Digital Image Processing

Assignment 4

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1 INTRODUCTION

In this assignment we will be focusing on the application of Image processing fourier transformation techniques and exploring different image processing techniques. The concept of fourier transformation is used to change the images into frequency domain and then necessary thresholding and other techniques are used on the frequency domain, and then the domain is applied on inverse fourier transformation to bring back the image. Each image has a unique fourier transformation and each freqeuncy domain has its own corresponding image. They are unique. This helps a lot in application of image processing techniques. We explore the following filters and functions. They are:

- dft: To use discrete fourier transformation to convert an image to its magnitude domain.
- invdft: To execute discrete fourier transformation and then take its correspoinding frequency domain and then convert back the freqency domain back to its spatial domain, which is the image
- lowpass: To execute low pass filtering technique on fourier image
- highpass: To execute high pass filetering technique on fourier image.
- edge sharpening:THis function takes in the fourier transformation , then applies unsharp masking to bring in the sharpening of images. .
- Edge Smoothing: This function takes in the image and applies unsharp masking concepts to bring in the smoothening of the edges only by making changes in the fourier image or frequency domain.
- hsv filtering: This function applies all the above initiated filters on hsv images. It gives thef unctionality to apply the filters on h, s, and v channels of a hsv image.

2 COMPARISIONS PERFORMANCE

The basic functionality that is implemented is the conversion of an image in spatial domain to a fourier image in frequency domain and then convert back the fourier image back to its original image in spatial domain. Once this is implemented, we start applying the filtering techniques that are lowpass and high pass filters. Once the freqeuency domain fourier image is genereated, the points which are farther from the center are made 0 in low pass and the points which are nearer to center are made zero in high pass filters. High pass filters brings about edge detection. It starts highlighting only the edge parts where as the low pass filters helps in bringing about smoothing. So these can be considered as alternatives to edge detection and smoothing. The pro about these techniques is that they are very fast as compared to the traditional way of smoothing and edge detection. The conversion into frequency domain and back is not time consuming and the filtering of a data is also not much time consuming. Hence, when compared, these are having lower time complexity and hence better performance when high amount of filtering and data are to be involved.
We have also implemented edge sharpening using the concept of unsharp masking. So, here the main concept we follow here is the sharpened image = original + original - smoothed.
This can also be said as sharpened = original + high passed image. Hence, all this edge sharpening or high boost filtering is also applied w.r.t fourier image present in frequency domain same as the case as in high and low pass filters. Hence, the large amounts of data are processed in frequency domain thus making the amount of time taken to reduce drastically when compared to traditional methods. Hence, we can see that the performance has increased proportional to the size of data, with large amounts of data being more significant.

Filtering of color images are done w.r.t hsv channels here in this session. We have split the hsv image into 3 respective channels, and then each channel is considered seperately and the process of fourier transformation is applied. Here, we have observed fourier filtering on all the 3 channels. And we are gonna depict more in results section of the variations in results they have brought about as we applied. But as we can guess, the value filtering helps in depth and intensity, hue filtering in altering of colors and saturation in the image pixel color saturations.

3 IMAGE RESULTS

We will be observing the results of all functions described above one by one. First let's start with Fourier Transformation. In figure 1 we will see the actual image and In figure 2 we will see the fourier transformation of an roi, and in fig 3, you will see the image that has come from inverse transforming the fourier transform image in fig2.

In the Fig 4 and Fig 5 we will see the low pass and high pass filtering of the traditional baboon image with both same ROI's.

In Fig 6 and fig 7, we can see the edge sharpening and edge smoothing of the original baboon image with a similar roi as to the above images.

In Fig 9, Fig 10 we can see the lowpass and high pass filtering techniques on value channel of hsv images after converting the rgb image. We can see the effects it has by comparing it with the original image which is shown at Fig 6

In Fig 12 and Fig 13, we can see the filtering techniques of high pass filtering applied on color image with 12 on hue channel and 13 on saturation channel. We can see the result it has on the images.

