Large scale interactions in brain networks and their breakdown in brain diseases

Sprawozdania

Informacje na temat projektu

BRAINSYNC

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Strona internetowa projektu

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Ten projekt został przedstawiony w...

Periodic Report Summary - BRAINSYNC (Large scale interactions in brain networks and their breakdown in brain diseases)

The goal of BrainSync is to understand how neuronal assemblies exchange information (functional neuronal communication), and how variability in neuronal communication explains variability in behavioural performance, both in the intact and injured brain. While we know a lot about neural signals at the local level (single neurons and individual areas), and how they encode information about objects in the environment, motor actions, and even cognitive functions, almost nothing is known on how ensembles of areas exchange information and communicate to mediate complex behaviour.

The second year of the project has been characterised by a strong acceleration in the development of novel methods for recording, analysing, and modelling neural signals from human and non-human primates. The consortium as a whole has developed ex-novo or optimised at least 8 novel techniques that will be hereafter briefly described. As coordinator of BrainSync, I am especially proud of these achievements as science typically advances in leaps and bounds mostly and foremost based on the development of novel technologies or analyses.

Novel methods
- Two different pipelines of MEG data have been developed to look at interactions across brain regions in the resting state. One pipeline from UdA Chieti focuses on both band-limited power fluctuations and imaginary coherence of the signal. The first method was used to describe for the first time MEG brain networks of spontaneous correlation at rest (de Pasquale et al. 2010 Proc Natl Acad Sci U S A. 2010 Mar 30;107(13):6040-5). The second method is able to pick consistent lagged signal interactions between regions. The second pipeline from UKE Hamburg employs phase delays of the envelope of the power fluctuations to extract maps of orthogonalised phase correlation that solve the problem of local leakage between neighbouring voxels (Jorge Hipp, David J Hawellek, Andreas K Engel 2010 Society for Neuroscience, 2009: 381.24).
- KU Leuven in collaboration with UdA has developed a novel method to compare patterns of temporal correlation in the fMRI signal between monkeys and humans. The method is based on the cross-correlation and feature specificity of time series in one species onto time series from the other species

(D.Mantini M.Corbetta S.Kolster GL.Romani G.Orban V.Wanduffel Society for Neuroscience, 2009: 13.7).
- RU has continued to optimise the subdural grids for the recordings of local field potential activity from large swaths of the neocortex in monkeys (Rubehn B, Bosman C, Oostenveld R, Fries P, Stieglitz T. J Neural Eng. 2009 Jun;6(3):036003).
- RU and KU Leuven have combined MR-compatible subdural grids of electrodes with fMRI recordings in the monkey.
- KU Leuven and UCL have combined TMS with fMRI recordings in monkeys following the initial development of combined electrical microstimulation and fMRI as published in Science (Ekstrom LB, Roelfsema PR, Arsenault JT, Bonmassar G, Vanduffel W. Science. 2008 Jul 18;321(5887):414-7).
- UCL has pioneered in humans the combination of TMS with fMRI. In a recent study they extended this approach to the study of interactions during active behaviour (Blankenburg F, Ruff CC, Bestmann S, Bjoertomt O, Josephs O, Deichmann R, Driver J. Cereb Cortex. 2010 Feb 22)
- ICS Prague has developed a novel clustering algorithm for RSN's identification based on average association criterion which divides input elements (fMRI voxels) into disjoint clusters and a residual set.

Another important development in the second year was the convergence of results across a number of work packages on the presence of strong feedback interactions between regions in higher order parietal and frontal regions and visual cortex.

Finally, a number of important developments have occurred in each of the work packages as research in the consortium has steadily progressed.

Powiązane dokumenty

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