Synchronisation on structural connectivity brain networks

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A key question in neuroscience is the relation between the structure (the physical wiring of the brain: the pathways of axons connecting brain regions) and the functioning of the brain.

A way to address this question in general is to simulate a (highly simplified) model of neural activity on a network that models/represents the structure of the brain, and to analyse the properties of the results of this simulation. I investigate a specific sub-question: can we understand the occurrence of epilepsy (excessively synchronised neural activity), based on the Kuramoto model implemented of different subnetworks of the whole brain structural connectomes? The Kuramoto model is a model of coupled oscillators. These oscillators evolve independently if the coupling (mutual influence between the oscillators) is low, and synchronise when the coupling is high (mediated by the spread in the natural frequency of the oscillators). The interesting stuff happens in between: for what critical coupling do the oscillators start to synchronise and how abruptly does this transition happen? If this transition happens very abruptly, then it's more likely that a seizure originating in that region will spread faster. This is why the Kuramoto model could give some insight in the relation between the occurrence of epilepsy (function) and the physical wiring in the brain (structure). This is still work in progress, rather then a finished work with clear conclusions.