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RESTING STATE FMRI FUNCTIONAL CONNECTIVITY ANALYSIS USING SOFT COMPETITIVE LEARNING ALGORITHMS

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Summary: Resting state fMRI data analysis for functional connectivity explorations is a challenging topic in computational neuroimaging. Several approaches have been investigated to discover whole-brain data features. Among these, clustering techniques based on Soft Competitive Learning (SCL) have been shown effective in providing useful information in various context; however, although significant achievements have been reached, these techniques still present critical aspects that require further investigations. We selected three clustering algorithms, i.e. Self-Organizing Maps (SOM), Neural Gas (NG) and Growing Neural Gas (GNG), to study the intrinsic functional properties of images coming from a shared repository of resting state fMRI experiments (1000 Functional Connectome Project); specially, we used Oxford dataset [N=22 healthy subjects; 12M/10F; ages:20-35; TR=2, slices=34; timepoints: 175; magnet: 3T) because it has a nice gender balance and a small age spread. Before starting the analysis, we processed data using FSL standard tools to made filtering, motion correction, standard registration and brain segmentation; to compute the data reduction, we extracted the BOLD signal with the semantics of Harvard-Oxford atlas (96 ROIs). To test the gender difference, we used parametric and non-parametric statistical methods (one-way ANOVA and Kruskall-Wallis test). Furthermore, we investigated the within gender variability with algebraic metrics such as Manhattan/Taxi-cub (L1 distance) and Euclidean (L2 distance). Also, to compare the functional connectivity based on soft clustering, we calculated the Seed Based Linear Correlation (SBLC) to study the Default Mode Network (DMN) functionality, i.e. we found that Precuneus L/R has the higher Correlations Coefficients (CC > 0.80) with its controlateral part and with the posterior division of Cingulate Gyrus. The differences among the three soft clustering algorithms adopted were deeply analyzed and measured basing on Jaccard Similarity Coefficient (JSC), whereas the quality of clusters has been evaluated with Davies-Bouldin separation measure (DB Index). The preliminary results obtained show, globally, a good behavior of the clustering techniques adopted with mutual advantages and disadvantages. In the final paper, we will compare the brain's temporal properties, i.e. the DMN functional connectivity computed by Seed Based Linear Correlation analysis (SBLC), with the discovered whole-brain functional features, clustered by Soft Competitive Learning algorithms (SCL).