

DIFFERENTIATION OF MR BRAIN ALZHEIMER IMAGES USING BI-PLANAR CANONICAL CORRELATION BASED FEATURE FUSION

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ABSTRACT

Alzheimer's Disease (AD) is a progressive irreversible neurodegenerative disorder which involves the deformations in brain sub-anatomic regions. Recent studies suggest that these deformations could be characterized using bi-planar information extracted from structural Magnetic Resonance (MR) image features. However, analysis and fusion of these bi-planar features have been a challenging task in AD differentiation. In this study, an attempt has been made to fuse the characteristics of axial and sagittal view MR images using Canonical Correlation Analysis (CCA) for the differentiation of Healthy Controls (HC) and AD. For this, MR brain images obtained from a public database are skull stripped and spatially registered. Morphometric features are extracted from the pre-processed mid-sagittal and mid-axial images using histogram of oriented gradients. Further, these extracted features are fused using CCA. The performance of classifier is analyzed for the variations in canonical component dimensions. Results indicate that the morphometric feature spaces extracted from sagittal and axial planes individually overlap for HC and AD. The proposed CCA based fusion of sagittal and axial features exhibit variations between HC and AD images for a canonical feature dimension of 30. Performance of the adopted approach confirms that the bi-planar feature fusion is essential for the differentiation of AD.

Keywords: Alzheimer's Disease, Magnetic Resonance Images, Feature Fusion, Canonical Correlation Analysis

INTRODUCTION

Alzheimer's Disease (AD) is an insidious neurodegenerative disorder which is symptomatically characterized by a decline in the executive, memory and thinking abilities. It is the most prevalent form of dementia among elderly population. According to the World Alzheimer's Report, it is estimated that the number of AD patients world-wide will reach about 152 million by 2050 [1]. Due to this increasing prevalence, it is essential to accurately diagnose AD.

Pathological hallmarks of AD include formation of neurofibrillary tangles and accumulation of amyloid plaques, which leads to a consequent loss of brain tissues [2]. This brain atrophy assessed on structural Magnetic Resonance (MR) images is considered to be an important biomarker in characterizing AD. MR images are widely preferred for the disease diagnosis as they are able to accurately quantify the neurodegeneration of specific gray and white matter structures [3].

Several MR image-based Computer-Aided Diagnosis (CAD) approaches have been proposed for AD diagnosis. CAD methods employing whole brain MR analysis have been used in the differentiation of disease stages as they do not require prior knowledge or involvement of segmentation techniques for delineating brain structures [4]. In order to capture the characteristics from brain MR images, different feature extraction techniques have been employed. Shape descriptors such as geometric and Histograms