CSE 803: Homework Set #2 Fall 2019

due Friday, Sep 27th 11:59pm

This work is to be done individually. Please read the syllabus information regarding academic integrity and late policy. Submit your homework to d2l.msu.edu. Submit your report (in PDF format ONLY) and program in one file (zip or rar).

Objective

The objective of this homework is to gain experience with 2D object extraction from an image that can be thresholded into a binary image. A secondary objective is for the student to become familiar with working with image files and simple programs that process them. Before handing in your work, re-read these specs to make sure that your tests are done on the required images.

Problem 1 (70pt)

Write a connected components extraction program (or function) to perform the operations listed below. Some resources are discussed further below. You may obtain an existing image class or code for storing and operating on an image, but you must code your own components and feature extraction operations.

1. The program should read one input image file as described in Ch 2 (Fig. 2.12). You may assume that no image will be larger than 512 x 512.
2. The program should threshold the input image into background (0) and objects (1). You may find an appropriate threshold by trial and error using your own program, or by using an image tool (gimp, etc.); it is not necessary to do thresholding automatically.
3. The program should detect and summarize each separate object (blob) by giving its (a) area, (b) centroid, (c) three second moments (rr; cc; rc), (d) and min inertia and max inertia about an axis through the centroid. Clean output should be produced for the report as well as some discussion about why it is correct or interesting. Make sure you discuss/sketch which image coordinate system is being used.
4. Report the results for the images hw2-2B and hw2-3A and for one image of your own choosing.

5. Compute the circularity of the any three blobs of your choice among all the above images, according to formula 3.12 of the text.

6. Compute the circumference of any two blobs of your choice among all of the above images. Please use morphlogical operators to estimate the boundary pixels and then compute the circumference.

Problem 2 (30pt)

Match up two blobs from image 2B to similar objects in image 2A. Compute the rotation and translation that maps the coordinates of the centroids in image 2B to the corresponding centroids in image 2A. You can find an example of how to do this at the bottom of page 335 of the text. (You may do this by hand, calculator, or tiny program.) Then, map all of the centroids for regions that have correspondences and note the error for each (difference between the extracted centroid in image A and the result of mapping the centroid from image B). For error, use Euclidean distance in the R-C-plane (pixel units). Discuss the results.

Resources

Students may use the following resources.

1. Students may use any of the C++ code referenced from the course web pages, but should not search for code anywhere else, except that an image class may be obtained. Those using MATLAB should not use the image processing library, but can use MATLAB image I/O. Cite your acquisitions.

2. Students may use image tools to change the format of the test images supplied, including the thresholding operation, (but not connected components (coloring)).

Notes

1. Program code or tools used that are developed by others should be documented. This is not a programming project; the objective is not to produce a beautiful program, but rather to learn to use an algorithm and to get correct results. But, you may use this code again in a future homework, so take care not to put it together too badly.

2. Your report must show the use of the program, the results, and some discussion of the results. Review the report format given in the syllabus.

3. Partial credit will be given for partial completion of the tasks.

4. Intermediate output beyond the requirements is allowed/encouraged, but please do not submit verbose output in your report.