Magnetic Source Imaging

Magnetoencephalography (MEG) and Electroencephalography (EEG) are the only two available non-invasive modalities for assessing direct neurophysiological activity in the human brain. MEG measures tiny magnetic fields and EEG measures electric potentials on the scalp surface, both arising from neuronal activity during cognition and during rest. Many emergent engineering challenges have been overcome in the process of reconstructing brain activity from MEG and EEG measurements – including calculation of accurate models of expected magnetic and electric field activity, accurate modeling of sources of noise and interference in the sensor measurements, and finally the ability to reconstruct brain activity from non-invasive measurements.

Advances in biomedical engineering and machine learning have enabled solutions to these problems resulting in high-fidelity reconstructions of brain activity and functional brain connectivity from MEG and EEG data – and such source reconstruction procedures are also referred to as electromagnetic brain imaging or MEG-EEG imaging. A review of these recent advances will be covered in the first part of this workshop talk.

MEG and EEG reconstruction algorithms can be used in conjunction with structural and functional MRI imaging data and in the second part of this talk, I will discuss emergent techniques for principled fusion of multimodal structural and functional imaging data, and novel techniques for connectivity analyses.