



Principles and Applications of Digital Image Processing

【Fall, 2022】

Homework 3

Part 1: (25%)

Solve the problems 3.22, 3.28, 3.44, 4.3, 4.51 in the textbook.

Part 2: (25%)

Design a computer program for **spatial filtering operations using various types of masks**. Test your program with several images and report your results. Discuss **the effect of mask size** on the processed images and the **computation time**.

You should design a mask operation function that is flexible for adjusting mask size and setting coefficients in the mask.

Part 3: (25%)

The Marr-Hildreth edge detection method operates by convolving the image with the Laplacian of Gaussian operators. Laplacian of Gaussian (LoG) is a second derivative of a Gaussian filter. The LoG can be broken up into two steps. First, smooth the image with a Gaussian filter, and second, convolve the image with a Laplacian mask. Read the Section 10.2 of our textbook for a detailed theory and procedure of this edge detection method.

Implement a computer program for **edge detection** using the **Marr-Hildreth edge detector**. Test your program with at least 4 images and **compare the results with those processed with the Sobel operator**. Sample images are provided in the NTU COOL course website. To locate the edges of the images processed with the Marr-Hildreth detector, you will need to further process the images with the zero-crossing detector as described in the textbook.

Discuss the effect of zero-crossing threshold on the Marr-Hildreth edge detection method.

Part 4: (25%)

Implement a computer program following the local enhancement method described in Example 3.10 of the textbook. You need to complete the following task with your program:

1. Reproduce the enhanced image of Figure 3.27b using the original image provided (image 4-1.jpg).
2. Process the original images (image 4-1.jpg, image 4-2.jpg) with the local enhancement method and compare the results with the processed images using histogram equalization method.
3. **Discuss** the effect of neighborhood region **size**, S_{xy} , on the local enhancement image processing results.



Notes:

1. Please submit your programs and report to the AUTOLAB course website before **Oct. 19 (2:20PM)**.
2. Late submission will have a penalty of 10% discount per day of your homework total score toward a maximum of 50% discount. No late submission over five days will be accepted.