

# BIL 415 - Image Processing Practicum



**HACETTEPE UNIVERSITY**

Department of Computer Engineering

## Problem Set 4

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**Due Date: 23:00pm on Friday, December 11th, 2015**

Your 4th assignment comprise of 2 parts. First, you will use Laplacian and Gaussian pyramids for image enhancement. Second, you will work on Frequency domain of an image corrupted by Moire pattern to eliminate it by analyzing related frequencies.

## Using Laplacian Pyramid for Image Enhancement

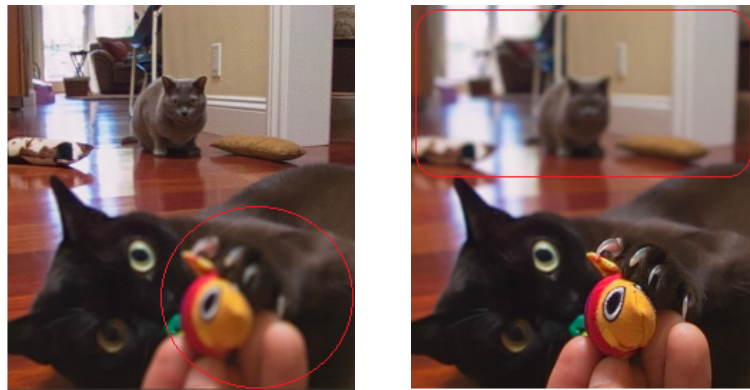


Figure 1: Images with different regions in focus



Figure 2: Multifocus image enhanced by using laplacian pyramid

Images from <http://www.ampercent.com>

## Background

Image enhancement deals with improvement of the perceptual quality of digital image that is distorted by a variety of reasons. Some of these reasons are related to camera calibration or capability. Focal length

and exposure time are some of the most important parameters for cameras. Different focal lengths cause different regions in focus, in the same way different exposure time causes different contrast and luminance on image regions. You can see an example with different regions in focus at Figure 1.

Several different approaches are proposed to enhance such images. One such approach proposed in [1] uses Laplacian Pyramid. Accordingly to this approach, same images with different regions in focus are first decomposed into their Laplacian pyramids, and then these pyramids are blended with respect to high frequency components of these images. In the last step multifocus image reconstructed from blended Laplacian pyramid. You may refer to [1] the article for the details and to understand how those processes are performed.

## Overview

The goal of this assignment is to obtain a multifocus image like in Figure 2 from the input images with different regions in focus like in Figure 1 by using their Laplacian pyramid.

## Details

For this assignment you need to obtain two images of the scene, but with different regions in focus via a digital camera. You can also share your own photos with your friends via Piazza. After you have these images, your program should compose two image by carrying out the following steps.

1. Construct two,three or more level Laplacian image pyramids (pyr1,pyr2) for two images with different regions in focus. (You can not use a toolbox or MATLAB built-in function to generate image pyramids. )
2. Define a mask M for each pyramid level i:

$$if \ abs(pyr1_i(n)) > abs(pyr2_i(n)) \ then \ M_i(n) = 1 \ else \ M_i(n) = 0$$

3. Blend two pyramid pyr1 and pyr2 by using mask M:

$$pyr_i(n) = M_i(n)pyr1_i(n) + (1 - M_i(n))pyr2_i(n)$$

4. Average the low-pass bands from the two pyramids and assign it as low-pass band of blended pyramid
5. Reconstruct multifocus image from the blended pyramid

