Answers to questions in

Lab 2: Edge detection & Hough transform

Name: \_\_\_\_\_Hugo Norberg\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Program: \_\_TIEMM1\_\_\_\_\_

**Instructions**: Complete the lab according to the instructions in the notes and respond to the questions stated below. Keep the answers short and focus on what is essential. Illustrate with figures only when explicitly requested.

Good luck!

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 1**: What do you expect the results to look like and why? Compare the size of *dxtools* with the size of *tools*. Why are these sizes different?

Answers:

The image with the edges marked. The size is 2 pixels smaller in each direction, this is because the 3\*3 kernel is convoluted in a way that it is always inside the picture and an out put will only be yielded in the middle of the matrix thus at the edge of the whole image on pixel will disappear.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 2**: Is it easy to find a threshold that results in thin edges? Explain why or why not!

Answers:

It is a balance to find a threshold that is optimal, there can be a clear edge with a human eye but a small difference in shade compared to the background making the magnitude small. With a larger threshold such an edge could be lost. On the other hand, we would like to have a higher threshold to remove noise edges.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 3**: Does smoothing the image help to find edges?

Answers:

Smoothing removes noise which allows us to avoid detecting “false edges” and making other edges smoother/less irregular.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 4**: What can you observe? Provide explanation based on the generated images.

Answers:

For small scales we see a lot of noisy edges and for large scales we only see a squiggly shape of a house. This is because a small scale does little smoothing to the picture and the second derivate between pixels can be zero on surfaces that are not edges. When smoothing increases this disappears as higher frequencies are filtered. The downside is that it can remove the sharpness of dominant edges and blur out edges we want to detect.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 5**: Assemble the results of the experiment above into an illustrative collage with the *subplot* command. Which are your observations and conclusions?

Answers: We see edges of the objects along side noisy dots and lines depending on the scale.

We can kind of see the peaks and valley of the derivative, especially for higher scales. This gives us clearer areas and it becomes visible how this could be combined with the second order derivative for better edge detection.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 6**: How can you use the response from *Lvv* to detect edges, and how can you improve the result by using *Lvvv*?

Answers:

We want to use Lvv and Lvvv to see when Lvv = 0 och Lvvv < 0 to determine when the gradient magnitude reaches a local maxima as described in section 3. In short we use the edges from zero crossings in Lvv and then only keep pixels where corresponding pixels are < 1 in Lvvv of the image.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 7**: Present your best results obtained with *extractedge* for *house* and *tools*.

Answers:

For tools it was with parameter scale = 9 threshold = 30 and for the house image the parameters where scale = 8 threshold = 24

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 8**: Identify the correspondences between the strongest peaks in the accu-mulator and line segments in the output image. Doing so convince yourself that the implementation is correct. Summarize the results of in one or more figures.

Answers:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 9**: How do the results and computational time depend on the number of cells in the accumulator?

Answers:

If nrho and ntheta are unbalanced the result become worse. It becomes for example many high values in matrix for theta direction because they are close to the maximum because of small incremenets. Then the top solutions can become similar lines and others directions not making it. According to my tests the computational time increases less than linearly to the size of the matrix. The results become more accurate with a bigger accumulator matrix.

**Question 10**: How do you propose to do this? Try out a function that you would suggest and see if it improves the results. Does it?

Answers:

This is the function I came up with, it works well in some cases where it gives a higher weight to points with higher magnitude. Sometime for example in the house picture there are important lines where the magnitude is not very large so in that case it might be preferable to go with the standard +1 vote.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_