Proposal of final project for
Professional Master or Engineer

Project title:
Development of new diagnostic techniques for analyzing the structural Magnetic Resonance Imaging (sMRI) of the brain in Alzheimer's disease.

Background:
Alzheimer disease is the major causes of dementia in people over 65 years, and this incidence is expected to increase in coming years with the rapid aging of the population. This disease presents a complex diagnosis, being certainly a challenge in the early stages. The clinical assessment of evolution or detection in these stages, can be useful to decide the treatment to be followed for the patient, which can slow or even stop the progress of the disease.

In recent decades, it has grown exponentially interest in incorporating data from different medical imaging modalities in clinical practice to achieve a more effective diagnosis of patients in study practice. In patient care, the clinical benefits of medical imaging depend critically on the quality of the acquired images and the ability of their interpretation by physicians. For many years, it has been recognized that even the best and the most experienced specialists make mistakes in interpreting medical tests. These mistakes that often lead to failures in the perception and interpretation of data. Perceptual errors occur when there is an abnormality in the visual field of the observer but remain undetected. The misunderstandings occur when there is abnormality, but are incorrectly interpreted as normal or benign. These errors can be attributed to fatigue observer of the human visual system limitations, distractions, level of experience, etc.

In this context, Computer aided diagnosis (CAD) systems are introduced to help the improvement of the disease detection. The diagnosis by computer has become one of the major areas of research in the field of analysis and interpretation of medical imaging. The aim
of these CAD systems is not to achieve accuracy value equal to or even higher than that of physicians, but rather to provide additional information to aid in the decision making.

In the future, these CAD systems could be incorporated as essential diagnostic test elements available in the hospitals. These systems will improve the capacity of early detection of neurodegenerative diseases, such as, Alzheimer's disease. Furthermore, they can evaluate the treatments, which slow or delay the disease progress.

**Objective:**

The general aims of this project are to develop, implement, validate and integrate a specific computer-based model for cerebral neurodegenerative disease. It can be used for early and differential diagnosis of Alzheimer's diseases, characterizing its different stages.

This model will be based on existing, intensive, computer-based statistical and intelligent system. In addition, we will take the advantage of large and shared datasets of sMRI images from the Alzheimer's disease Neuroimaging Initiative (ADNI) datasets.

Firstly, the candidate will focus mainly on the pre-processing step which will be based on the use of feature selection methods, such as, t-test, Mann-Whitney-Wilcoxon and the feature extraction methods, such as, PLS, PCA and ICA. These methods can reduce the data dimensionality using the voxel information contained within the data set. Moreover, they are capable of extracting the most relevant information related to the disease.

Secondly, an automatic classification of sMRI will be applied in the context of identifying patients with Alzheimer's disease.

The performance of the proposed CAD system will be estimated through a k-fold cross-validation strategy.

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Bibliographic references:


