Segmentation of lesion in MR images

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*Abstract*—

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# Introduction

Magnetic Resonance Imaging (MRI) is a modern tomographic technique that allows healthcare professionals to investigate thoroughly, through virtual planar slices, the patient’s tissues morphology. It’s a very effective tool for diagnostics and surgery planning, especially when investigating soft tissues. This paper presents a comprehensive analysis on the segmentation of MR images for detection and surface estimation of a lesion in the brain area, moreover we investigate the effect of image noise on our approach.

# Material & Methods

The MATLAB programming language was used to perform all data analysis and visualization in this work.

The first step of the process consists in volume visualization to approximately assess the slices of interest and the extension of the lesion.

Single slice segmentation is carried out by means of an algorithm that employs filtering, thresholding and density analysis.

To evaluate the robustness of the segmentation approach, sensitivity analysis to two noise types is implemented. The type of noises considered are "salt & pepper" and Gaussian noise.

To assess the accuracy of the segmentation, a comparative analysis between Otsu thresholding and the proposed approach is conducted, using the Dice index to compare similarities.

## Image Segmentation

The image is cropped to a rectangle to identify a ROI of the image. A median filter is preventively applied to reduce eventual salt & pepper noise degradation. An empirical thresholding is applied to the standardized image, with range between 0.5 and 0.85. The resulting continuous regions are labelled using the MATLAB function *bwlabel*, and subsequently statistical properties of those regions are computed, such as solidity and area. To find the area corresponding to the tumor, it is assumed that such area is the one with the densest region in the image based on an empirical density value. The image is corrected with the *imfill* function.

## Noise Sensitivity

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To investigate how noise effects the implemented algorithm and to tackle its weaknesses we performed tests comparing the detected area without noise and subsequently with increasing levels of noise, either ‘additive gaussian’ noise or ‘salt & pepper’ noise.

## Comparison with other methods

We also tested our against method with Otsu thresholding.

To compare results we manually segmented the whole volume using MTLAB built-in apps, then calculated the Dice index between the ‘true’ segmentation and the one obtained with Otsu’s method.

Further investigation on the effect of local operators such as gamma correction was pursued, testing whether brightnening or darkening the image improved segmentation results, also in the presence of noise.

# Results & Discussion

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##### Acknowledgment *(Heading 5)*

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