IMAGE Report 5 - Segmentation

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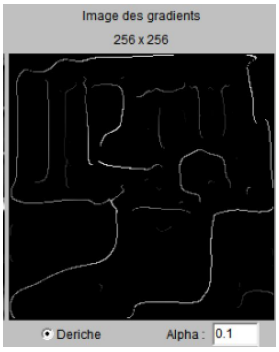
Segmentation / contours

1)

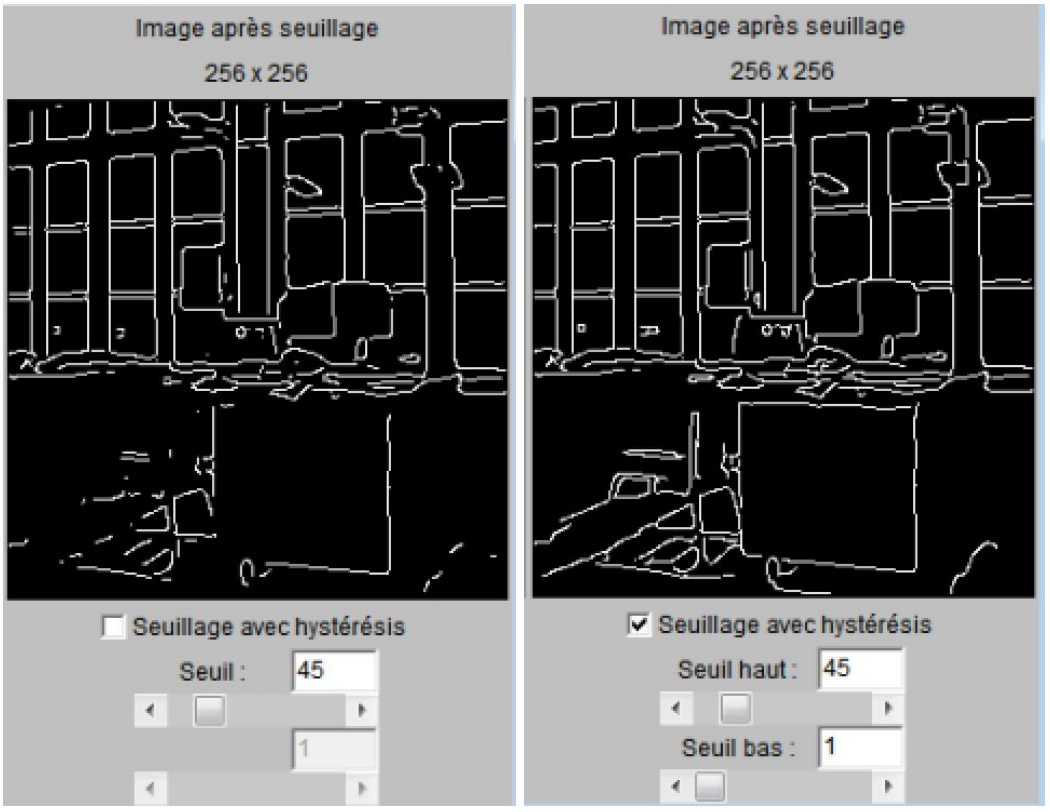
The Deriche filter uses a smoothing parameter ***α*** to influence the quality of the segmentation with respect to the number of contours found, the accuracy of the localisation of contours, and the strength of detection.

Alpha = 0.1	**Alpha = 1.0**
 Few contours, poor localisation, good detection	 Many contours, good localisation, poor detection
 Low alpha causes a poor localisation of contours, which do not precisely match the outline of the window frame. Fewer contours try to fit multiple distinct objects in the real image, giving odd curves.	 High alpha results in a much closer, more accurate fitting of contour lines to the real contours of the original image. There are more contours, with each more precisely fitting a single object in the image.
 A good example is the right angle of the desk. Here the contour is clearly curved, poorly fitting the sharp angle. However the line is very bright, indicating a strong detection. This shows that a low alpha offers a high detection level with poor localisation.	 Here the contour accurately fits the right angle. However, the brightness of the contour line is much lower with a high alpha than a low alpha. This shows that a high alpha offers a poorer detection level, but with better localisation.

