IUMS CMRC INSS

5th Basic and Clinical NEUROSCIENCE Congress 2016

December 7-9, 2016 Razi Hall, Tehran, Iran

This is to certify that

Mahdi Saadatmand Tarzjan

Had an Oral Presentation Entitled:

"A Novel Automated Method for Early Diagnosis of Alzheimer Disease by Using T1-Weighted Magnetic Resonance Images"

in the 5th Basic and Clinical Neuroscience Congress

7 - 9 Dec. 2016 Tehran, Iran

Prof. Mohammad Taghi Joghataie
Chairman

Dr. Ali Yoonessi
Basic Scientific Secretary

Dr. Mohammad Ghadiri
Clinical Scientific Secretary

A Novel Automated Method for Early Diagnosis of Alzheimer Disease by Using T1-Weighted Magnetic Resonance Images

Abstract

Introduction:

Alzheimer disease (AD) is a devastating cognitive disorder caused by progressive degeneration of synapses and neurons of the brain regions related to learning and memory. In many patients, AD starts with the mild cognitive impairment (MCI). MCI causes cognitive serious-enough changes such as problems with memory, language, thinking, and judgment, but they are not severe-enough to interfere with daily life. Generally, 60% of MCI patients will not progress to AD or any other dementia. Therefore, for early diagnosis of AD, evaluation of the brain atrophy is necessary. In this research, we propose a novel method for distinguishing AD from MCI and control by registration of T1-weighted MR brain images with a digital medical atlas.

Method:

First, the patient's MR image is aligned with the digital atlas ICBM152 by using the (rigid) affine transformation. The rigid transformation is not flexible-enough to accurately fit local structures of the patient's brain to the corresponding features of the atlas. Thus, in the second step, by using a non-rigid transformation which provides a displacement vector for each voxel, the patient's MR image is accurately registered to ICBM152. For both the rigid and non-rigid registrations, we take advantage of the well-known frequently-used SPM toolbox on the MATLAB programming environment. Third, by mapping the digital atlas MNI AAL to the domain of the patient's MR image (using both the rigid and non-rigid transformations), different regions of the brain gray-matter are separated. Clearly, the displacement vector field (*i.e.* the non-rigid transformation) involves important data of the brain atrophy. Therefore, in the fourth step, we compute the average and covariance matrix of displacement vectors of all voxels within every region of the gray-matter. Then, all the resultant coefficients are sequentially arranged in a feature vector. Finally, AD, MCI, and control are distinguished by using the maximum a-posteriori probability (MAP) classifier.

In this research, we take advantage of 30 AD, 30 MCI, and 20 control MR images chosen from the database ADNI of the LONI image data archive (LONI IDA). In all categories, 50% of feature vectors are used for training of MAP.

Results:

The proposed algorithm could successfully register patients' images to the digital atlas with the cross-correlation coefficient of 0.87, on average. Furthermore, by visual comparing the feature vectors of AD and MCI patients, considerable volume changes were observed in the hippocampus, mid temporal lobe, and precuneus. Finally, the proposed MAP classifier could successfully distinguish AD from MCI and Control with the accuracy of 97%.

Conclusion:

In this paper, a new method was proposed for early diagnosis of AD based on registration of T1-weighted MR image of patient's brain with the digital atlas ICBM152. We trained a MAP classifier by using feature vectors computed by using the displacement vector field of the non-rigid registration. Experimental results demonstrated that the proposed algorithm could successfully distinguish AD from MCI and control with significantly large accuracy.

Keywords:

Alzheimer Disease (AD); Mild Cognitive Impairment (MCI); Magnetic Resonance Imaging (MRI); Image Registration; Maximum A-posteriori Probability