Alzheimer’s disease (AD) is an irreversible, progressive neurodegenerative disorder, and the most frequent cause of dementia. It is characterized by structural changes in the brain, caused by an ongoing loss of neurons and connections between them, leading to a gradual loss of cognitive functions, and eventually to death. A successful diagnosis and assessment of the disease severity is difficult, since the early symptoms such as memory impairment can easily be mistaken for a natural part of ageing. Moreover, the structural brain changes in AD patients are also present in the brains of the normal elderly, as well as in other forms for dementia.

The most commonly used imaging modality for AD detection is magnetic resonance imaging (MRI), which successfully detects the already advanced AD atrophy and aids the diagnosis. However, there is an urging need to accurately quantify and evaluate the progression of atrophy in AD, which would allow accurate assessments of the severity of the disorder. Furthermore, treatment assessment also require the precise ability to measure if the rate of atrophy decreases or stops entirely.

The aim of this thesis was to provide methods utilizing the morphology of cortical sulci as a structural biomarker for quantifying the atrophy in AD and mild cognitive impairment (MCI), a substantial risk factor for AD, where a patient exhibits a noticeable and measurable decline in cognitive abilities. Four studies have been conducted in the process, where both the global and local properties of cortical sulci were analyzed. Sulcal surface, volume and curvature were computed as global features for AD classification in Study I, whereas an algorithm was developed in Study II to extract the local sulcal features: depth and length. Cortical thickness was incorporated in Study III to increase classification accuracies of AD and MCI. Study IV aimed at predicting the future conversion to AD in MCI subjects by means of analyzing the features that distinguish MCI subjects who subsequently progress to AD, and those who remain stable.

The results presented in this thesis show that sulcal morphology could be a potentially powerful biomarker for detection of AD or other neurodegenerative disorders. Sulcal morphology features have been shown to accurately distinguish AD from normal controls with an accuracy of 87.9%. The addition of cortical thickness measures significantly increased the classification accuracy of AD to 96.4%, but sulcal features were more sensitive in classifying early MCI from AD and CN. The combination of these two morphometric measures provided high prediction rates of AD conversion in MCI subjects, competitive with the state-of-the-art methods.
To fulfill the requirements for the PhD degree, Maciej Plocharski has submitted the thesis: “Sulcal Morphology Analysis from MRI Data for Classification of Alzheimer’s Disease”, to the Faculty Council of Medicine at Aalborg University.

The Faculty Council has appointed the following adjudication committee to evaluate the thesis and the associated lecture:

**Professor Rolf Heckemann**  
Gothenburg University  
Sweden

**Professor Rasmus Larsen**  
Technical University of Denmark  
Denmark

**Chairman:**  
Associate Professor Carsten Dahl Mørch  
Department of Health Science and Technology  
Aalborg University  
Denmark

**Moderator:**  
Associate Professor Mette Dencker Johansen  
Department of Health Science and Technology  
Aalborg University  
Denmark

The PhD lecture is public and will take place on:

**Friday 18 August 2017 at 13:00**  
Aalborg University  
Fredrik Bajers Vej 7 C2-209  
9220 Aalborg East

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**Program for PhD lecture**

**by**

**Maciej Plocharski**

**Friday 18 August 2017**

**Sulcal Morphology Analysis from MRI Data**

**for Classification of Alzheimer’s Disease**

Chairman: Associate Professor Carsten Dahl Mørch  
Moderator: Associate Professor Mette Dencker Johansen

13.00 Opening by the Moderator
13.05 PhD lecture by Maciej Plocharski
13.50 Break
14.00 Questions and comments from the Committee  
Questions and comments from the audience at the Moderator’s discretion
16.00 Conclusion of the session by the Moderator

After the session a reception will be arranged in C1-215, FRB 7 C