Segmentation Status report | July 18th 2005

Automated Visual Event Detection

_INTRODUCTION

In the analysis of the objects in images it is essential to disting the objects and the background. The techniques that are used to find the objects of interest are usually referred to segmentation : segmenting the foreground from background.

_EDGE DETECTION

Edges characterize boundaries and could be therefore a way for detecting objects in frames. Edges in image are areas with strong intensity contrasts (a jump in intensity from one pixel to the next). Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural proporties in an image.

1.Canny edge detection

The **Canny edge detector** first smoothes the image to eliminate noise with a Gaussian filter. Then it compute the gradiant magnitude and orientation using finite-difference approximations for the partial derivatives.It apply nonmaxima suppression to the gradient magnitude and use the double thresolding algorithm to detect and link edges.

Figure 1 – The Radiolarian unprocessed Image on the left and the result of the Canny algorithm on the righ.

The results show that the shape of the object is detected but with a lot of discontinuities. In order to improve this algorithm, two ways are possible, on the one hand a preProcessing step is required. In that way, the **homomorphic filtering** could be a good deal. On the other hand, a postProcessing step could be attempted : the **edge linking**, which could allowed to connect the discontinuities performed by the edge detection.

a.*Homomorphic filtering*

Non-uniform lighting in video seqences filmed by the ROV's, lead to low contrast in regions of Images. This could be has the origin of the non detection of objects obscured by shadows. In order to decrease this effect, the homomorphic filtering enhance the reflectance properties and reduce the effects of varying illumination in the image.

The homomorphic filtering attempts to separetly analyse illumination and reflectance information in images. In that way, it use a logarithm function to separate both of the composante.

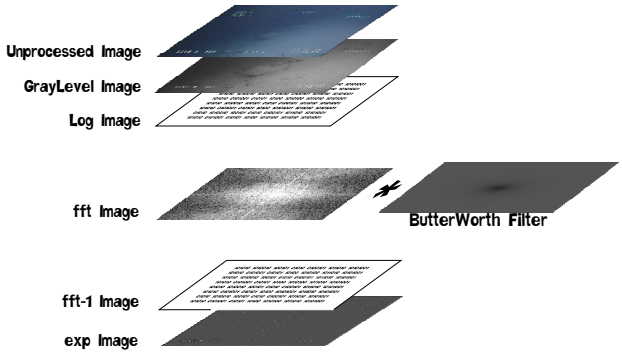
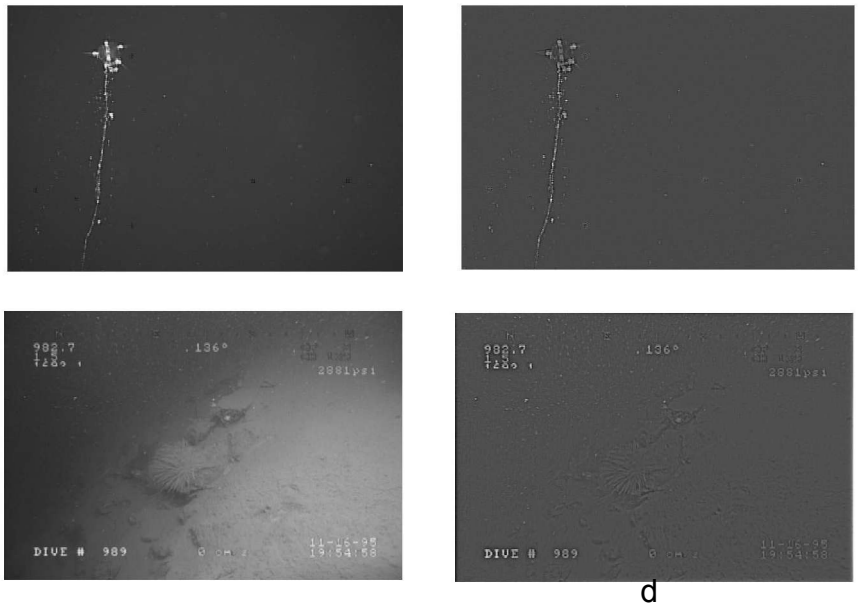


Figure 2 – The Homomorphic filtering algorithm steps.

