

Individual modeling of neurophysiological brain connectivity

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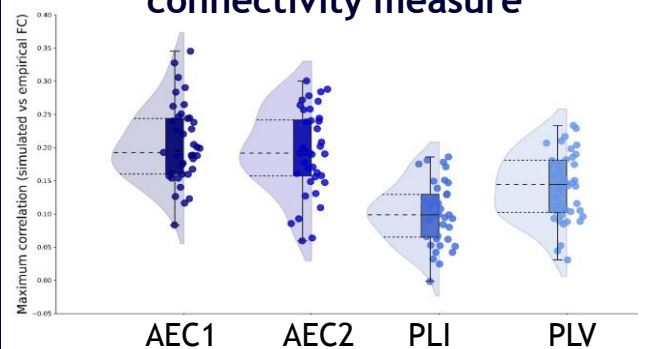
Aim:

Correlating MEG empirical functional connectivity in individual subjects with simulated functional connectivity based on individual structural connectivity

Methods

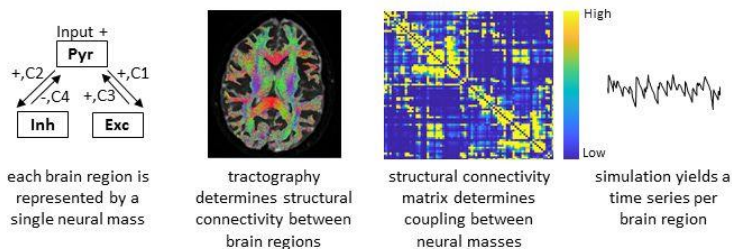
- Healthy participants (N=40) underwent structural and diffusion MRI as well as magnetoencephalography (MEG)
- Individual structural connectivity between the 78 cortical regions of the Automated Anatomical Labeling (AAL) atlas was determined using probabilistic tractography (Meijer et al, 2020)
- MEG data were source-reconstructed and time series were extracted from the 78 cortical regions of the atlas (Derks et al, 2018)
- Time series were also simulated using 78 neural masses as defined by Jansen-Rit, with the individual structural connectivity between atlas regions determining coupling between masses
- Functional connectivity between time series was determined using the amplitude-envelope correlation on the full length of recording (AEC full) or on individual epochs (AEC), phase lag index (PLI) or phase locking value (PLV)

We find reasonable correlations between empirical and simulated functional connectivity per connectivity measure

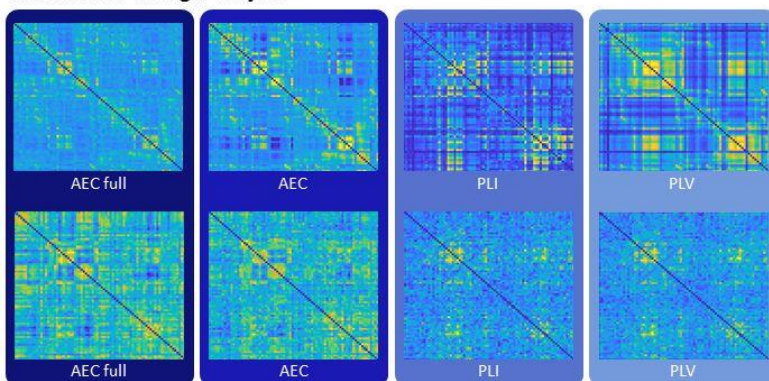


Schematic of the analysis pipeline

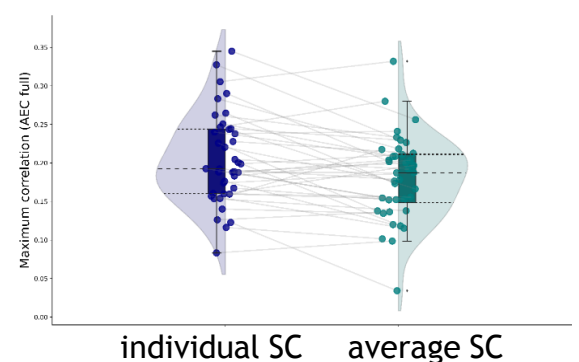
A. Simulation of time series for a single subject



B. Simulated (top row) and empirical (bottom row) functional connectivity matrices for a single subject



Use of individual structural connectivity yields slightly higher correlations than using an average structural connectivity matrix...



... but using individual SC did not result in higher correlations compared to using individual SC from other subjects.

Conclusions:

- Simulated and empirical MEG functional connectivity match to a reasonable extent, with values comparable to the generally expected correlation between structural and functional connectivity
- Amplitude-based empirical functional connectivity shows better correlations with simulations than phase-based functional connectivity
- There is potential relevance of individual simulations with neural mass models for the study of healthy brain functioning and disease progression in neurological disorders