt functions.

Results : Following result has been obtained after applying the invisible watermarking.



Original Image

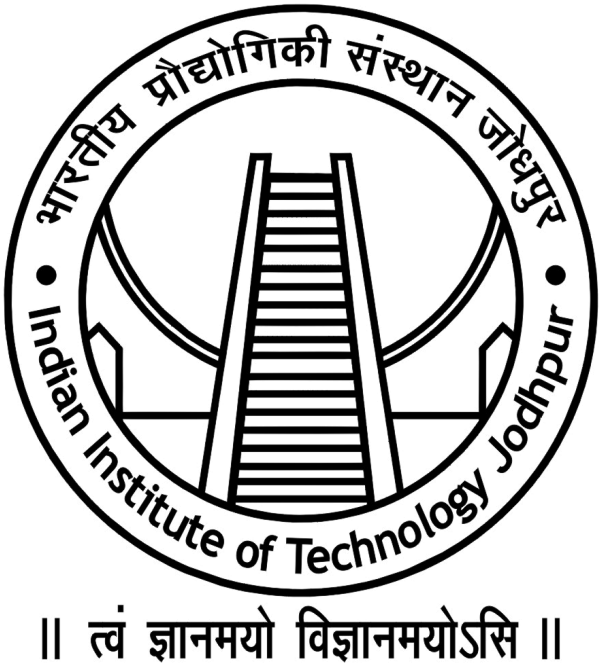
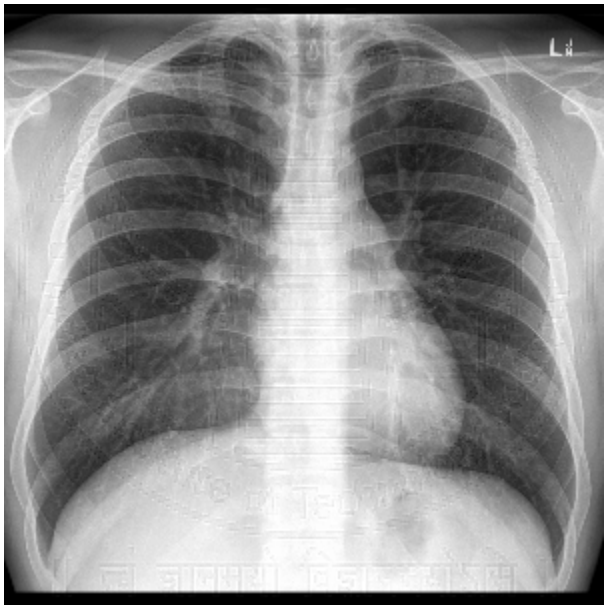


Image to be used for water marking



Final watermarked image