

BRAIN EXTRACTION FOR ANALYSIS OF MAGNETIC RESONANCE IMAGING IN PATIENTS WITH MULTIPLE SCLEROSIS

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INTRODUCTION

- Magnetic resonance imaging (MRI) is the gold standard exam for diagnosis and follow-up of neurodegenerative diseases, such as multiple sclerosis (MS).
- MS is characterized by demyelination of axons. This demyelination process (neurodegeneration) causes lesions in white matter that can be observed in MRI (Figure 1).

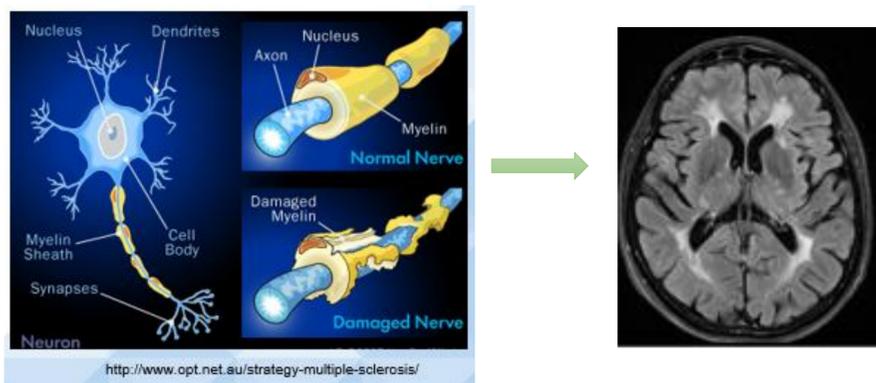
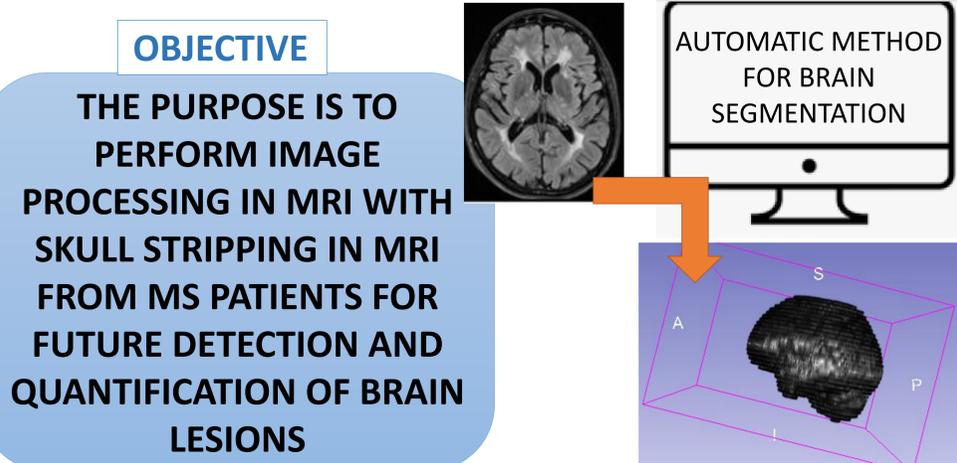


Figure 1. Demyelination process and MS lesion by MRI.

- MRI allows the evaluation and follow-up of sclerotic lesions in different sequences: T1 (isointense lesions), T2 and FLAIR (Fluid Attenuated Inversion Recovery) with hyper intense lesions.
- In order to perform the identification and quantification of sclerotic lesions, it is necessary to perform a pre-processing of images to extract of the region of interest (brain).



MATERIALS AND METHODS

- Five subjects with 10 scans (two sequences: T1 and FLAIR):

 1. **RIRIGIDLY REGISTERED:** T1 MRI were rigidly registered to 1 mm³ through general registration (BRAINS). The FLAIR images were registered to the T1 image space.
 2. **SKULLSTRIPPED:** Sequences were stripped by swiss skull stripper. The algorithm registered a grayscale atlas image to the grayscale patient data. Through registration transform, an atlas mask was propagated with patient data. This brain mask was eroded and served as initialization for a refined brain extraction.
 3. **INTENSITY CORRECTION:** the third step performed image bias correction by N4ITK after brain stripping.

