Answers to questions in Lab 2: Edge detection & Hough transform

Name: _Badi Mirzai (badim@kth.se) Program: Systems Control and Robotics

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 results were as expected, in the dx operator we only see the changes in the x-direction and the opposite for the y direction. The size difference is because at the far end of the image we have a edge and there is no next pixel to compute the derivative of, therefor we will have 1 smaller column in the dx operator and one smaller row in the dy operator.

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

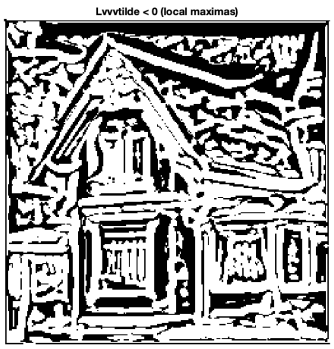
Answers:
One could look at the histogram and find where the values that are not as important than the peak values and use that as a threshold to filter out those values. These values can be seen as noise and when we filter them out we can get sharper edges in the image.

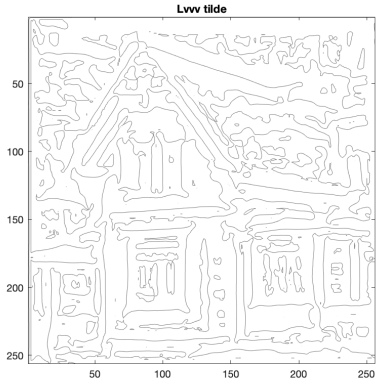
Question 3: Does smoothing the image help to find edges?

Answers:
Smoothing the image removes some noise and can help to find edges since we remove everything that is smaller than out threshold. But smoothing too much can also make it hard to find edges. So there needs to be a balance between hoe much one should smooth the image.

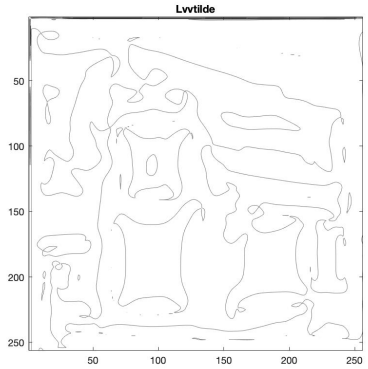
Question 4: What can you observe? Provide explanation based on the generated images.

Answers:
The signs convention on the local Lvvvtilde < 0 gives out all the local maxima points, unlike without the sign convention, it will give both local maxima's and minima's, i.e. extreme points in the gradients magnitude. Below we have with the scale 3.





If we for example increase the scale to 64 we will get this images:



And we can therefore see that the scale of which we look at local maximas has increased, since we remove more change in the image by blurring. So we have removed anything here that is smaller than 64 pixels when we fins the local maximas in the image..

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

Answers:
See above for images.
The bigger the scale the more details we remove and therefor will we in a way look at a larger area for our local maximas, and therefor the image will be in less detail when we extract the edges (maximas).

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

Answers:
The response from Lvv=0 gives the maximum of the gradient, in other words where we have extreme point in the derivative of the pixels.
Lvvv<0 shows us all the maximums for the gradient.

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

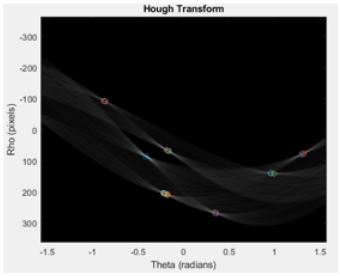
Answers:

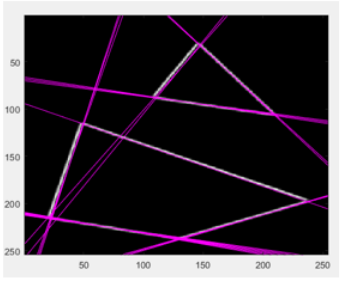
Edges detection for house, with scale 1 and threshold 10:

The best result for the tools image was obtained with scale 4 and 10 as threshold :

Question 8: Identify the correspondences between the strongest peaks in the accumulator 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:





As seen, the peaks of where the sinusoids intersect and is at its maxima, corresponds to the rho and theta that represents the lines seen in the image.

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

Answers:
The results are plotted by the values obtained from the accumulator, in other words the rhos and thetas that corresponds to the different lines. If we have smaller steps between our angle for each point, we will then get more columns and more rhos will give more rows in our accumulated matrix H. the more cells we have in the accumulator, the more lines will we eventually try to plot in out original image, and this might result in stronger lines, but might as well also result in random lines that are nor visible in the image if we choose too many number arguments in accumulated matrix compared to the actual lines in the picture.

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:
The local gradient is orthogonal to the edges, which gives the theta angle and the rho is given directly by the distance to the gradient at that point that corresponds to the lines in real image. The gradient can be found within a much smaller range of angles, compared to 180 degrees and thus reduces the amounts of useless votes in our accumulates. This is why we will increase the strength of the lines that actually corresponds to image lines.
The gradient is not monotonic along the edges, and when we add the gradient magnitude in the accumulated increment, we will get different amount of lines on different edges. Some edges are thicker than others and we will therefore get more lines on those places and less on other places.
