MIT CSAIL

6.869 Advances in Computer Vision

Fall 2016

Problem Set 4: Laplacian Pyramid

Posted: Thursday, September 29, 2016	**Due:** Thursday, October 6, 2016
Your report should include images and plots showing your results, as well as pieces of your code that you find relevant.	

This problem uses pyramid image processing. Download and install the pyramid image processing toolbox by [2]. When forming pyramid decompositions for these problems, you may always use the default decomposition filters.

Problem 1 *Image blending*

(a) Build a Laplacian pyramid of one image and show you can reconstruct back the original image. Code for the Laplacian pyramid is available in the pyramid image processing toolbox.

(b) Implement the function `PyrBlend(im1,im2,mask)` that takes as input two images and a binary mask (determining which part to use from each image) and produces the Laplacian pyramid blend of the two images. Use your function to blend two images of your favorite pets, friends or objects. Include in your report the original images, their Laplacian pyramids, the blending mask, and the resulting blended image.

Problem 2 *Research Problem (6.869 only; optional for 6.819)*

In this question, we will explore reconstructing an image, `prob2.jpg`, without the information contained within the low-pass residual. For each part, submit your images, results, and code.

(a) Repeat 1a except this time, simply omit the low-pass residual. Measure and report the reconstruction error as the sum of squared differences. Describe the perceptual differences between the original and reconstructed images. Include in your analysis the 2D Fourier transforms of the original and reconstructed images with an explanation in terms of the frequency content of the images.

(b) Experiment with varying the number of layers in your Laplacian pyramid. How does does number of layers affect the reconstruction error and visual similarity? Again, include in your response an explanation in terms of the frequency representation of the operations performed.

(c) Now, using the same number of layers as you used in 1a, explore at least one other method of reconstruction using a fixed amount of information. For instance, you might try one of the following suggestions or something of your own design.

- changing the bandwidth of your Laplacian filters
- using a steerable pyramid instead of a Laplacian pyramid
- performing super-resolution using a Markov Random Field [1] or a neural network

As before, report your reconstruction error and describe the perceptual similarity. Additionally, include your reconstruction and its Fourier transform. Venture to explain why your method produces the results it does.

References

[1] William T. Freeman and Ce Liu. Markov Random Fields for Super-Resolution. `https://people.csail.mit.edu/billf/project%20pages/sresCode/Markov%20Random%20Fields%20for%20Super-Resolution.html`.

[2] Eero Simoncelli. matlabPyrTools. `http://www.cns.nyu.edu/~eero/software.php`.