Homework Assignment 3
Due Wednesday, October 7, 2015

Notes: Please email me your solutions for these problems (in order) as a single Word or PDF document. If you do a problem on paper by hand, please scan it in and paste it into the document (although I would prefer it typed!).

1. (25 pts) The file “eye-hand.png” from the course website is an image of a robot arm, with a certain amount of periodic noise. The noise looks like a pattern of close lines running diagonally from bottom left to top right. The closeup subimage below, taken from the center of the image, shows the pattern. Using the method of notch filtering, remove this noise. Show (a) the Matlab code, (b) the mask you used, and (c) the resulting image (also please show a subimage from the result, like the one below).

2. (25 pts) You are given the binary image A and the structuring element B below (assume the origin of B is its center).

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This image is from Klaus Hansen of DIKU.
(a) Label (by hand) the 4-connected components, for foreground (1) pixels.
(b) Compute (by hand) the morphological opening of A with B.
(c) Demonstrate using this example that dilation and erosion are duals of each other; i.e.;
\[(A \ominus B)'O = A'O \oplus B\]

3. (25 pts) On the course web site is an image\(^2\) of zirconia/silica particles called “Particles.jpg”. Using morphological operations, determine as accurately as possible how many distinct particles are in this image (the result won’t be exact). On the original image, mark the center of each detected particle (for example, using Matlab’s “rectangle” function). Give the program, images, and the resulting count.

4. (25 pts) Apply the Matlab Canny edge detector to the image below, which can be found at the website [http://people.csail.mit.edu/bkph/pictures](http://people.csail.mit.edu/bkph/pictures). Adjust the algorithm parameters (i.e., thresholds and sigma) to try to get the best results, in terms of finding the edges of the blocks, and no other edges. (When the field of computer vision began in the 1960’s, people thought that extracting edges and lines from real images like this would be easy, but it has proven surprisingly hard!)
   a. Give the best result you can achieve and report the algorithm parameters used. Comment on where edges are missed, or false edges are found.
   b. Find another real (i.e., not synthetic or computer-generated) image containing objects that you think might give better results, and repeat the steps in part (a). I suggest finding something on [www.flickr.com](http://www.flickr.com).

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