Medical Imaging Analysis : Image segmentation

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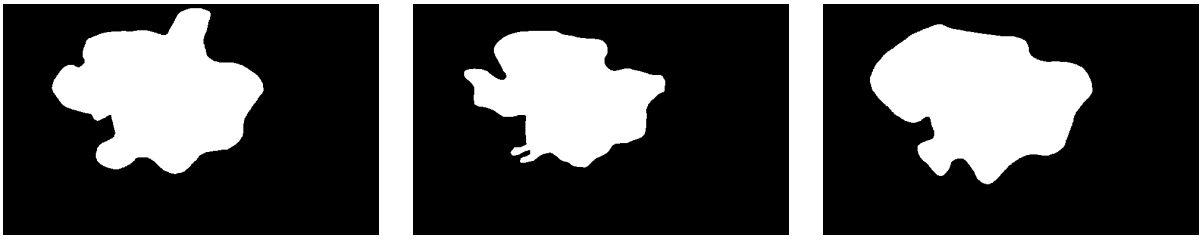
1 Introduction

Image segmentation is an important pre-processing step. For instance, it can used to focus further machine learning processing on a specific organ or probable lesions.
In this practise, we will focus on dermatoscopic images in which the lesions in each image has to be delineated. Thus, this practise will follow three guidelines. First, the problem of multi-expert delineations will be presented and a solution to fusion these ground-truth will be implemented. Then, three different methods are proposed to segment the dermatoscopic images. The source code of these segmentation methods are provided and their principles will have to be discussed. Moreover, the results of the segmentation methods will have to be evaluated with some insightful discussions regarding the metrics used. Finally, it will be asked to implement your own segmentation algorithm and evaluate the results obtained using the same framework.

2 Ground-truth generation

2.1 Implementation



(a) Expert 1. (b) Expert 2. (c) Expert 3.

Figure 1: Example of ground-truth images from three different experts of a same lesion.

Several experts proposed a ground-truth of the original images. These ground-truth images are in the folder `images/gt`. An example is depicted in Fig. 1.
The first task will be to fusion these different opinions to obtain a single ground-truth. You can implement the method of your choice to perform this task. You can also take a look to the following methods to be more inspired: majority voting scheme, STAPLE [2].
For the remaining of the practise, paste the image in the following `images/gt/fusion` folder. Keep the original name (eg., "D134_mask.png").

2.2 Report

Provide the results and explain the method used to performed this task.

3 Segmentation

3.1 PDF-based segmentation

The code implementing this segmentation method is available in the folder:
`segmentation-algorithms/pdf-based-segmentation`.
Open and execute the `main.m` file, to perform this segmentation.
Check the file `pdfBasedSegmentation.m` in order to understand the principle of this method.

3.2 Fuzzy C-means segmentation

The code implementing this segmentation method is available in the folder:
`segmentation-algorithms/fuzzy c-means`.
Open and execute the `main.m` file, to perform this segmentation.
Check the file `fuzzyCMeansClustering.m` in order to understand the principle of this method.

3.3 Level-set segmentation [1]

The code implementing this segmentation method is available in the folder:
`segmentation-algorithms/level-set`.
Open and execute the `main.m` file, to perform this segmentation.
Check the file `levelSetSegmentation.m` in order to understand the principle of this method.

3.4 Report

Provide a brief discussion to explain the principle of each method.

4 Evaluation

4.1 Implementation

The code implementing the different evaluation metrics is presented in the folder: `matlab-evaluation`. The file to execute is `main.m`. Take a look at the different implemented methods to understand their computation principles.

4.2 Report

Report the results obtained. Moreover, explain the principle of each metric implemented.

5 Own implementation

As a final step, implement any segmentation method of your choice and evaluate your algorithm using the previous framework implemented (see Sect. 4).

5.1 Report

Explain your method and provide an evaluation of your method.

References

[1] Chunming Li, Rui Huang, Zhaohua Ding, J.C. Gatenby, D.N. Metaxas, and J.C. Gore. A level set method for image segmentation in the presence of intensity inhomogeneities with application to mri. *Image Processing, IEEE Transactions on*, 20(7):2007–2016, July 2011.

[2] Simon K. Warfield, Kelly H. Zou, and William M. Wells. Simultaneous truth and performance level estimation (STAPLE): an algorithm for the validation of image segmentation. *IEEE transactions on medical imaging*, 23(7):903–921, July 2004.