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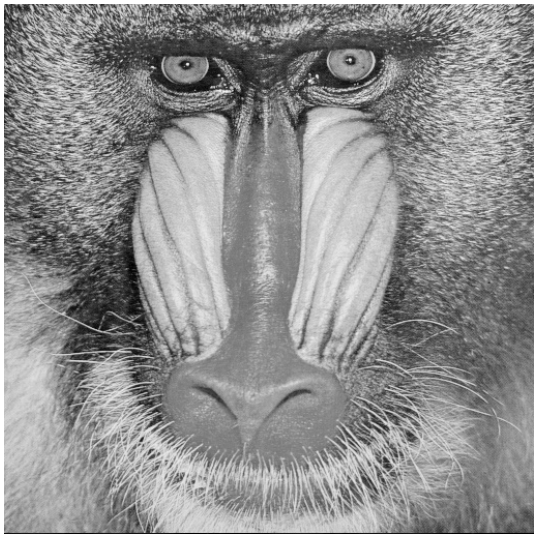

Figure 1: The Original Image.

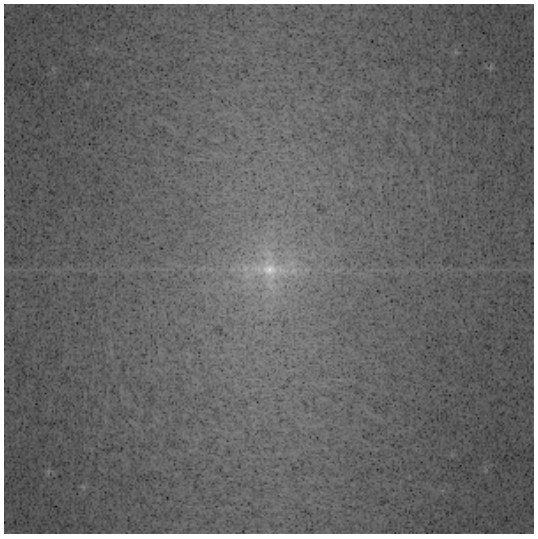

Figure 2: Fourier Image of the Baboon

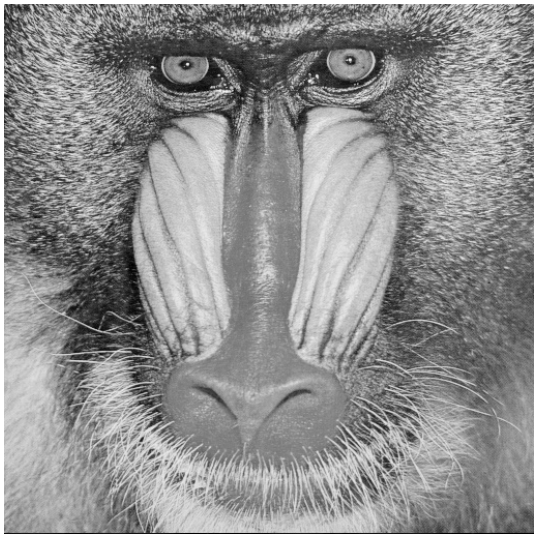

Figure 3: Inverse Transformed Image

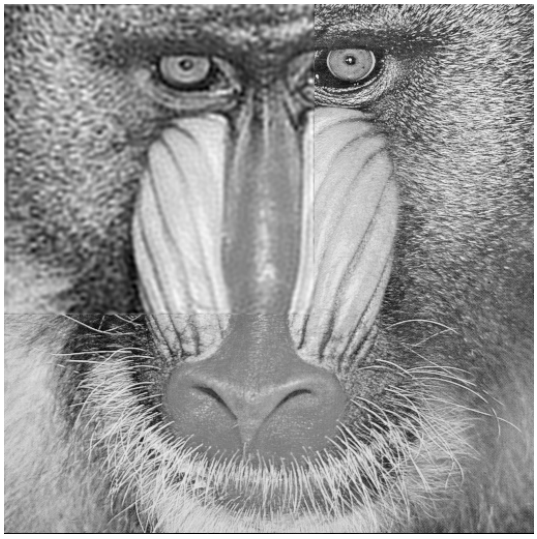

Figure 4: Low Pass Filter.

