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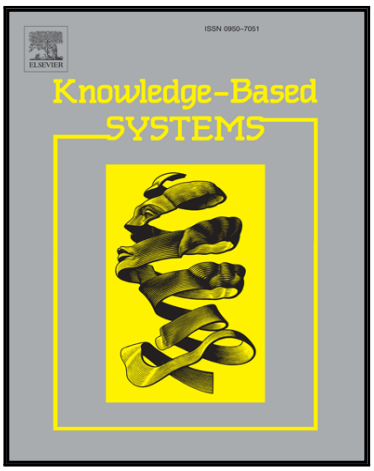

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Francisco Lozano, Andrés Ortiz, Jorge Munilla, Alberto Peinado, for the Alzheimer's Disease Neuroimaging Initiative

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Automatic computation of regions of interest by Robust Principal Component Analysis. Application to automatic dementia diagnosis

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Abstract

Computer aided diagnosis systems based on brain imaging are a powerful tool to assist in the diagnosis of Alzheimer's Disease (AD). The goal is the automatic recognizing of neurodegenerative patterns that characterize the disease. In this regard, determining regions related to the disease results crucial to select the most discriminative voxels and to optimize the number of features to be used in the learning algorithm. In this paper, we propose a method based on the robust principal component analysis (Robust PCA) algorithm that allows to automatically compute Regions Of Interest (ROIs) over a training set of images and rank them according to their diagnostic relevance. Robust PCA is used to compute the sparse error matrix, which is, in turn, employed to determine the brain areas related to the Alzheimer's disease. These areas are further used as a mask to select and weight the most discriminative voxels to construct a classification model. We then describe a method to fuse the features computed from different image modalities based on the weights assigned by the individual Support Vector Classifiers during the training process. The method presented here has been applied to multimodal image containing both functional (18F-FDG PET) and structural (Magnetic Resonance) data. Experiments, conducted using 68 control subjects and 70 AD patients, show the effectiveness of the proposed approach for the exploratory analysis. At the same time, classification experiments using the features computed by the proposed method and assessed by cross-validation showed accuracy values up to 92% and AUC (Area Under the Curve) of 0.95. Thus, the proposal seems as an effective technique to reveal ROIs in differential diagnosis applications and to combine multimodal image data, outperforming other classification methods, including the voxel-as-features (VAF) baseline.

Keywords: Robust PCA, Exploratory Analysis, Multimodal image data, Regions of Interest, Information Fusion, Alzheimer's Disease, Computer-aided diagnosis.

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[1]Data used in preparation of this article were obtained from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database (adni.loni.ucla.edu). As such, the investigators within the ADNI contributed to the design and implementation of ADNI and/or provided data but did not participate in analysis or writing of this report. A complete listing of ADNI investigators can be found at: http://adni.loni.ucla.edu/wpcontent/uploads/how_to_apply/ADNI_Acknowledgement_List.pdf.

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