

BrainCON: software tool for graph theory based multimodal brain connectivity analysis and visualization

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PURPOSE OF THE SOFTWARE

Graph theory based structural and functional brain connectivity analysis is a novel method providing new insights into the dynamics and complexity of the brain by modeling its regional interactions [1]. Due to the heterogeneity and dynamic development of the applied mathematical models and analysis techniques the software support of this field is still poorly accomplished [2].

Our purpose was to develop a user friendly software system dedicated for the analysis and visualization of multimodal brain connectivity data based on EEG, fMRI and DTI data.

METHODS/IMPLEMENTATION/HARDWARE REQUIREMENTS

The software system has modular architecture which provides the opportunity to rapidly follow the latest improvements of connectivity analysis and visualization methods by incremental development. Reconstruction of brain networks is modality dependent and can be performed with various state-of-the-art software tools, eg. BrainLOC (www.minipetct.com/brainloc) [3], Matlab and R for fMRI, FSL or Matlab softwares for DTI and NeuroGuide for EEG-LORETA data. These software tools can be easily fitted into the processing pipeline of the system. The resulting connectivity matrices can be displayed and thresholded interactively. Various interchangeable components are present for global (eg. small-worldness), modular (eg. community detection, modularity scores) and nodal (eg. various hub-scores) analysis of binary and weighted graphs in both individual and population level [4]. Cost-integration [5] technique was implemented to solve the problem of thresholding networks. Interpreting the results is aided by real-time 2D and 3D “galss brain” visualization techniques and various plots.

The program is built upon the MultiModal Medical Imaging (M3I) software library system (www.minipetct.com/m3i) and runs on Windows 7 and Windows Xp operation systems and various Linux distributions (www.minipetct.com/braincon). The hardware requirements of the application match the current average PC configurations used in medical image analysis.

The software system was implemented mainly in C++ and partly in R.

FEATURES ILLUSTRATED AT THE EXHIBIT

At the exhibit fMRI, EEG-LORETA and DTI based connectivity data analysis is demonstrated.

Different methods (like binary and weighted analysis) are evaluated on the same data, connectivity patterns and hub-scores corresponding to brain regions are visualized in 3D.

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