The results are presented below :

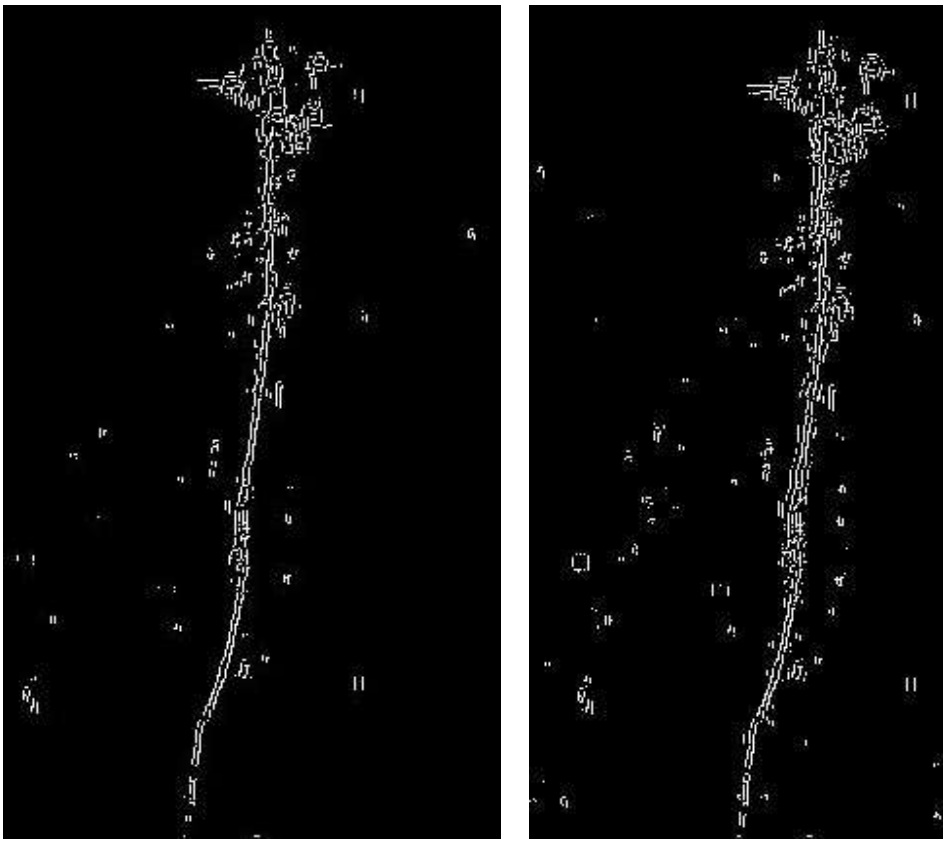


d

Figure 3 – (a) Unprocessed Radiolarian Image, (b) application of homomorphic filtering to a, (c) Unprocessed Baxter Image, (d) application of homomorphic filtering to c.

The Homomorphic filtering succed to correct the non-uniform lighting presente in the ROV's frames. But the contrast don't seems to be efficiently improve.
Indeed, the preprocessing of the Image by the Homomorphic filtering algorithm don't give better results than the only Canny algorithm.

The results are presented below :



a b

Figure 4 – (a) Radiolarian Image after Canny edge detection, (b) Radiolarian Image after Canny edge detection combinated with Homomorphic filtering.

The preProcessing of the Radiolarian Image by homomorphic filtering don't allowed to improve the edge detection, indeed, the discontinuities are always present.

b.*Edge Linking*

After the Canny edge detection algorithm, a couple of discontinuities could be observed. In this way, a edge linking could allow to reconnect the hole in the edge performed by the canny algorithm.

