BIL 415 - Image Processing Practicum

HACETTEPE UNIVERSITY

Department of Computer Engineering

Due Date: 23:59pm on Monday, December 19th, 2016

Your 4th assignment consists of 2 parts. For the first part, you will use Laplacian and Gaussian pyramids for image blending. In the second part, you will work on Frequency domain of an image corrupted by Moire pattern to eliminate it by analyzing related frequencies.

1. Using Image Pyramid for Image Blending

(a) Lady with an Ermine (Image1)

(b) La belle ferronnire (Image 2)

(c) Blended Image

Figure 1: Image Blending on Leonardo da Vinci's Paintings

Background

In the image editing tools such as Adobe Photoshop, GIMP, image blending is the one of most fundamental task ans used for many purposes. For example you can prepare a poster for an advertisement or a film. The most important thing for image blending methods to blend images seamlessly. In other words for an successful image blending method, seams where images or image regions are stitched must be invisible.

There are many ways to blend two or more images. One such approach proposed in [1] Laplacian Pyramid. According to this approach, images are first decomposed into their Laplacian pyramids, and then these images are blended in pyramid levels so that seamless .

Overview

The goal of this part is to obtain blended images like in Figure 1. You will combine the images with the help of the mask that you will create using the code given to you for this assignment.

Another important point to note while performing blending is that the images must be aligned. For a better understanding, let's clarify the situation through the example: suppose you want to change the faces over the pictures above, for that both images need to contain different faces in the same positions so that your process is successful. For convenience, the provided code (imageblending_starter.m) performs alignment operation on the images. After that, the mask and the new images obtained at the alignment stage are going to use for blending.

Details

Your program will take an image as an input and a masked image region from another or same image and produce blended image. A masked image is a binary image that tells you which pixels from which image will be used to generate the final image.

Specifically, you should carry out the following steps:

1. Build Laplacian pyramids over the pictures you align

2. Build a Gaussian pyramid for each region mask

3. According to the formula given below, blend each level of pyramid using region mask from the same level

$$L_{12}^i = L_1^i.R^i + L_2^i.(1 - R^i)$$

- R^i : $RegionMask$
- L_1 : $Laplacian\ pyramid\ of\ first\ image$
- L_2 : $Laplacian\ pyramid\ of\ second\ image$

Note: To generate Gaussian, Laplacian pyramid, you can use MATLAB's function impyramid or toolbox that implements pyramids [3].

4. Collapse the pyramid to get the final blended image.

- You must show results of main steps in your report at least 5 different images with your comments

- You must analyze how number of Pyramid levels affect your results so you will obtain results for different number of Pyramid levels

- You are given a starter code to select a region for an image so that you can create image mask easily.

2. Moire Pattern Suppression

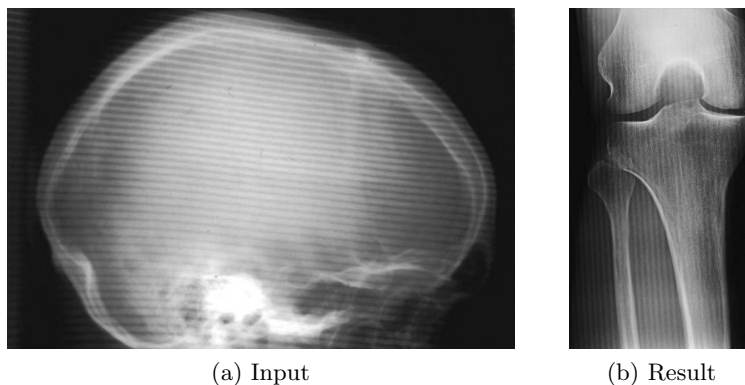(a) Input   (b) Result

Figure 2: 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.

Grading

- The assignment will be graded out of 100 : Code + Report
- The following features will be taken into account while grading:

  - Completeness - does your program implement the whole assignment?
  - Correctness - does your program provide the right output?
  - Programming style (including documentation and program organization) - is the program well designed and easy to understand?
  - Your LATEX report should contain a brief overview of the problem, the details of your approach. 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).

What to Hand In

You are required to submit all your code along with a short report. For that purpose, prepare a folder containing

- `README.txt` *(text file containing details about your code)*
- `code/` *(directory containing all your code)*
- `report.pdf/` *(a report which is prepared with LATEX)*

Archive this folder as `pset4.zip` and submit via https://submit.cs.hacettepe.edu.tr .

Policy

All work on assignments must be done individually unless stated otherwise. You are encouraged to discuss with your classmates about the given assignments, but these discussions should be carried out in an abstract way. That is, discussions related to a particular solution to a specific problem (either in actual code or in the pseudo code) will not be tolerated. In short, turning in someone elses work(from internet), in whole or in part, as your own will be considered as a violation of academic integrity. Please note that the former condition also holds for the material found on the web as everything on the web has been written by someone else.

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/

[3] https://www.mathworks.com/matlabcentral/fileexchange/30790-image-pyramid-gaussian-and-laplacian-