

# Automatic Classification of Multiple Sclerosis Lesions in the Spinal Cord

In this project we aim at automatically classifying multiple sclerosis (MS) lesions in the spinal cord without a known ground truth, working with magnetic resonance (MR) images that have been produced with a recently developed acquisition sequence.

During the progress of MS, which is an inflammatory disorder of the central nervous system, characteristic lesions appear in the nervous tissue of the brain and spinal cord. Monitoring these lesions in MS patients over time may be helpful to monitor the disease progress and assess treatment effects, where monitoring lesions in the spinal cord is especially interesting regarding the patients' sensorimotor skills. MS lesions appear both in the gray matter (GM) and white matter (WM) regions of the spinal cord, having different implications on the patients' status. Distinguishing between spinal cord GM and WM lesions, however, is a notoriously difficult task, mainly for two reasons. First, distinguishing between spinal cord GM and WM itself requires carefully designed MR acquisition sequences. Second, even if a good GM–WM tissue contrast is present in the MR images, GM and WM lesions may still be hard to distinguish.

In this project, we use MR images that have been acquired with the AMIRA acquisition sequence, which has been recently developed at University Hospital Basel. While AMIRA has already proven to provide both excellent GM–WM contrast in healthy spinal cord tissue and a clear visibility of MS lesions in general, its potential in discerning GM and WM lesions is yet to be shown. The main research questions for this project are:

- Given manual segmentations of MS lesions in AMIRA MR images, can GM and WM lesions be distinguished automatically?
- Are there different types of MS lesions, some of which can be classified into GM and WM lesions, others which cannot be distinguished?

The project candidate will be provided with manually labeled lesions in a suitably large amount of MS patient MR images. The candidate will apply clustering or other techniques from unsupervised learning to distinguish between different lesion types, especially concerning their allocation to the GM and WM parts of the spinal cord. Together with neurological experts from the University Hospital Basel, the candidate will evaluate the clinical plausibility of the findings.