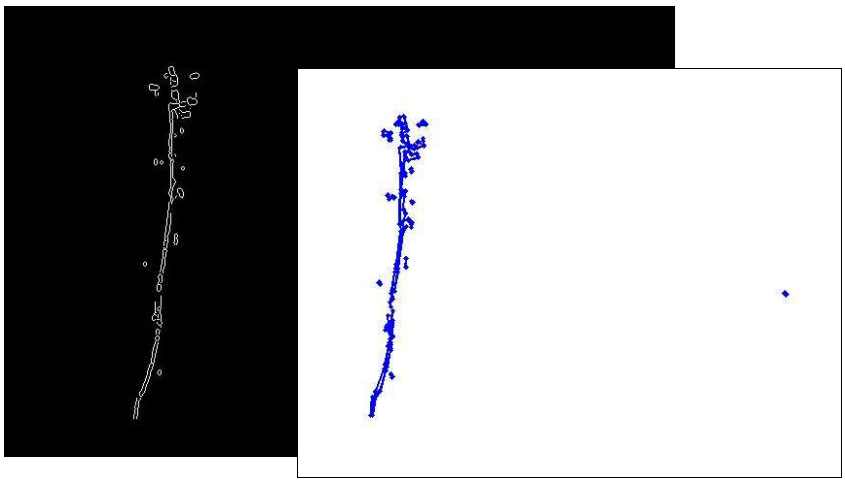


Figure 5 – Radiolarian processed by Canny algorithm on the left and the map of edges after the edge linking on the right

The results of the edge linking present less discontinuities then the results of the only edge detection algorithm. But some holes are so huge to be corrected by the edge linking algorithm.

2.*Discussion&Perspectives*

The Canny edge detection could give some good results after a edge linking. The next step will be to fill the edge linking map in order to have the segmented object.
However, the Homomorphic filtering seems to be useless even if this algorithm correct the non-uniform lighting caused by the ROV's.
Moreover, others filter(Sobel and Prewitt) and kind of edge detection have to be tried(acive contour).

_THRESHOLDING

The Thresholding is based on a simple concept, a parameter ***θ*** called the brightness threshold is chosen and applied to the image as follows :

If Im(i,j) >= θ, Im(i,j) = object = 1
Else Im(i,j) = background = 0

Because of a poor contrast in the ROV's frames, a preProcessing is required. The background substraction followed by an histogramme adjustement give the following results :

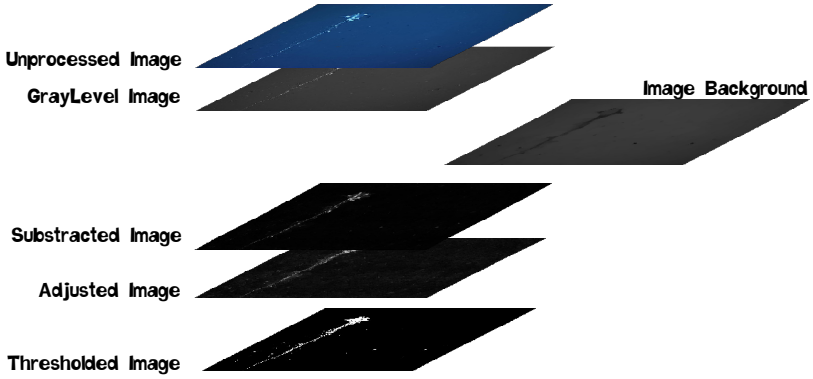


Figure 6 – Steps of the thresholding tested

After the thresholding, an opening followed by an erosion are used in order to clean and connect the image objects.

The results are presented below :

Figure 7 – Radiolarian UnProcessed Image on the left and the Radiolarian thresholded on the right.

The thresolding used don't give good results because of a lot of discontinuities, even if the opening and eroding algorithm help.

Moreover, other kind of Thresholding could be used (fuzzy C mean, K mean) this kind of algorithm allowed to classify image areas in differente class (the number is predefined). In this way some areas could be detected as object and others near the object. By comparaison with the next and the precedent frames, some near areas could be incorported in the object area.