RESULTS

- First step: size images 0.43x0.43x4.6mm³ were transformed to 1mm³ and spatial resolution:

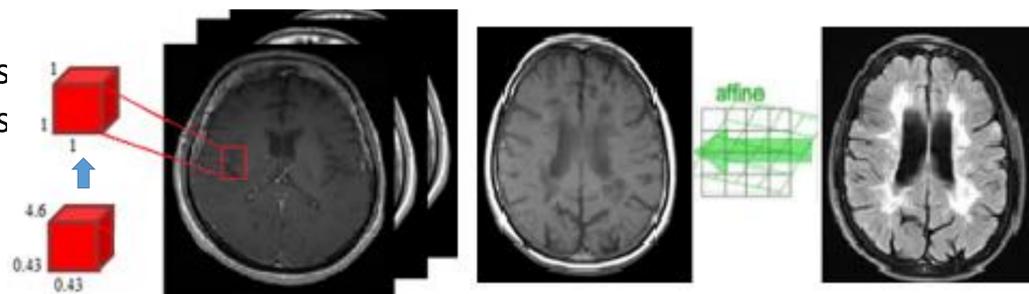


Figure 2. Original image voxel size 0.43x0.43x4.6 mm³ and image rigidly registered to 1 mm³, and spatial resolution from FLAIR to T1.

- Figure 3: skullstripping and bias correction for brain extraction, which was applied to all slices of the exam, and we obtained the brain volume (see Figure 4).

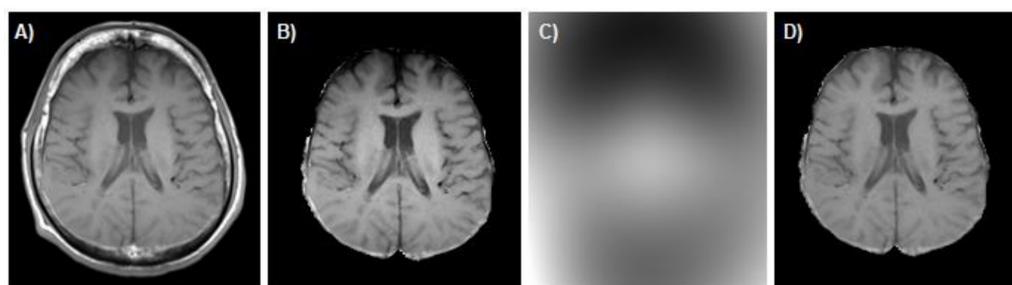


Figure 3. A) Rigidly registered image. B) Skull stripped image. C) Bias correction. D) Final image.

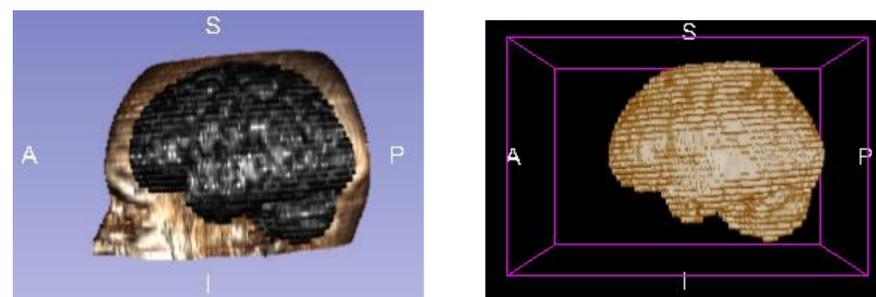
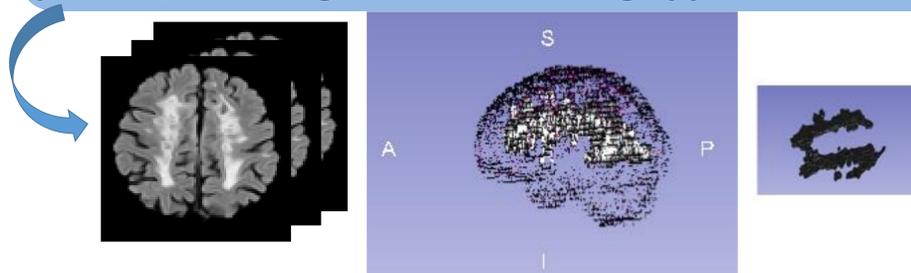


Figure 4. Brain Volume after brain extraction process applied to all slices.

CONCLUSION AND FUTURE WORK

The automatic preprocessing method applied in this work for skull stripping can be used for the brain extraction process. This is an important and necessary pre-process for future analysis of brain lesions.

In future work, we expect to implement more automated methods to lesions identification and segmentation process, including machine-learning approaches.



ACKNOWLEDGMENT

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