

Neurodegeneration markers from structural MRI and FDG-PET brain images: the Alzheimer's disease case study

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In the framework of neurodegenerative diseases, and in particular the Alzheimer's disease (AD), we are witnessing an increasing presence of neuroimaging data, magnetic resonant images (MRI) and positron emission tomography (PET) above all. Despite the fact that clinical scanners have been around for some decades, MRI and PET images have only recently become a dependable support in diagnosing early and prodromal AD. The purpose of image analysis is to find supporting evidence to help in early clinical assessment. In the case of neurodegeneration leading to AD, we would ideally look for a measure (marker) able to discriminate between normalcy versus pathology at a pre-clinical stage, easy to implement in clinical practice and possibly based on quick, low- cost, and widely available procedures. In addition, a “good” marker should have predictive value as to whether a subject with current unknown or unclear clinical assessment will or will not develop the pathological condition in a given timeframe. Research supported by INFN experiment MIND (Medical Imaging for Neurodegenerative Diseases) is targeted at developing physical and statistical methods to find reliable and accurate image-based markers, with potential applications in the clinical practice. From a data analysis point of view, the problem can be restated as a measure of a “signal” (the pathology marker) on a “background” of normalcy. Whether a marker can have predictive value at all implies that it must be sensitive to some key aspects of the pathology process well before their effects have a clear clinical counterpart. We shall give an overview of some relevant branches in brain image analysis and the requirements to define a suitable signal over the confounding variability (noises) peculiar to life-science studies.