

## Master Thesis

### „Characterization of CSVD-Biomarkers in a Clinical Cohort“

Neurodegenerative diseases such as Alzheimer’s disease commonly coexist with cerebrovascular disease in older people. Cerebral small vessel disease (CSVD) is the most common vascular cause of dementia, a major contributor to mixed dementia, and responsible for about a fifth of all strokes worldwide.

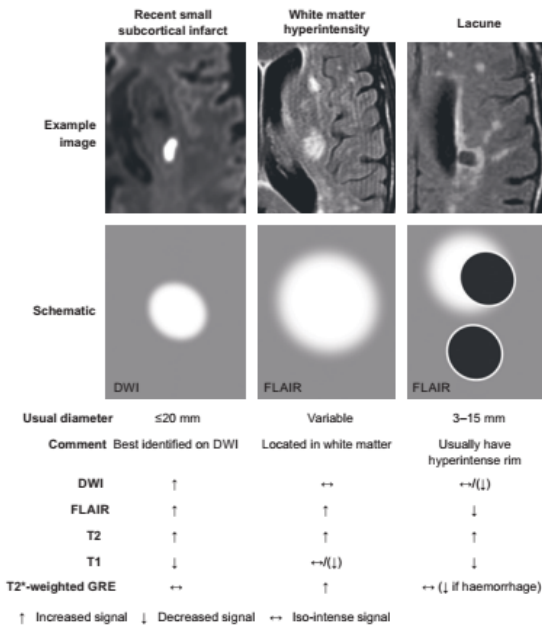
Signs of SVD on conventional MRI include white matter hyperintensities (WMHs), lacunes, recent small subcortical infarcts and others [1]. Examples for typical findings are depicted in the figure on the left.

Thanks to automated methods, segmentation masks of these imaging biomarkers can be obtained in large numbers with minimal time needed. In order to gain further understanding in the pathophysiology of CSVD, further analyses, such as the derivation of second and higher-order features from the segmented biomarkers and feature clustering for phenotype identification are required [3].

[1] Pantoni, Cerebral small vessel disease: from pathogenesis and clinical characteristics to therapeutic challenges, *The Lancet Neurology*, 2010, 9, 689-701

[2] Wardlaw et al., Neuroimaging Standards for Research into Small Vessel Disease and its Contribution to Ageing and Neurodegeneration, *The Lancet Neurology*, 2013, 12, 822-838

[3] Gwo et al., Brain White Matter Hyperintensity Lesion Characterization in T<sub>2</sub> Fluid-Attenuated Inversion Recovery Magnetic Resonance Images: Shape, Texture, and Potential Growth, *Frontiers in Neuroscience*, 2019, 13, 353



Excerpt from a compilation in [2]: Examples of MRI findings for lesions related to small vessel disease (upper), schematic representations of MRI features for changes related to small vessel disease (middle) and an overview of imaging characteristics for individual lesions (lower).







Shape type	Number of lesions	The six lesion images closest to the cluster center
1	105	
2	86	
3	176	
4	237	
5	211	
6	178	

Figure in [3]: Typical examples from shape clusters resulting from a K-means algorithm (6 clusters, 12 feature dimensions).

In this thesis, a variety of different high-level characteristics shall be extracted from the segmented/detected biomarkers of the CSVD. Thereafter, potential subtypes/phenotypes shall be identified and the relation between the markers and different vascularization patterns as well as the relations amongst them shall be investigated using techniques such as clustering and statistical analysis.

The effort will be part of the collaboration of the “MedDigit” (Medicine and Digitalization) and the “Mixed cerebral pathologies and cognitive aging” research groups, a multi-disciplinary team with profound expertise in both, the technical as well as the medical aspects of this project. The groups are based at the campus of the University Hospital in Magdeburg.

#### We offer:

- participation in cutting-edge, clinically relevant research
- cooperation with clinical partners, joint publication of results
- assistance and approachable supervision with thesis implementation und writing
- pleasant and supportive atmosphere

#### We expect:

- good programming knowledge (Python)
- basic knowledge of (medical) image processing and clustering techniques
- excellent knowledge of statistics
- good study achievements (Computerscience or Neuroscience related)

#### Additional information:



Please send your relevant and persuasive application together with an actual transcript of grades per e-mail to:

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