2)

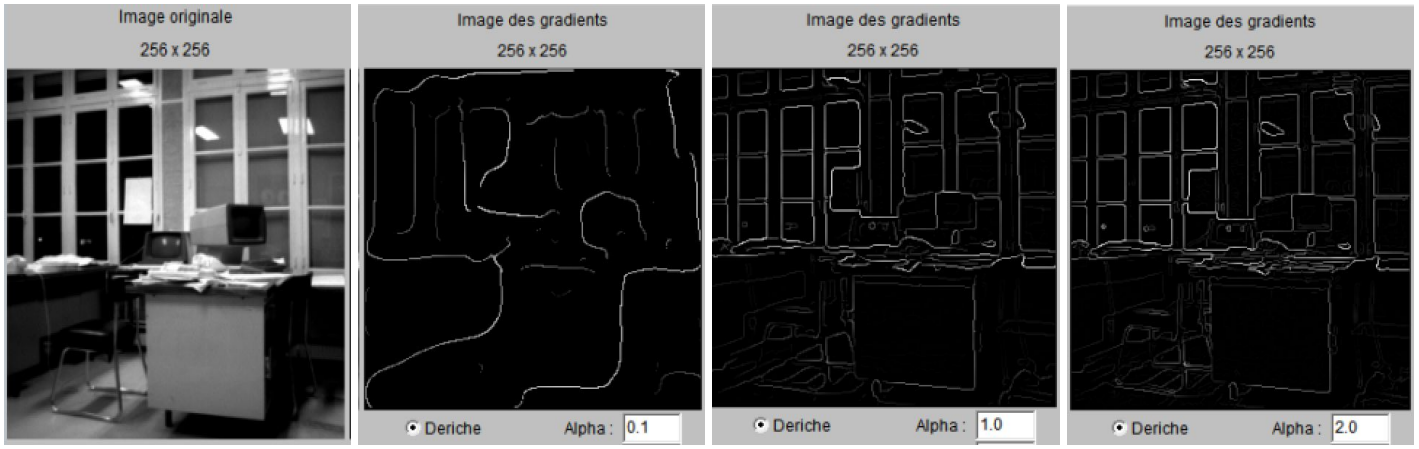
Hysteresis thresholding uses two thresholds that lead to the creation of 3 classes of contours:

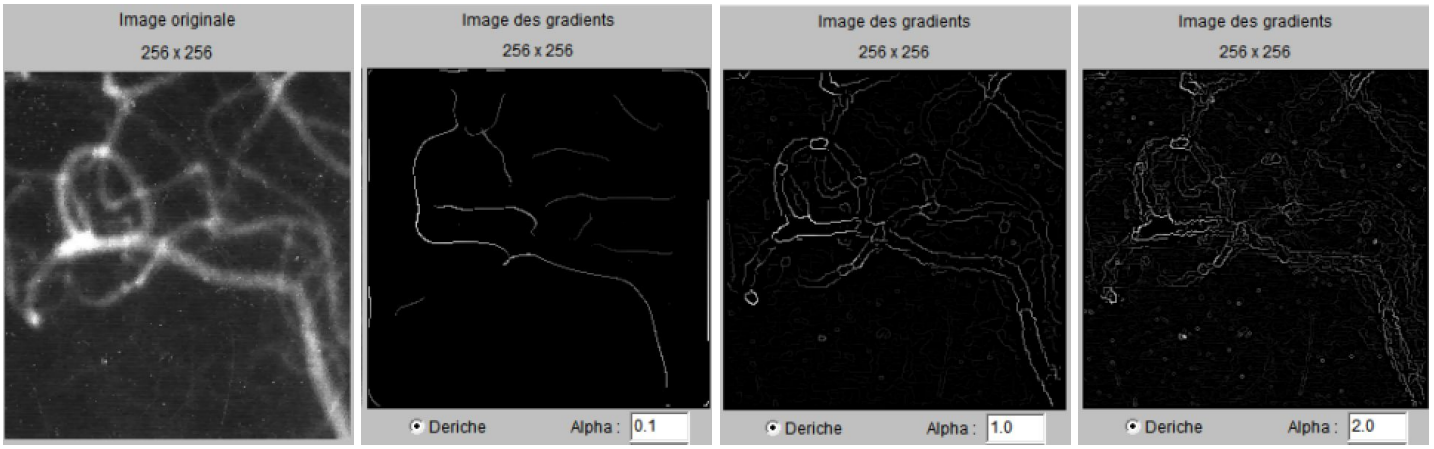
1. Contours with all points (gradients) below the low threshold are removed
2. Contours with all points above the high threshold are kept
3. Contours with points between low and high thresholds are kept only if they are connected to at least one contour which has all points above the high threshold (a contour of class 2).



In the above example, the first image contains many contours with discontinuities. For example, the edge of the desk is not a complete square. This is because it contains contours with points below the simple threshold, so are removed by the thresholding operation. However, when we use hysteresis, these contours are kept in the image, because they are connected to the high threshold contours that appear in both images.

