Specialty area: Connectomics: A New Frontier in Neuroscience

Speaker Name: Klaas Enno Stephan (stephan@biomed.ee.ethz.ch)

Highlights

- Understanding (patho)physiological processes in the brain requires formal system models.
- Connectivity is a core component of such models.
- Methods for inferring anatomical, functional and effective connectivity are essential to obtain this information non-invasively in the human brain.

Title: Establishing the brain's connections: How connectomics will change basic and clinical neuroscience

Target audience: experimental and computational neuroscientists, neurologists, psychiatrists

Complex cognitive processes cannot be localised to circumscribed brain “modules” but require the functional integration of spatially segregated neuronal populations. Similarly, many brain disorders cannot be understood in terms of focal disturbances, but result from aberrant functional interactions among different areas, e.g., due to abnormal synaptic plasticity. Understanding these functions and disease processes, respectively, in depth therefore requires non-invasive methods for inferring anatomical, functional and effective connectivity in the human brain. In this presentation, I review the strengths and limitations of presently available methodologies, particularly those which are based on structural or functional MRI. Various empirical examples will serve to illustrate how these methods (and their combination) enhance our ability to tackle long-standing questions about cognitive functions and disease processes in the human brain. In particular, diagnostic classifications and clinical decision-making could greatly benefit from robust estimates of brain connectivity and and its changes under therapeutic interventions.