

BSB 663 - Image Processing

Using Laplacian Pyramid for Image Enhancement

Due Date: 19:00 on Tuesday, May 14th, 2013



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. A sample of images also provided in the course webpage. 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 use Matlab Pyramid Toolbox in [2]
2. Define a mask M for each pyramid level i:

$$\text{if } \text{abs}(\text{pyr1}_i(n)) > \text{abs}(\text{pyr2}_i(j)) \text{ then } M_i(j) = 1 \text{ else } M_i(j) = 0$$

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

$$\text{pyr}_i(j) = M_i(j)\text{pyr1}_i(j) + (1 - M_i(n))\text{pyr2}_i(j)$$

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

What to Hand In

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

- `README.txt` (*text file containing details about your assignment*)
- `code/` (*directory containing all your code*)
- `pdf/` (*directory containing all your pdf report*)
- `pdf/pa2.pdf` (*pdf report*)

Archive this folder as `pa2.zip` and submit via e-mail to `erkut@cs.hacettepe.edu.tr`

Your PDF report should contain a brief overview of the problem, the details of your approach, and the results of your algorithm on at least 3 images with your comments. 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). You should also compare and contrast the results obtained with different pyramid levels.

References

- [1] Pyramid methods in image processing, E. H. Adelson, C. H. Anderson, J. R. Bergen, P. J. Burt, J. M. Ogden, 1984
- [2] E. Simoncelli. `matpyrtools`. <http://www.cns.nyu.edu/~eero/software.php>.