CMSC733: Homework 0 - Alohomora!

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I. Phase 1

A. Filter Banks - Oriented DoG

I started by defining a 7x7 image matrix and filled it with values defining the standard Gaussian equation

$$e^{-(x^2+y^2)/(2\sigma^2)}$$

x and y values are the pixel coordinates. I chose 2 σ values for 2 scales - 1 and 2.

To obtain the Derivative of Gaussians (DoG), I convolved the above gaussian image with a Sobel filter i.e a vertical derivative approximation matrix of 3x3.

Next is to obtain the orientations. Since 16 orientations are needed, define the rotations and rotate the DoG images. The result is shown below:

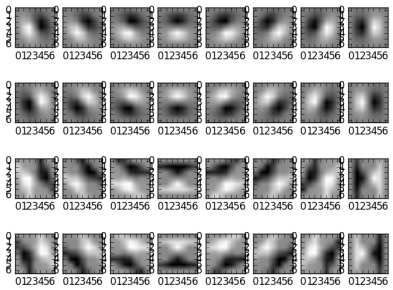

Fig. 1. DoG filter bank

B. Filter Banks - Leung-Malik Filters

The LM filters require 3 scales i.e 3 gaussians to be used. Also $\sigma_y = 3\sigma_x$. σ_x values to be taken are $1, \sqrt{2}, 2$. I started by defining 3 empty image matrices and filled them with gaussian values with the following equation:

$$e^{-(x^2)/(2\sigma_x^2)-(y^2)/(2\sigma_y^2)}$$

After filling up the image matrix values, first and second order derivatives need to be obtained. I obtained this by convolving the 3 image matrices with sobel filter i.e a horizontal derivative approximation matrix of 3x3.

One time convolution gives first derivative. To obtain the second derivative, I convolve the first derivative image again with the sobel filter.

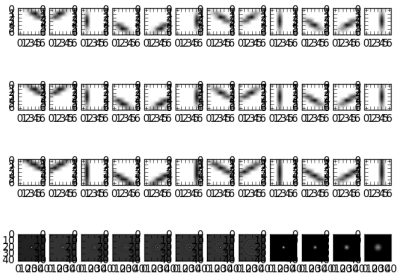

Fig. 2. DoG filter bank

There are 6 orientations for each of the 6 images i.e 3 first derivative images and 3 second derivative images. I define the orientations and wrap the 6 images with 6 orientations for each image. This results in 26 images of the filter bank.

Next, for the laplacian of gaussian, I create 8 gaussian images of size 41*41 with σ values $1, \sqrt{2}, 2, 2\sqrt{2}$ and thrice the first 4 values. The images are filled with the equation:

$$e^{-(x^2+y^2)/(2\sigma^2)}$$

Once I have the gaussian images, to obtain the laplacian of gaussian (LOG) filter, I convolve the images with a laplacian filter of size 3*3. This results in 8 LOG filter images. The rest four images in the filter bank are regular gaussians at four basic scales. The result is shown in Fig 2.