Medical Imaging Analysis : Algorithm Evaluation

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1 Goal

The aim of this lab is to evaluate different 2D and 3D segmentation algorithms through area overlap measures and distance measures. After the completion of this lab, you should be able to:

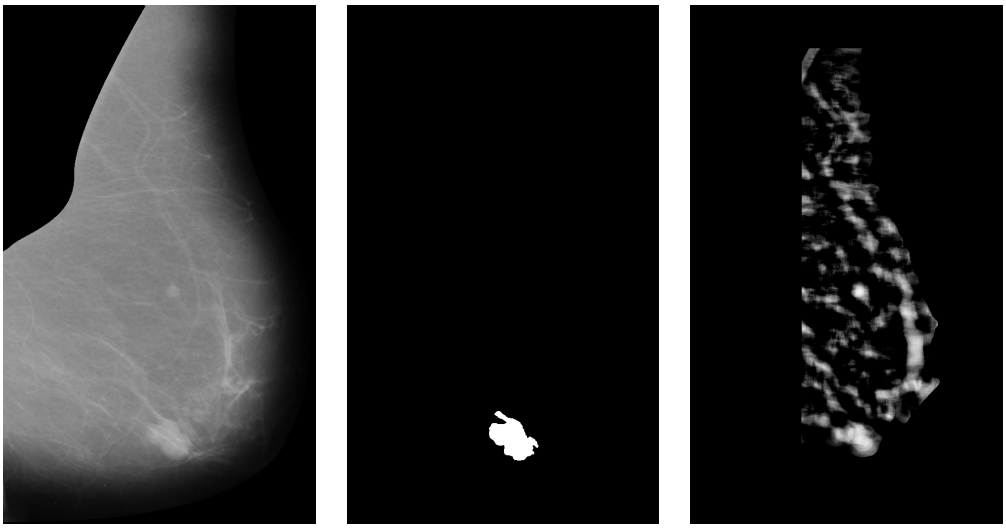
- Understand how to provide a measure to evaluate a segmentation algorithm.
- Understand how to compare the performance of several segmentation algorithms.
- Understand the suitability of area overlap measures and distance measures when evaluating algorithms.

2 Material and Methods

2.1 Segmentation Evaluation in 2D

Open the 2D segmentation files you are provided, which contain 4 clinical cases obtained from the MIAS public database (http://www.mammoimage.org/databases/). For each clinical case, the following information is provided, as is shown in Figure 1:

- The original mammogram.
- Its ground truth.
- The output of 6 segmentation algorithms.



Original image Ground Truth Segmentation output

Figure 1: Information contained in the 2D segmentation files

Obtain the ROC curve and compute the Area Under the Curve (AUC) for each segmentation. In order to obtain the points in the ROC graph, threshold the output of the 6 segmentation algorithms for each clinical case at different levels, and plot the True Positive Rate against the False Positive Rate at each level.

Compute the following area overlap measures and distance measures for each segmentation algorithm:

- Jaccard Index
- Dice Coefficient Similarity
- Hausdorff Distance

The measures should be computed at the best threshold (must be the same for all the images for a given segmentation algorithm, despite could differ for different segmentation algorithms).

2.2 Segmentation Evaluation in 3D

Open the Matlab file (.mat) containing the following information:

- An original 3D MRI volume with Multiple Sclerosis lesions.
- The volume with manually segmented lesions.
- The volume with automatically segmented lesions.

Extend the algorithms to evaluate the results for 3D volumes.

3 Questions

Write down a summary of your work, indicating:

3.1. The Matlab code of each measure.

3.2. A table comparing the results for the 2D segmentation evaluation. Which algorithm do you think is the best?

3.3. The 3D results for the 3D segmentation evaluation.

3.4. What evaluation measure do you think is the best?

3.5. The troubles you have encountered in the assignment.

3.6. Any suggestion to improve the assignment.