

Multiple Sclerosis Lesion Segmentation

DeepHealth

Multiple Sclerosis (MS) is a potentially debilitating neurological disease that affects approximately 2 million people worldwide. The current standard of MS characterization is manual lesion labelling on MRI images by an expert, which is a time-consuming process with the potential for variability between doctors. DeepHealth provides new efficient and reliable tools for automatic lesion segmentation and characterization.



Early MS diagnosis for better prognosis and quality of life

Challenge

Multiple Sclerosis is characterized by the body's immune response attacking the myelin sheaths surrounding nerve cells, causing lesions in the white matter of the brain. These brain lesions can be detected and segmented by neuroimaging specialists through the analysis of various modalities of MRI scans. Training Deep Learning models to replicate this image segmentation task usually requires vast amounts of consistently labelled data.

This is particularly challenging in the medical domain, where the variability of criteria among experts usually leads to inconsistent labels that hinder the machine learning training process. In addition, the amount of available data is highly dependent on the prevalence of the target disease and on the complexity and cost of the medical tests, and for Multiple Sclerosis both factors are unfavourable.

Solution

In our case, the source data for this study was a reduced set of just 15 MRI images from different patients in multiple modalities (T1-weighted, T2-weighted and FLAIR), with consensus labels obtained from 7 different experts. Using the 3D sub-image processing and data augmentation capabilities of the DeepHealth ECVL library, we created a training dataset with 1 734,960 samples.

In this way, it was possible to effectively train a state-of-the-art model of two Convolutional Neural Networks in cascade with the DeepHealth EDDL library, deployed on the EPFL HPC infrastructure involving both CPUs and GPUs.

Benefits

Our general model for MS segmentation with the DeepHealth libraries has achieved a segmentation precision of 85.9%, and it has been successfully applied to a new cohort of 20 patients provided by CHUV. This opens the door to a faster, more reliable, earlier diagnosis that will improve the prognosis and the quality of life of MS patients.

Medical specialty:
Neurology

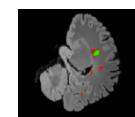
Use Case:
Multiple Sclerosis
Characterization

Site:
Lausanne (Switzerland)

Entity:
EPFL **CHUV**

DeepHealth Project

DeepHealth is a H2020 collaborative project which develops new HPC and Deep Learning techniques applied to large and complex biomedical datasets to support new and more efficient ways of diagnosis of diseases. The technologies developed (EDDLL, ECVL, etc.) have been validated by clinicians on 14 Use Cases like this, providing 14 Success Stories ready to scale to other healthcare institutions.



Comparison of automatic and manual segmentations of a test MRI scan.