CPS 843 (CP 8307) Problem Set 2

(25 points)

Purpose

- Familiar with programming for image processing
- Understand the principle of edge detection and image enhancement

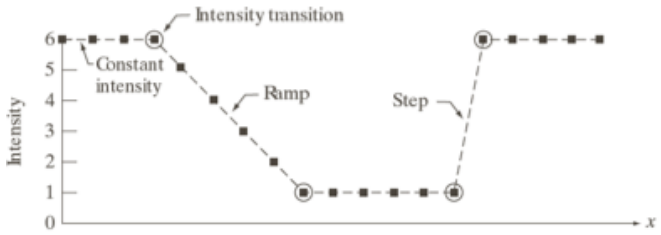
Requirements

- The assignment is due on Monday, October 25th @ 11:59 pm. Late submissions will not be accepted.
- Submit all your work in one PDF file through D2L, including the source code (multiple submission is allowed, but only the last submission will be kept and evaluated).
- Highly recommend using IEEE double-column format. The Word and LaTeX template can be found at http://www.ieee.org/conferences_events/conferences/publishing/templates.html
- Please resize all images properly in line with the text of your report.
- Submit the source code, if any, along with the report of each part in one PDF file.
- You can directly use available functions or software packages of Matlab in your work.
- Complete the report by yourself. We will use Turnitin® for similarity check.

Part 1:

Problem 1. Write down the masks for Robert, Prewitt, and Sobel edge detectors. Then, take or download an image and perform edge detection using these three edge detectors, respectively. Show your results and make a reasonable analysis of your results. (4 pts)

Problem 2. Given a 1D image $f(x)$, write down the 1st order and 2nd order derivatives of the function $f(x)$. Then, compute the 1st order and 2nd order derivatives of the following image (use zero-padding if necessary). (4 pts)



Problem 3. Write down the image sharpening process based on unsharp masking and high-boost filtering. Take or download an image, and sharpen the image based on the high-boost filtering (choose k=1 and k=5). Show your results and make some reasonable analysis. (4 pts)

Problem 4. Take or download an image and convert it to a grayscale image. Add Gaussian noise to the image, then, use the average filter and Gaussian filter to remove the noise. Choose two different noise levels and select proper filter sizes to achieve reasonable performance. Show and analyze your results. (4 pts)

Problem 5. (1) Write down the equations of 1st-order derivative $\frac{\partial f(x,y)}{\partial x}$ and $\frac{\partial f(x,y)}{\partial y}$ and the Laplacian of a 2D image $f(x, y)$. (2) Compute the 1st derivative of the following 3-bit image directly using the equations of (1). (3) Compute the Laplacian of the following 3-bit image using the given Laplacian mask. (4) normalize the Laplacian result. (Use zero-padding if needed, do the problem manually and show necessary steps) (5 pts)

0	1	0
1	−4	1
0	1	0

0	2	5	7
2	5	7	3
5	6	3	1
5	2	1	0

Part 2: (4 pts)

Software:
Matlab example for low-light image enhancement
https://www.mathworks.com/help/images/low-light-image-enhancement.html

Work to do:
- Have a careful read and try to understand the basic idea of the paper "Fast efficient algorithm for enhancement of low lighting video," which can be accessed on D2L under the "Assignments" folder.
- Download or take two low-light images and resize them if necessary.
- Follow the steps as instructed in the example to enhance the two images you have using different approaches.
- The steps include (1) Enhance Low Light Image using Dehazing Algorithm; (2) Improve Results Further Using imreducehaze Optional Parameters; (3) Another Example of Improving Poorly Lit Image; (4) Reduce Color Distortion by Using Different Color Space; (5) Improve Results Using Denoising; (6) Estimate Illumination Map.

Report:
- A brief technical description of the image enhancement algorithm (in about a half page).
- A description of each step, the source code, and the corresponding results.
- A brief analysis of your results.

Part 3: (no credit)

What is the tentative topic of your final project?