



OPPONENT ASSESSMENT OF THE DISSERTATION

Dipl. Ing. Christiane Malá

Title of Dissertation: *Correlation of Neuroimaging and Cognitive Parameters in Presymptomatic and Manifested Parkinson's Disease*

Author of the Dissertation: Dipl. Ing. Christiane Malá, Katedra biomedicínské informatiky, Fakulta biomedicínského inženýrství, ČVUT v Praze

Opponent: doc. Ing. Marek Piorecký, Ph.D., Katedra biomedicínské techniky, Fakulta biomedicínského inženýrství, ČVUT v Praze

The dissertation thesis is focused on research into Parkinson's disease. The proposed work aimed to analyze possible connections between the cognitive performance of iRBD and PD patients and their brain morphology. The main goal was to evaluate whether early cognitive decline might help detect neurodegeneration earlier. The author analyzed a dataset consisting of brain MRI, the results of a broad cognitive test battery, and detailed gait analysis of iRBD patients, PD patients, and Healthy Controls. The main evaluation tool was the analysis of correlations between morphological changes in patients' brains and cognitive performance.

Relevance of the Dissertation Topic: The topic of the dissertation is relevant and important to the field of neuroscience and has the potential to advance clinical knowledge. The state-of-the-art chapter is very extensive (40 pages, which is disproportionate to the entire work, which has 75 pages). The overview of the current state is complete; however, in some passages, there is a lack of references to the literature, making it unclear where, for example, certain parameters and value ranges were obtained. The range of literature supporting the overview of the current state is sufficient.

Fulfillment of the Objectives of the Dissertation: The author had three objectives for the dissertation. The first was to define an image processing pipeline. The other two objectives involved the validation of the clinical hypothesis on the acquired data of individuals suffering from Parkinson's disease. According to the documented publications, in which the doctoral student is a co-author, all the set goals were realized. Regarding the first goal—the design of a pipeline for MR data processing—it is not clear from the dissertation whether the author only used a publicly available toolbox and set analysis parameters in the graphical interface or **if** she implemented some new MR data processing methods.

Dissertation Results and Specific Contributions: The results of the dissertation are particularly useful in the medical sector. From an engineering perspective, it is not clear whether new data processing methods or procedures have been implemented. The results were presented in conference contributions and professional journals, mainly from the last three years. The doctoral student has a first-author contribution in a professional journal. The publication activity thus underscores the contribution to the medical field in the context of understanding the mechanism and progression of Parkinson's disease.

The text of the dissertation is very concise, and the methods and results are not clearly described. The discussion lacks a comparison of the settings of MR sequences, and an evaluation of the first goal—the proposed pipeline and a comparison with a standard procedure—is also missing. This is partly compensated by information in professional publications, where some relevant details can be found, but it is not clear what role the author of the dissertation played in these publications and specific details.

Significance for Practice and Development in the Field of Biomedical and Clinical Technology:

The work has potential relevance to clinical practice, where it can contribute to the earlier detection of the manifestations of Parkinson's disease. If the pipeline proves to be of higher quality than the common standard used in the SPM toolbox, it could be adopted by the wider scientific community for processing other MR data.

Formal Preparation of the Dissertation and Language Level: The dissertation is formatted in a non-standard way, and the inclusion of images like the butterfly and drums is surprising. The work uses several font types and different indentations. The text is understandable, with relatively few errors.

Comments and Final Evaluation of the Dissertation: The dissertation fulfills the set goals, but it is not clear whether the author implemented her own methods or simply used publicly available software for data processing. The lower level of the dissertation text is compensated by the author's peer-reviewed publications.

Based on its clinical contribution, despite the mentioned shortcomings, I recommend the work for defense.

Defense Questions:

1. Have you compared your pipeline with a standard—if so, which one?
2. Why did you use the definition of the Theta band as 4-10 Hz—in standard clinical practice, this already overlaps with the alpha band. Could this have affected the results?
3. You use FDR and FWE corrections in your work. Why did you use different approaches, and which do you find more advantageous for different datasets?