

Towards understanding the human brain: Imaging of function and connectivity from cortical columns and layers to whole brain

Since the introduction of functional brain imaging (fMRI) approximately two decades ago, there has been a revolution in the ability to image brain function going from early experiments demonstrating relatively coarse images of activity in the visual cortex to mapping columnar organizations with laminar differentiation. These developments have relied on ever increasing magnetic fields, new imaging and image reconstruction methods, and a rigorous, albeit as of yet incomplete, understanding of the mechanisms underlying the functional mapping signals. These functional studies have been complemented with imaging of morphology, providing increasingly detailed depictions of axonal fibers, cerebral blood vessels, myelin distribution etc.

The latest application of these methodological developments target comprehensive description of the connections among gray matter locations in the human brain at the millimeter scale, under support from the Human Connectome Project (HCP). Exploiting the recent advances in instrumentation and imaging methods, studies undertaken in the HCP provide data on whole-brain connectivity with previously unavailable resolution and insights through systematic studies of large population of twins and their non-twin siblings.