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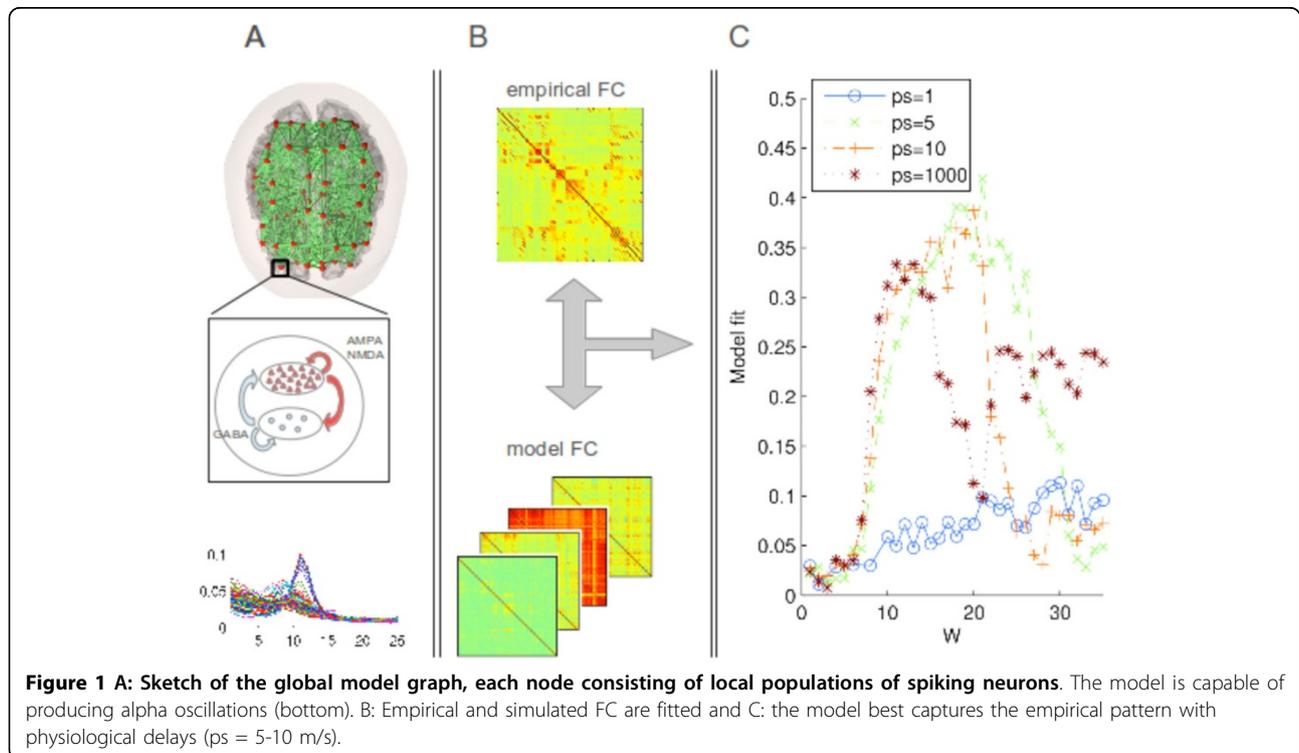
Modeling Alpha-Band Functional Connectivity for MEG Resting State Data: Oscillations and Delays in a Spiking Neuron Model

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The study of structural and functional connectivity (SC, FC) and dynamics in spontaneous brain activity is a rapidly growing field of research [1]. The existence of Resting State Networks (RSN) has been well established

in fMRI over the past decade, [1] and computational models [2] have successfully captured their connectivity patterns and slow oscillations, but have not been applied to recent MEG findings of coherent RSN [3] yet.



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Here, we extended a recent neurophysiologically realistic spiking-neuron model of spontaneous fMRI activity [4] to exhibit noisy oscillatory activity in the alpha band (Figure 1A, bottom) and studied how connectivity and delays influenced the model fit with the oscillatory MEG FC. The global network was described by a graph of nodes (local populations of excitatory and inhibitory spiking neurons), connected to each other according to a DTI-derived anatomical connectivity matrix, which fixed the relative connectivity and delay/distance structure, but left global scaling factors W (coupling weight) and ps (propagation speed in m/s) as free parameters in the model. FC was measured by correlating the low-pass filtered Power Envelopes of the bandlimited signal. Simulations showed the largest margin of good concordance with empirical FC over W when neurophysiologically realistic delays (5-10 m/s) were included (Figure 1C).

Conclusions

In the presence of noisy oscillations on the same order of magnitude as system delays, the temporal connectivity structure plays a role in shaping the functional network connectivity. By effectively decreasing strong synchronous inputs to nodes, the network is stabilized and the need for fine-tuning of global coupling reduced when compared to the absence of delays.

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References

1. Lang EW, Tomé AM, Keck IR, Górriz-Sáez JM, Puntinet CG: **Brain Connectivity Analysis: A Short Survey**. *Comput Intell Neurosci* 2012, 2012:1-21.
2. Deco G, Jirsa VK, McIntosh AR: **Emerging concepts for the dynamical organization of resting-state activity in the brain**. *Nat Rev Neurosci* 2011, 12:43-56.
3. Brookes MJ, Woolrich M, Luckhoo H, Price D, Hale JR, Stephenson MC, Barnes GR, Smith SM, Morris PG: **Investigating the electrophysiological basis of resting state networks using magnetoencephalography**. *Proceedings of the National Academy of Sciences* 2011.
4. Deco G, Jirsa VK: **Ongoing Cortical Activity at Rest: Criticality, Multistability, and Ghost Attractors**. *J Neurosci* 2012, 32:3366-3375.

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