Assignment 03 on Fitting

Sampath Perera

March 25, 2023

Your task is to use image processing techniques to estimate the slope of a building's roof, represented by angle θ. The image of the building is provided in Fig. 1a, with the roof slope marked in Fig. 1b. To simplify the processing, a cropped section of the image (Fig. 1c) is utilized to estimate the roof angle θ.

(a) Image of the building. (b) Image of the building. (c) Cropped segment of the image

Figure 1: Images of the building.

1. To begin, apply the Canny edge detector algorithm to the image provided in Fig. 1c. This can be done using the "cv.Canny(img, minVal, maxVal)" function available in the OpenCV toolbox. For this particular task, set the values of minVal and maxVal to 350 and 390, respectively. More information about the OpenCV canny edge detector function can be found in https://docs.opencv.org/4.x/da/d22/tutorial_py_canny.html. Using the "imshow" function from the matplotlib library, plot both the original image and the edge image that displays the extracted edges. You may get an image similar to the Fig. 2

2. We will now use the coordinates of the extracted edges to estimate the slope of the roof.

   (a) Step 1: Assign the extracted features positions to x and y coordinates, which can be done using the following code:.

```
edges = cv.Canny(img,350,390)
indices = np.where(edges != [0])
x=indices[1]
y=-indices[0]
```

3. Plot the x and y in a scatter plot.

4. Use all the points (x, y) to find the least-squares-fit line and show the line graphically in the a scatter plot with x and y points.

5. What is the estimated value of the roof angle based on the least-squares-fit? It's important to note that for a line with the equation $y = mx + c$, the angle can be calculated using the following "np.arctan(m)*180/π".

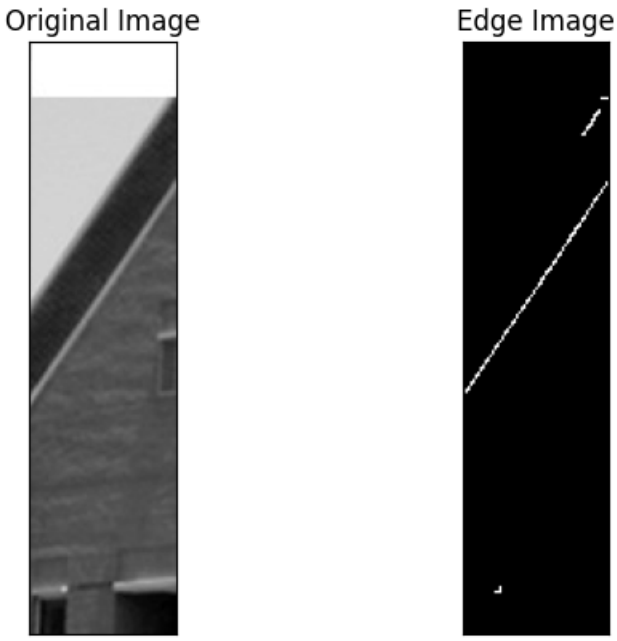

Figure 2: Sample output of Canny edge detector.

6. Do you think the estimation is correct? if not explain reason for this error.
7. Use all the points (x, y) to find the total least-squares-fit line and show the line graphically in the a scatter plot with x and y points.
8. What is the estimated value of the roof angle based on the total least-squares-fit?
9. Do you think the estimation is correct? if not explain reason for this error.
10. Propose a better algorithm than the least-squares-fit and total least-squares-fit for this scenario.
11. Estimate the line using your proposed algorithm and show the line graphically in the a scatter plot with x and y points.
12. What is the estimated value of the roof angle based on the your proposed algorithm?
13. Explain, why your proposed approach is performing better than the least-squares-fit and total least-squares-fit.

GitHub Profile
You must include the link to your GitHub (or some other SVN) profile, so that I can see that you have worked on this assignment over a reasonable duration. Therefore, make commits regularly. However, I will use only the pdf for grading to save time.

Submission
Upload a report (eight pages or less) named as your_index_a03.pdf. Include the index number and the name within the pdf as well. The report must include important parts of code, image results, and comparison of results. The interpretation of results and the discussion are important in the report. Extra-page penalty is 2 marks per page.