## Moire Pattern Suppression[2]

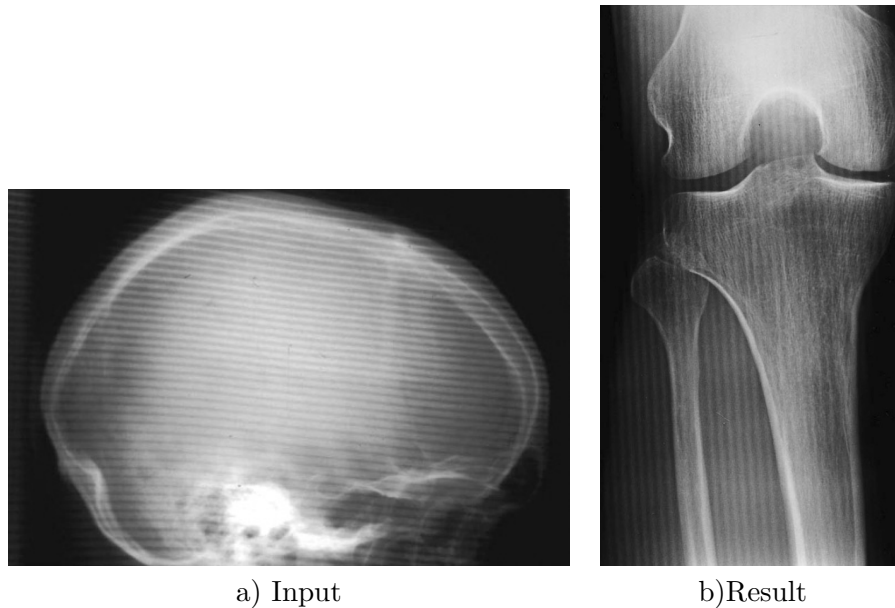


Figure 3: Images Corrupted by Moire Pattern[2]

## Background

Radiographs of tissue more than 10 cm thick are typically acquired through a Bucky grid, a fine pattern of alternating lead and plastic strips that suppresses scattered radiation and thus improves the contrast of the image. Unfortunately, when the radiograph image is sampled, Moire patterns can result. This problem studies how to reduce Moire patterns while properly preserving the salient features for diagnosis. Each of these images is corrupted by a clearly visible Moire pattern as shown in Figure 2.

## Overview

The goal of this part is to suppress Moire pattern in Frequency domain and show related frequency components.

## Details

Your program will take an image corrupted by Moire pattern and show filtered image in frequency domain. You should carry out the following steps:

- **Label Moire Pattern in Frequency Domain**

For each image, compute its Discrete Fourier Transform (DFT)(functions:fft2 and fftshift ) and submit an image showing the DFT magnitude(function:abs). A log display may be most appropriate. Clearly identify and label the frequency components that correspond to the Moire pattern. (Hint: Repetitive noise in an image is sometimes seen as a bright peak somewhere other than the origin. )

- **Design A Notch Filter To Suppress Moire Pattern**

For each image, design a notch filter so that the frequency components for the Moire pattern are suppressed as much as possible while other frequency components are preserved. Apply your notch

filter to the images DFT and submit an image showing the filtered DFT magnitude. Display the filtered image in the spatial domain.

**Notch Filter:** Notch filtering is an ad hoc procedure requiring a human expert to determine what frequencies need to be removed to clean up the signal. You can suppress such noise effectively by carefully erasing the peaks.

## What to Hand In

For submission, prepare a folder containing

- `README.txt` (*text file containing details about your project*)
- `code/` (*directory containing all your code*)
- `pset4.pdf` (*PDF report - L<sup>A</sup>T<sub>E</sub>X*)

Archive this folder as `studentid.zip` and send to `submit system`.

Your report should contain a brief overview of the problem, the details of your approach, and the results of your algorithm with your comments on at least 3 images. Show the results of all of the main steps . If your algorithm failed to give a satisfactory result on a particular image, provide a brief explanation of the reason(s).

## Notes

- You have to implement this assignment individually.
- You have 2 days for late submission (December 12th - over 80 points, December 13th- over 70 points)

## References

- [1] Pyramid methods in image processing, E. H. Adelson , C. H. Anderson , J. R. Bergen , P. J. Burt, J. M. Ogden, 1984
- [2] <https://web.stanford.edu/class/ee368/>