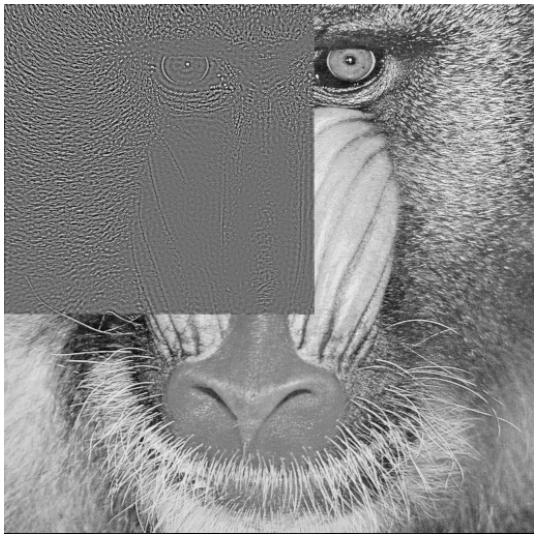

Figure 5: High Pass Filter

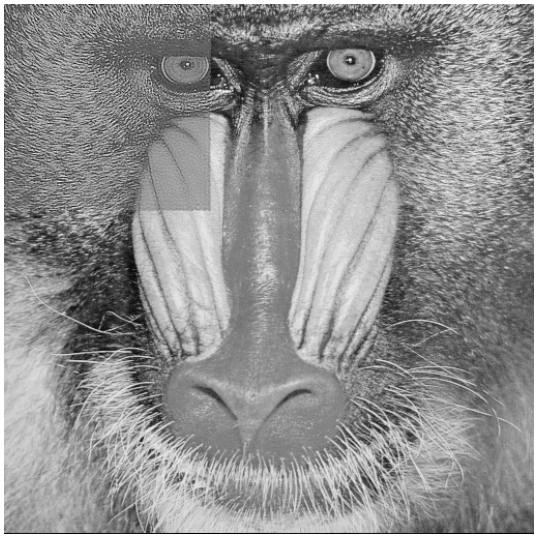

Figure 6: Edge Sharpening of the baboon image

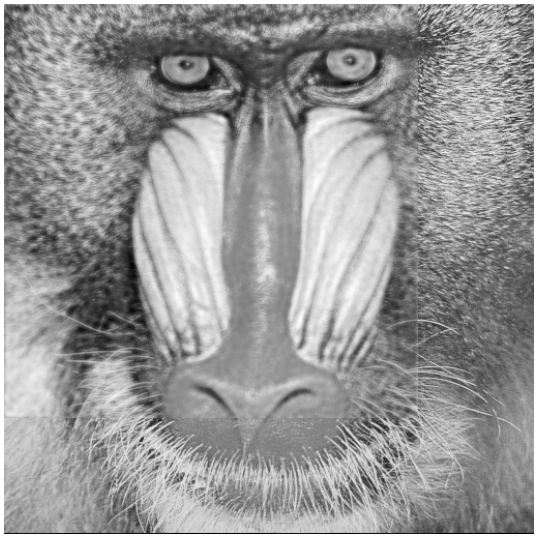

Figure 7: The Edge Smoothing using Fourier Transformation

Figure 8: The Original RGB Image

Figure 9: Low pass filter on value channel.

Figure 10: High pass filter on value channel

Figure 11: The Rgb image after applying high pass filter on hue channel

Figure 12: The Rgb image after applying high pass filter on saturation channel