Computational Vision - Assessed Assignment

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1. Instructions

You are to work in pairs for this assessment, and produce one report. You will have to complete a form when you hand in your report that assesses the relative contribution of each partner which can be found here:

www.cs.bham.ac.uk/~dehghanh/vision_files/assessment/Project%20Assessment%20Handout.pdf

The report must be **no more than three pages long** including graphs and tables. The report should be submitted via School of Computer Science Reception by 12 noon on the 11th December 2015.

The work will involve some implementation and some experimentation, plus the write up.

2. Assignment: Cell Detection

2.1 Background

Serological testing for anti-nuclear antibodies (ANAs) plays an integral role in diagnosing a plethora of autoimmune diseases. ANAs are detected by indirect immunofluoresence (IIF) on HEp-2 cells, a human epithelial cell line originally derived from a larynx carcinoma. In brief, patient serum (containing ANAs) is incubated on HEp-2 cells and detected with a commercially produced fluorescein conjugated anti-human secondary antibody. When viewed under a fluorescent microscope, the distinct patterns - a result of the ANAs targeting the nuclear components of HEp-2 cells - can then be associated with a specific disease.

A semi-quantitative evaluation of fluorescent intensity can be obtained by conducting serial dilutions of the serum sample to endpoint (the final antibody titre where positive staining is still visible). However, this methodology is still reliant on subjective interpretation and therefore prone to both high inter- and intra-laboratory variance. As such, standardization of ANA testing by IIF remains a significant issue.

2.2. Task

You will find THREE images of fluorescing cells in http://cs.bham.ac.uk/~dehghanh/vision_files/assessment/cells.zip

together with manually detected edges. Now I want you to devise, carry out and test the efficacy of the various edge detectors we have seen. These are: simple gradient, Roberts, Sobel, first order Gaussian, Laplacian and Laplacian of Gaussian. To test the accuracy of an edge detector you will need to threshold the results to produce a binary image. You will then need to measure the edge points you have detected, against those in a labelled image. How can you measure how accurate an edge detector is? To do this you will need to do what is called ROC (Receiver Operator Characteristic Analysis). As shown in your Lectures, ROC analysis allows you to produce two numbers telling you how sensitive and specific each edge detector is. As part of this you will have to implement a routine that compares your edge image to the labeled edge image, and calculates the matches, the non-matches and the type of each.

Write an experimental report of three pages detailing the experiments you have carried out. Make sure that you include the Aim, Method, Results and Conclusions. You should be able to draw a limited conclusion about which detector or detectors are best for the images you have chosen from the database.

3. Notes

Remember, credit will be given where there is detail and reasoning. If you use any edge detection filters NOT used in class, you need to outline its implementation.

Although I have made quite detailed suggestions about how to analyse each technique you are free to do your own investigations and report them. You will obtain significant credit for doing this if your investigations are interesting and well reported. You will also gain considerable credit for extending the techniques in other ways.