Universitätsklinikum Hamburg-Eppendorf

Master-Project/Thesis Medical Image Processing

Machine Learning-based Detection of White Matter Lesions in Magnetic Resonance Images

Background: White matter lesions can be found in brain diseases like multiple sclerosis, stroke, and various forms of dementia. Total lesion volume is considered related to the disease progression process. Hence, lesion detection and segmentation is important – and computer-assistance could help to improve consistency and throughput of expert readings.
At this, the application of machine learning algorithms is promising [2]. In close collaboration with the Department of Neuroradiology of the University Medical Center Hamburg-Eppendorf, we aim at establishing a respective machine learning-based lesion detection and segmentation framework to allow for (semi-)automated analysis of large magnetic resonance (MR) image data bases.

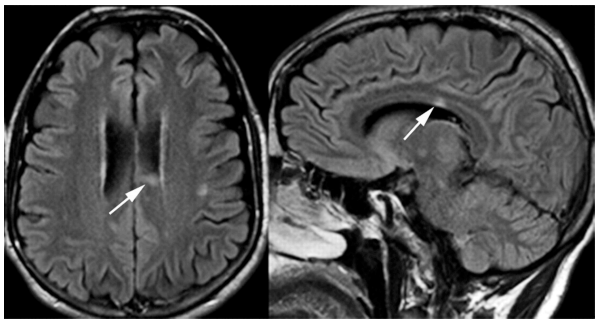

Fig. 1: FLAIR MR image, revealing a multiple sclerosis lesion (white arrow) in corpus callosum [1].

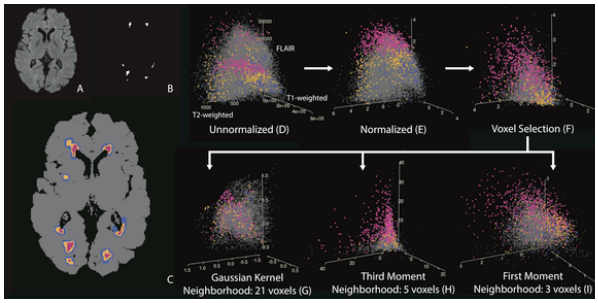

Fig. 2: Examples of image features considered promising in white matter lesion detection and segmentation [2].

Project/Thesis Topic: You will implement and extend state-of-the-art machine learning classification approaches like randomized decision forests (ensemble of decision trees; Fig. 3), identify suitable image features (Fig. 2), evaluate and optimize the choices – and so significantly contribute to the framework to be established.

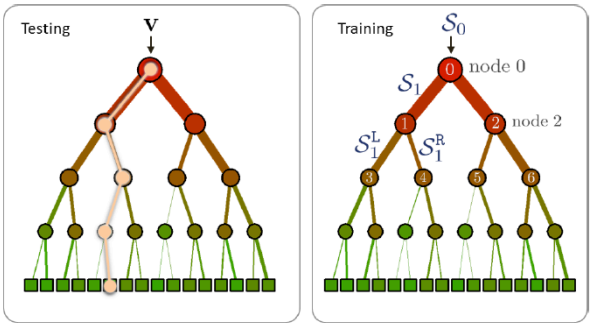

Fig. 3: Principle of decision trees; cf. [3] for details.

Contact:

Dr. René Werner

Group Image Processing/Medical Informatics
Department of Computational Neuroscience
University Medical Center Hamburg Eppendorf

Tel.: 040 / 7410-58026
Email: r.werner@uke.de

Prof. Dr. Tobias Knopp

Institute for Biomedical Imaging
University Medical Center Hamburg-Eppendorf /
Hamburg University of Technology

Tel.: 040 / 7410- 56786
Email: t.knopp@uke.de

[1] Ge Y. Multiple sclerosis: The role of MR imaging. *AJNR* **27**: 1165-76, 2006.
[2] Sweeney EM, et al. A Comparison of Supervised Machine Learning Algorithms and Feature Vectors for MS Lesion Segmentation Using Multimodal Structural MRI. *PLoS ONE* **9**: e95753, 2014.
[3] Criminisi A, et al. Decision Forests: [...]. *Foundations and Trends in Computer Graphics and Vision* **7**: 81-227, 2012.