

## Cortical Thickness Estimation Techniques using MRI images

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### Abstract

The thickness variation over time of the cerebral cortex of an individual serves as an indication of the presence of neurodegenerative diseases such as Alzheimer's disease. A computational tool capable of performing the estimation of the thickness of the cortex efficiently is of great interest to neurologists. A study based on well-known tools, such as FreeSurfer and FSL, was performed and identified important information about the influence of some pre-processing steps on the accuracy of the final result.

*Key words: MRI, FreeSurfer, Cortical Thickness.*

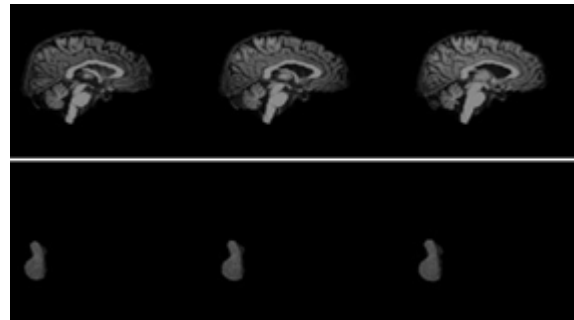
### Introduction

The human cerebral cortex plays a fundamental role in most cognitive processes. Its average thickness is 2.5 mm, ranging between 1.0mm and 4.5mm in different parts of the brain<sup>1</sup>. The cortical thickness has a significant variability between healthy subjects and patients with neurodegenerative diseases such as Alzheimer's disease. So, being able to estimate its thickness accurately is important for the monitoring and early diagnosis of patients<sup>2</sup>. A computational tool capable of performing the estimation of the thickness of the cortex efficiently is of great interest to neurologists. However, current tools such as FreeSurfer, can take up to eighty hours to estimate the cortical thickness of a single brain and are complicated to use for the health professionals who do not have experience with computing.

### Results and Discussion

Throughout the study, it was developed an online processing platform which allows doctors to perform studies using FreeSurfer software without the requirement to install it on their machine or even having the trouble to set it up. With the help of this tool, it was possible to process about 650 images provided by the Hospital at Unicamp.

As a result, it was found that the pre-processing steps, such as extraction and registration of the skull, affect the accuracy of the final result. Thus, new tests are being performed using the FSL software to extract the skullcap and make the registration, instead of FreeSurfer, and so to verify if the accuracy of the results in which the FreeSurfer was unable to provide a satisfactory result can be improved. In Image 1 it is possible to verify a case in which the extraction of the skull made by FreeSurfer was not successful, and the same process carried out using the FSL.



**Image 1.** Skull-stripping using FSL and FreeSurfer (from top to bottom).

### Conclusions

Through the study of FreeSurfer tool, the results obtained by the processing with the online platform and the tests using the FSL tool to complete the skull-stripping step, it was concluded that the accuracy of FreeSurfer varies significantly with the pre-processing steps, such as the registration and the aforementioned skull-stripping.

### Acknowledgement

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<sup>1</sup> B. Fischl and A. M. Dale. Measuring the Thickness of the Human Cerebral Cortex from Magnetic Resonance Images, Proceedings of the National Academy of Sciences, 2000 Sep 26;97(20):11050-5, 2000.

<sup>2</sup> M. J. Clarkson, M. J. Cardoso, G. R. Ridgway, M. Modat, K. K. Leung, J. D. Rohrer, N. C. Fox and S. A. Ourselin. A comparison of voxel and surface based cortical thickness estimation methods, Neuroimage 57, 2011..