Beeldverwerken 4

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1 Introduction

In this assignment we try to find the edges in pictures and then describe these edged with the means of a line formula. By doing this we can transform an edge that is defined by points in an image into an edge defined by a line.

2 Finding Lines through the Hough Transform

We start by using the built in edge detector in MATLAB to find all points located on edges within a picture. A binary image is created in which all edges are ones and the rest black.

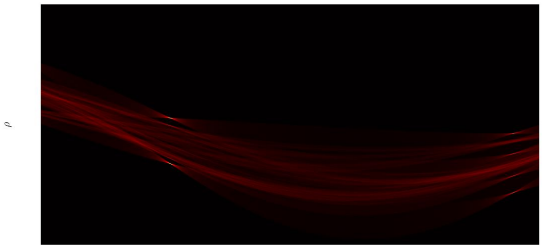
Because we know the range of θ and ρ and we know how many measurepoints of each variable we want we can calculate the interval for both θ and ρ. We calculate the value of ρ based on

$$\rho_i = x_i * sin(\theta_i) - y_i * cos(\theta_i)$$

where i is the index of an edge point.

It is possible for ρ to become negative, when this happends the $\theta = 180 - \theta$ that correlates to $-\rho$. The difference between the two is that the "direction" of the line is different

When we plot all these $\rho's$ and $\theta's$ in a graph we get all the cosinoids that represent edge points.



3 Finding the Lines as Local Maxima

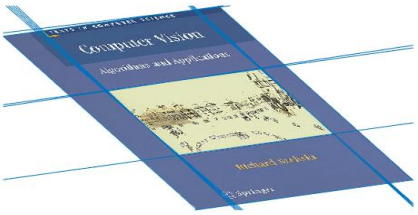
Points in the hough image where two cosinoids intersect represent (fictional) a line between two points in the original image. The more lines intersect, the more points are on the same line. As all points represent edges we can assume that if a lot of points are on the same line we are dealing with an edge.

To estimate these edges we look for maxima in the hough image, as the brighter a spot is the more intersections are in that spot. To find these maxima we filter out all the values that are below a certain threshold. This leaves us with the maxima-areas only.

When we go through these maxima one at a time and look for the maximum value within the area. The coordinates corresponding to that value are the values of θ and ρ that correspond to the line on top of the edge in the original image.

Alternatively there is way of using dilation to find the maxima. Here we use a kind of convolution matrix to create disks of average values of an area. When we compare this image to the original hough image we'll find that only on the maxima the image will be the same (and everywhere where it's black but filtered by the threshold).

Ones we've found all values corresponding to the maxima we can plot lines to these values and show them in the original image



5 Optimal Line Estimation

Now that we have determined the lines that define the edges in our image we want to optimise these lines. It could be possible that our line is not completely accurate and there for we want to adjust is based on the edge points.

We look at each line individually and look at the points that are closest to the line. We can expect that the points that are within a set distance should be on this line.

With these points we can calculate a new line that is better represented by these points by fitting a line with the least squares error method.

We first calculate the average of the points, the centroid. We get all vectors to the points by using

$$p'_i = p_i - centroid$$

After we have all the new vectors we calculate the covariance matrix and compute its eigenvector. We take the largest eigenvector as this represents the longest axis of the spread of vectors surrounding the centroid.

We now calculate the begin and end point of the edge by extrapolating the eigenvector from the centroid to the most left and most right point on the line, and draw the lines.

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