Graph Var

Quick Guide
GraphVar: A user-friendly toolbox for comprehensive graph analyses of functional brain connectivity.

• **features:**

  I. Pipeline construction of graph networks
  II. Calculation of network topological measures
  III. Generation of subject specific random networks
  IV. (Partial) correlation analyses of network measures with user defined variables
  V. Perform group comparisons (t-test, ANOVA) on network measures
  VI. Calculations on raw connectivity matrices (Network based statistics)
  VII. Parametric and non-parametric testing
  VIII. Interactive and visual results exploration

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Getting Started

I. Unzip in your preferred directory
II. Add to your Matlab path (Add Folder ...)
III. Start with the command „start_GraphVar“
IV. Create a new workspace or try the „SampleWorkspace“ with the sample data

Requirements:

I. This current version runs under Windows and Linux
II. Matlab Statistics toolbox for statistical analyses (calculation and export of graph measures will work without)
III. If SPM is installed you may have to move the statistics toolbox to the top to prevent conflicts
The Analysis Setup GUI
Welcome
Setup panel
Input:

- Time course...
- Node 1
- Node 2
- Node 3
- Node n

- Subject data (e.g. clinical data)

Pipeline network construction (incl. null-model networks)

Calculate network topological measures (incl. normalization)

Use raw connectivity matrices (generate null-model networks)

Statistical analyses (partial) correlation, t-tests, ANOVA with clinical data

Export graph metrics to spreadsheet (csv/xlsx)

Interactive results exploration (incl. network based statistics)

Workflows
Calculate and export graph metrics

Statistics on raw matrix

Workflows
Setup panel (mouse over help)
Underlying codes from the Brain Connectivity Toolbox (Rubinov and Sporns, 2010)
Parallel Computing (with toolbox)
General settings
Load (existing) Connectivity Matrices

Subject's Association Matrices
Generate Connectivity Matrices

Individual nodal time courses

Node 1 | Node 2 | Node 3 | Node n

Time course... | Time course... | Time course... | Time course...

GraphVar - Sample Workspace

Select Subjects (Conn Matrix)

- Partial correlation (control for nodes)
- Spearman correlation
- Percentage bend correlation
- Mutual information

Generate Conn Matrix (default: Pearson)

Weights
- No Change
- absolute weights
- negative weights to zero

Statistics with already calculated values

Test against random data

Number of repetitions

Calculate & Statistics

Switch Workspace
Open Previous Results
Label nodes
Label nodes
Redefine Network (Subnetwork analyses)
Variable Selection
Variable Selection
Network construction
Null model Networks
Network topological measures
Export Network topological measures
Correlate your variables with the network topological measures.
Perform group comparison (t-test, ANOVA) with the network topological measures.
Non-parametric testing on the metric level

Non-parametric testing (correlation)  Non-parametric permutation testing (group)

Non-parametric testing
Non-parametric testing on the network level

Non-parametric testing (correlation)
Network-based statistics can be calculated on raw matrix using correlational analysis, or group comparisons (t-test, ANOVA).
Network-based statistics

Similar as in the NBS toolbox, GrapVar uses graph components to test for significant associations (comparing against random data)
Ready to go!
Status bar
The Results Viewer GUI
### Select Variables to see the results

<table>
<thead>
<tr>
<th>Variable</th>
<th>GraphVar</th>
<th>Threshold</th>
<th>Brain Areas</th>
</tr>
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<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>0.12</td>
<td>Temporal_Sup_L</td>
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<tr>
<td>fantasy_score</td>
<td>clustering_coeff_bu</td>
<td>0.15</td>
<td>Temporal_Sup_R</td>
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</tbody>
</table>

Results selection box
Correction for multiple comparisons
One dimensional graph metrics

Association to dependent variable

Thresholds

Group mean female
Group mean male
sex (N=50) X clusterMeanBu
One dimensional graph metrics

Non parametric testing with random networks
Two dimensional graph metrics
Three dimensional graph metrics

Network nodes

Association to dependent variable

Thresholds

Network nodes
Associations to Rich club coefficients
Export Results
Plot single subject association matrices
Plot mean connectivity matrix across subjects
Identify Graph Components

Show graph component with Network Inspector
Network Inspector GUI
Identify Graph Components
Mouse over
Show association (correlation/group difference/ANOVA F)
Open directly in BrainNetViewer
(Xia et al., 2013; PlosONE)