A vertex clustering model for disease progression: Application to cortical thickness images

Răzvan V. Marinescu[1], Arman Eshaghi[1,2], Marco Lorenzi[1,4], Alexandra L. Young[1], Neil P. Oxtoby[1], Sara Garbarino[1], Timothy J. Shakespeare[3], Sebastian J. Crutch[3], and Daniel C. Alexander[1], for the Alzheimers Disease Neuroimaging Initiative*

[1] Centre for Medical Image Computing, Computer Science Department, University College London, UK
[2] Queen Square MS Centre, UCL Institute of Neurology, London
[3] Dementia Research Centre, UCL Institute of Neurology, University College London, UK
[4] University of Côte d'Azur, Inria Sophia Antipolis, Asclepios Research Project

Abstract. We present a disease progression model with single vertex resolution that we apply to cortical thickness data. Our model works by clustering together vertices on the cortex that have similar temporal dynamics and building a common trajectory for vertices in the same cluster. The model estimates optimal stages and progression speeds for every subject. Simulated data show that it is able to accurately recover the vertex clusters and the underlying parameters. Moreover, our clustering model finds similar patterns of atrophy for typical Alzheimer's disease (tAD) subjects on two independent datasets: the Alzheimer's Disease Neuroimaging Initiative (ADNI) and a cohort from the Dementia Research Centre (DRC), UK. Using a separate set of subjects with Posterior Cortical Atrophy (PCA) from the DRC dataset, we also show that the model finds different patterns of atrophy in PCA compared to tAD. Finally, our model also provides a novel way to parcellate the brain based on disease dynamics.

Keywords: Disease Progression Model, Cortical Thickness, Vertex-wise Measures, Alzheimer's Disease, Posterior Cortical Atrophy

1 Introduction

During the progression of Alzheimer's disease, many biomarkers based on Magnetic Resonance Imaging (MRI) such as cortical thickness become abnormal at

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