Analyzing Large-Scale Neuroimaging Data in Alzheimers Disease

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Country

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Title of project or programme

Analyzing Large-Scale Neuroimaging Data in Alzheimers Disease

Source of funding information

NIH (NIA)

Total sum awarded (Euro)

€ 2,280,602.75

Start date of award

30/09/2016

Total duration of award in years

1

The project/programme is most relevant to:

Alzheimer's disease & other dementias

Keywords

Acquired Cognitive Impairment... Aging... Alzheimer's Disease... Alzheimer's Disease including Alzheimer's Disease Related Dementias (AD/ADRD)... Brain Disorders... Clinical Research... Clinical Research - Extramural... Dementia... Diagnostic Radiology... Networking and Information Technology R&D... Neurodegenerative... Neurosciences

Research Abstract

Analyzing Large-Scale Neuroimaging Data in Alzheimer’s Disease Abstract: Advances in imaging technology offer great opportunities to study Alzheimer’s disease (AD) in many ways that are not previously possible. This leads to various large-scale imaging studies, i.e., ADNI, for discovering AD-related imaging biomarkers. In these imaging studies, image registration plays a key role in reducing the confounding inter-subject variability and also enhancing the statistical power of identifying abnormalities related to AD. However, automated processing of large-scale imaging data, i.e., involving anything from hundreds to thousands of 3D brain images, is not trivial and requires dedicated computational tools. The goal of this project is to develop a series of novel deep multi-layer groupwise registration methods for effective, efficient and simultaneous registration of all brain images with possibly large anatomical and appearance differences. Also, to accommodate for new images acquired from the on-going large-scale imaging study, an efficient incremental groupwise registration method will be further developed to avoid time- and resource-consuming re-registration of all new and existing images from scratch. Our key idea is to break down the complex groupwise registration problem into hierarchical sets of small- scale registration tasks that can be solved easily, thus making the large-scale registration more manageable and fast. Specifically, 1) for fast initialization of large-scale groupwise registration of brain images, we will develop in Aim 1 a hierarchical learning-based landmark detection algorithm, based on random forest regression, to detect salient anatomical landmarks and then jointly align all images with detected landmarks. Since all images are distributed in a complex manifold and also the registration of similar images is much faster and more accurate, we propose to first build a graph to link each image only with similar images, and then formulate groupwise registration as dynamic graph shrinkage. This avoids direct registration of each image to the group-mean image as done in the conventional methods, thus improving both speed and accuracy. 2) To significantly speed up and also improve this single-layer graph-based groupwise registration, we will further develop in Aim 2 a deep multi-layer groupwise registration by simultaneous layer-by-layer graph construction and layer-wise registration. 3) Finally, to significantly increase both the speed and accuracy of registration for new images acquired from on-going large-scale imaging study, we will develop in Aim 3 a novel incremental groupwise registration method to reuse previous registration results of existing images for guiding registration of new images. Specifically, each new image can be quickly registered to the common space of existing images by finding its most similar existing image(s). Accordingly, all new and existing images will become similar in the common space and then can be quickly updated for their overall groupwise registration. All computational tools developed will be made freely available to the research community, for accelerating the imaging study of Alzheimer’s disease.

Lay Summary

Narrative Description of Project Modern imaging techniques offer great opportunities to study Alzheimer’s disease (AD) in many ways that are not previously possible. This leads to increasing number of large-scale imaging studies, including ADNI. However, the overwhelmingly big data poses new challenges to researchers in automated data processing. Thus, modern computational tools are expected to be able to handle the vast amount of data within a manageable time frame. In light of this, we aim to solve this large-scale spatial registration problem – a critical step directly related to accuracy and precision of imaging biomarkers to be discovered for AD. In particular, we will develop novel deep multi-layer groupwise registration methods for effective, efficient and simultaneous registration of all brain images with possibly large anatomical and appearance differences. Also, to accommodate for new images acquired

from the on-going study, an efficient incremental groupwise registration will be further developed to avoid time- and resource-consuming re-registration of all new and existing images from scratch. The development of these advanced computational tools will eventually benefit for discovery of new imaging biomarkers for AD.

Further information available at:

Types:
Investments > €500k

Member States:
United States of America

Diseases:
Alzheimer's disease & other dementias

Years:
2016

Database Categories:
N/A

Database Tags:
N/A