ORAL SESSION: Connectivity: Global Signals & Network Interactions

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Oral Sessions

Presentations

Does global signal regression remove alpha power fluctuations? An EEG-fMRI study in humans at rest

Global signal regression (GSR) is a controversial topic in fMRI as it is believed that by removing the global signal (GS) from the data, neuronal-related activity is removed as well [1,2] . Often the rationale behind GSR is that a strong component of fluctuations in GS is related to systemic low-frequency oscillations (SLFOs; [3–6]). However, recent simultaneous EEG-fMRI studies reported a strong negative relation between the variance of the GS and EEG-derived measures of arousal levels across scans [7,8] . These results suggest that GSR may potentially remove neuronal-related fluctuations that are of interest in resting-state FC. In this work, we examined the effect of GSR in fMRI-based FC estimates related to alpha activity.

Presenter

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Gastric-brain coupling predominates in primary and association sensory-motor regions

Signals from the gastro-intestinal tract are constantly relayed to subcortical, cortical and neuromodulatory structures, interacting with spontaneous brain activity and its underlying organization into resting state networks

(Azzalini, Rebollo, & Tallon-Baudry, 2019). We present here a refined anatomo-functional characterization of the gastric network, a new resting-state network composed of brain regions phase-synchronized with delays to the slow (0.05 Hz) electrical rhythm continuously generated in the stomach (Rebollo, Devauchelle, Béranger, & Tallon-Baudry, 2018).

Presenter

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Consistent global propagations across cortical hierarchy in the electrophysiological and fMRI signal

Infra-slow (<0.1 Hz) propagating structures have been found in resting-state functional MRI (rsfMRI) by using a template-refining approach to extract repeated quasi-periodic patterns (QPPs) (Majeed, et al., 2009) or by decomposing rsfMRI lag structures to recover lag threads (Mitra et al., 2015). However, recent studies have shown that a systemic low-frequency oscillation (sLFO) of blood signals induces systematic rsfMRI delays that are consistent with the expected blood transit time (Tong, et al., 2010), suggesting a potential contribution of hemodynamic delays to apparent rsfMRI propagations. To understand the neural origin of the infra-slow rsfMRI propagations, we examine and compare infra-slow propagating brain activity in human rsfMRI and monkey electrophysiology that is free of hemodynamic confounding.

Presenter

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Global signal topography changes across the lifespan

The global signal (GS) in fMRI studies has been identified as both a source of unwanted noise (1) and important neural signal (2). Removal of the GS has shown to eliminate unwanted artifacts due to participant movement and respiration (1) and also increase the strength of brain-behavior correlations (3), suggesting a non-neuronal origin of the GS. However, our recent work has shown that the spatial topography of the GS is coherently related to a number of behavioral variables. This suggests that the GS may be linked to individual behavioral traits (1). Building on this surprising finding, we set out to systematically explore the spatial topography of GS changes across the lifespan. Changes in the spatial topography across the lifespan related to network organization would provide corroborative evidence for a neuronal origin of the GS.

Presenter

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Structural connectome manifolds guide dynamic functional network reconfigurations

A core assumption of neuroscience is that brain structure governs ongoing function (Park and Friston, 2013). Recent neuroimaging studies have established the pattern of structure-function coupling at macroscale (Mišic et al., 2016). Yet, studies have generally adopted an oversimplified model of brain function by assuming stationarity. The brain, however, is an inherently dynamic system, where function and ultimately cognition evolve over time (Allen et al., 2012). Here, we aimed to formulate a novel framework to understand how the emergence of momentary neural states, as identified using Hidden Markov Models (HMM), are constrained by the structural organization of the cortex.

Presenter

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Whole-brain estimation of directed connectivity from fMRI data

Developing whole-brain models that infer effective (directed) connectivity among neuronal populations from neuroimaging data represents a key challenge for computational neuroscience. Dynamic causal models (DCM) (1) have been used frequently to infer effective connectivity, but are presently restricted to small graphs (of approx. 10 regions) to keep model inversion feasible. Here, we report empirical applications of regression DCM (rDCM), a novel variant of DCM for fMRI that enables whole-brain effective connectivity analyses (2,3).

Presenter

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