3)



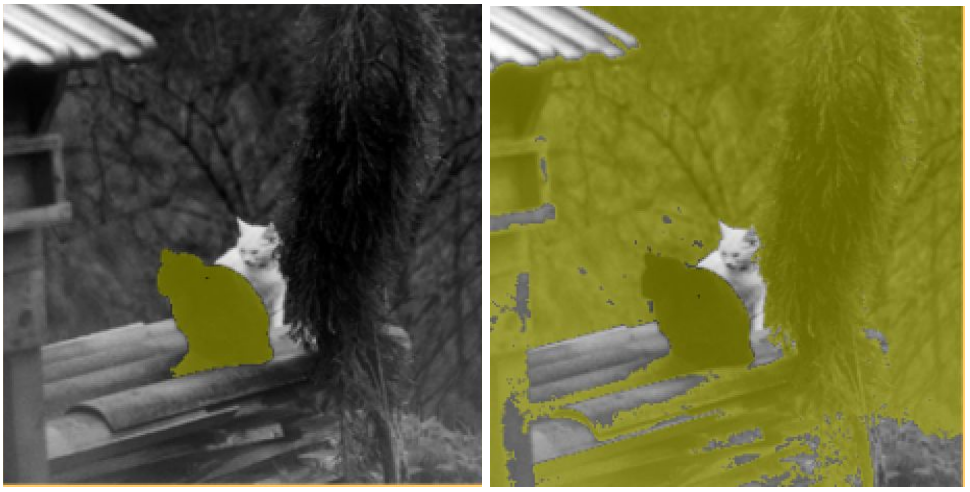


- We cannot obtain continuous contours in the Angiographie image.
- This is because the Angiographie image contains much more noise, giving it a blurred appearance, and consists of predominantly low colour gradients. In contrast, the Bureau image has many sharp edges (high colour gradients).
- If we take the gradients of a noisy image, the noise will be amplified by the operation. We must therefore apply a filter to remove the noise.
- The Deriche filter operation eliminates much of the noise (high frequency variations), but in the process it eliminates the small details in the image too. This leads to discontinuities in the contours that are created once the derivations are calculated, which makes it difficult to accurately segment the image.

Segmentation / regions

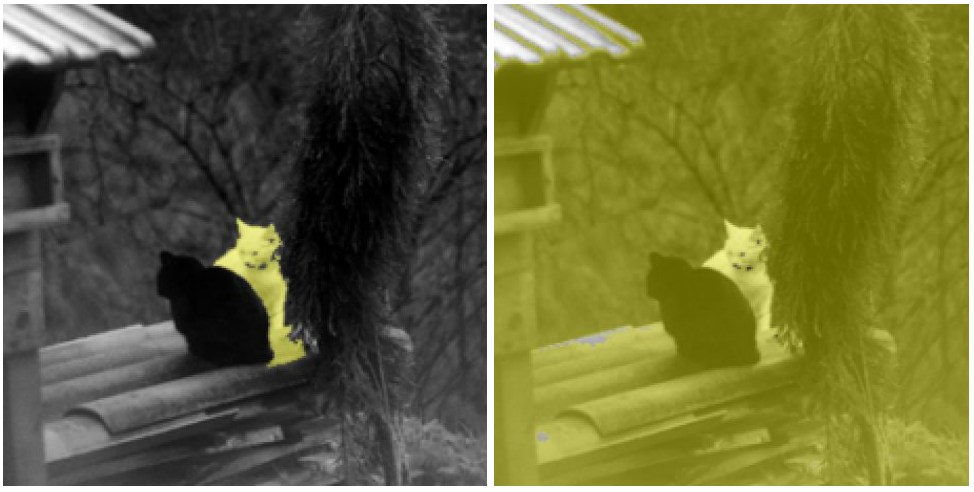
4)

Threshold with respect to the mean = 30 (left), 50 (right)



- When placing the seed on the black cat, a low threshold of 30 selects the cat well, because of the high homogeneity of colour of the cat (it's all black)
- Only a moderately high threshold of 50 causes the background to be selected too, because the contrast between the black cat and the dark background is low.

