

## Quantitative MRI characterization of brain tissues in stroke patients.

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# UNIVERSITY OF LIÈGE

## *Abstract*

Faculty of Applied Sciences

Master in Biomedical Engineering

### **Quantitative MRI characterization of brain tissues in stroke patients**

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Strokes are the second leading cause of death worldwide, the second leading cause of dementia and the leading cause of non-traumatic acquired motor disability in adults. Therefore, a pressing need exists to improve the revalidation treatment after strokes. The aim of the rehabilitation research is to discover and understand the relationship between brain, behaviour, and recovery after a stroke in order to use brain reorganization following a stroke to predict functional outcomes. This master thesis focuses on strokes inducing lesions in the left hemisphere which are causing aphasia and specifically anomia. The research investigates the brain plasticity and tissue microstructure properties changes in these patients through transversal studies. MRI data were acquired for both patients and controls using a specific "multi-parametric mapping" protocol, providing quantitative maps of tissue MR properties.

The first transversal study compares the brains of stroke victims against control reference subjects, from a morphological and microstructural point of view. The aim of the microstructural comparison is to find out whether lesions in the left hemisphere induce changes in the right hemisphere, which appears normal on conventional MRI. The second research compares the microstructures of patients' brains in relation to their performance. A third, more methodologically oriented research aims to determine the importance of the chosen data treatment pipeline by comparing the results obtained with two different pipelines on the control subjects.

The study of brain microstructures is carried out via a voxel-based quantification (VBQ) analysis. The data is first segmented and warped in the MNI standard space using the "Unified Segmentation" (US) method for control subjects and its extension for lesioned brains, the "Unified Segmentation with Lesion" (USwL) approach for patients. The data is then smoothed using a tissue weighted smoothing approach, for GM and WM separately.

Statistical tests showed GM atrophy for patients in some regions of the right hemisphere (brain stem, right thalamus proper, right supplementary motor cortex and right lingual gyrus). Furthermore, there is a significant decrease in MT values for patients versus controls in a voxel located in the WM of the right hemisphere; this could reflect a variation in the amount of myelin between patients and healthy subjects.

No voxel showed a difference within the patient group in terms of their performance. Comparing the results of two different pipelines on the control data revealed a large number of voxels with statistically significant differences. This highlights the importance of the data processing performed.