CSE 573 Computer Vision and Image Processing

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Introduction

This programming assignment is divided into 2 section. One deals with Fourier Analysis of the image and other with Laplacian Pyramid. For all the questions, we took one sample of image and tested in depth.

Methodology

In the first question, we applied Fourier Transforms on a standard 256x256 image. Then we applied Fourier equation for each output pixel of the resultant image. After that we visualized the output matrix and analyzed from spatial domain to frequency domain. After we applied inverse Fourier to reconstruct back the original image and compared the mean square error.

In the second question, we applied Laplacian of pyramid on a standard 512x512 image where image is first applied with Gaussian Blurring than passed down-sampled. Along with that, we calculate the difference of the blurred and the original image which gives Laplacian at each pyramid. We repeated 5 times until we get severely small and blurred image. Then we reconstruct the image step by step and add Laplacian to each up sampled image and reconstruct the whole image giving a good MSE of 0.0176. This value is not zero due to loss of information during Gaussian blurring and then from image reconstruction.

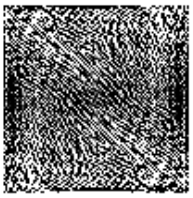
Results

The implementation is done on MATLAB 2016a. The .m file has name of the program as the question number named folder.

Original Image for Question 1

Original Image lena.png (100 x 100)

Image after Fourier Transform



Real Part of the complex matrix

Taking only the absolute value of the complex matrix and normalizing it

Image after Inverse Fourier Transform

Laplacian of Pyramid for question 2

Level 1

Original Image

Converted into grayscale

Blurred image

Level1 Laplacian

Level 2

Down-sampled (256x256)

Blurred

Level 2 Laplacian

Level 3

Down-sampled

Blurred Image

Level 3 Laplacian

Down-sampled

Blurred

Level 4 Laplacian

Down-Sampled

Blurred

Level 5 Laplacian

Up-sampling (Level 1)

Up-scaled

Laplacian

Reconstructed image

Like-wise we add their respective Gaussian to the up-scaled image to get reconstructed image

Level 2

Level 3

Level- 4

Level - 5

Conclusion

The MSE of the Laplacian is 0.1760. It is not zero because due to Gaussian blurring, most of the information was lost while reconstructing the image. However, we got as much pixels through adding Laplacian to the up-sampled image. The MSE of Fourier Transform is 0.7981.