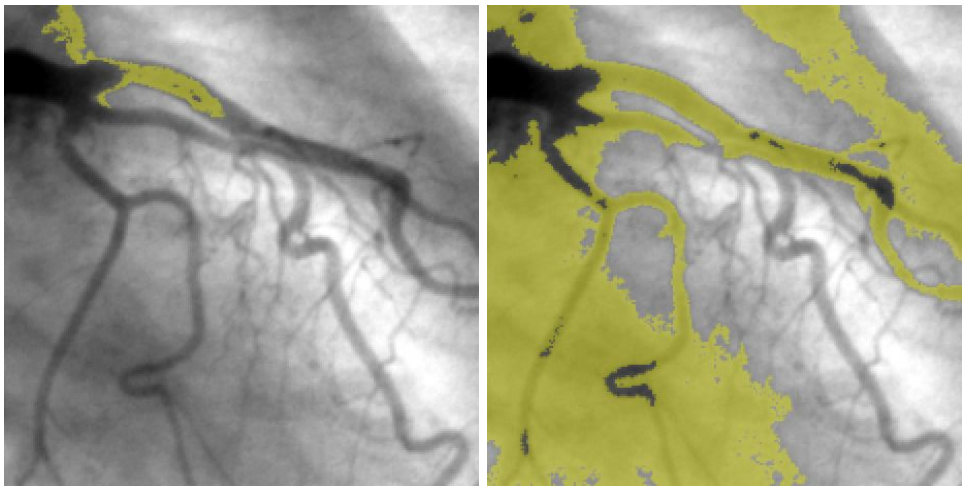
Threshold with respect to the mean = 80 (left), 95 (right)



- When placing the seed on the white cat, a high threshold of 80 is required, because of the low homogeneity of colour of the cat (white plus many shades of grey)
- A very high threshold of 95 is required to cause the background to be selected too, because the contrast between the white cat and the dark background is high.
- It is therefore possible to delimit each cat separably by placing a seed on the cat and using the appropriate threshold parameters.

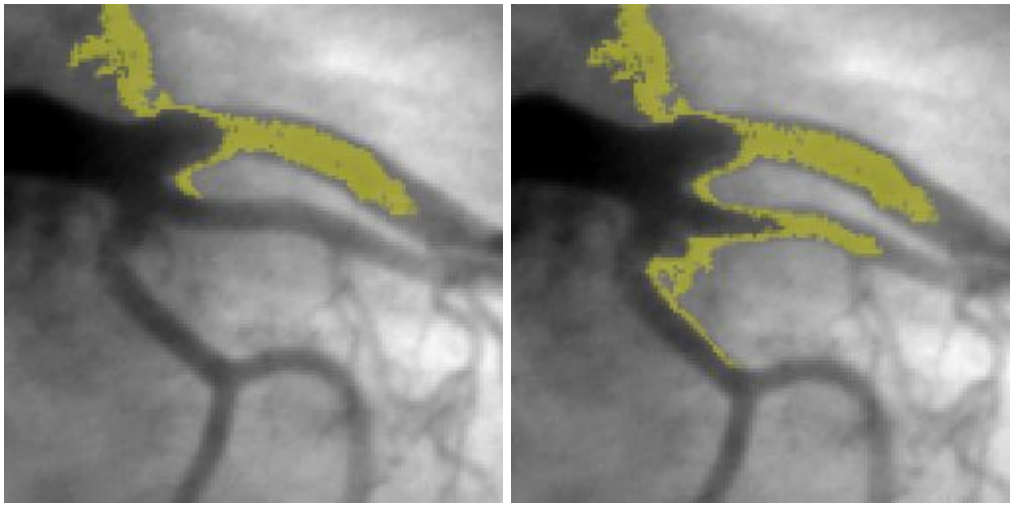
5)

Connections = 4, Threshold = 10 (left), 30 (right)



- The colour of the blood vessels are not homogenous. They range from dark black to lighter shades of grey. The same is true of the background. The blood vessels and the background do not occupy distinct areas of the colour histogram (they overlap), and therefore are not suited to segmentation using a threshold.
- With a threshold of 10, only pixels that are very similar in colour are selected. As the colour of the blood vessels is not homogenous, this leads to only a small region of the blood vessel being added to the region.
- On the other hand, when only a moderately higher threshold of 30 is used, a much larger region that includes much of the background is selected. This is due to the similarity in the range of colours of the blood vessels and the background. As the region grows, it easily spreads from blood vessel pixels to background pixels of a similar colour.

Threshold = 10, Connections = 4 (left), 8 (right)



- With the same seed and threshold, changing the connections from 4 to 8 causes more adjacent pixels to be examined, leading to more pixels being tested against the threshold and added to the region.
- However, it still does not overcome the problem caused by the low homogeneity of the blood vessels, and the low contrast with the background.

6)

- Using a threshold method is not an effective method to define the contours in this image. This is because there are a lot of colour variations in each object in the image (e.g. the hair, or the lines on the face), meaning the colour histograms of the objects overlap and are not easily separable by a threshold.
- For this type of image, we prefer contextual methods such as ‘region growing’ where the neighbouring pixels are taken into account.