Large-Scale Network Structure of the Human Brain

Goal: A comprehensive structural description of the network of elements and connections forming the human brain.

This foundational data set can serve as a structural basis for cognitive and computational neuroscience research.

Potential initial focus: thalamocortical system

- Microscale (neurons, synapses)
- Macroscale (parcellated brain regions, voxels)
- Mesoscale (columns, minicolumns)

Most feasible initial (short-term, medium-term) approach:
macroscale (first draft), followed by "filling-in" at the mesoscale.

Techniques: DTI/tractography, others?

Significant problems: Data integration and registration, inclusion of dynamic/functional data, issues of variability, developmental stages, pathologies.

Sporns, O., Tononi, G., and Kötter, R. (2005) The human connectome: A structural description of the human brain. *PLoS Comp. Biol.*

The Role of Spontaneous Neural Activity in Cognition

What is the role of resting state neuronal activity (spontaneous neural dynamics) for generating perceptual or cognitive states?

Does resting state activity generate rich spatiotemporal structure?

Is the resting state merely a “baseline” or does it play a crucial role for the way external stimuli are integrated?

Spatial scales: microcircuits, large-scale systems
Time scales: milliseconds, seconds, minutes

If a central role for spontaneous dynamics is found, what are the consequences for computational models and theoretical accounts of brain function?