Digital Metabolic Map of the Human Brain Cortex

Date & Time: 12:00 to 13:00, Friday, October 25, 2019
Speaker: Yuguo Yu, Fudan University
Location: Room 385, Geography Building, Zhongbei Campus, ECNU

Abstract:
Since energy limits coding and structural needs of cortical networks, a digital metabolic map of glucose oxidation of cortex will be important for understanding of how the human brain distributes its energy in different brain regions for different behavioral states. Importantly, whether (and how) do the high level animal brains utilize energy more efficiently than low level animals in neural information processing as well as cognitive computations? We first calculated a comprehensive CMRglc(ox)-derived energy budget for gray and white matter from the bottom-up, using biophysical properties of neurons and glia in conjunction with species-specific electrophysiological and morphological data. Comparing metabolic measurements by PET, 13 C MRS, and autoradiography in rat and human brain with budget-derived CMRglc(ox) revealed conserved properties. We observed that awake cortical signaling processes and mass-dependent nonsignaling processes demand ~70% and ~30% of CMRglc(ox), respectively. Then, we feed the energy budget calculations of individual neurons and glia into a 3-D human brain cell density map calculated based on BigBrain cell-stained histological data, formulating a 3-D brain energy map with energy calculations in unit of either glucose in micromole/min/gram. The results suggest 0.5-1.5 Hz firing rates across the entire human cerebrum. The reconstructed energy map can provide opportunities to reveal testable microscopic-level anomalies underlying metabolic neuroimaging of brain diseases and disorders.

Biography:
Prof. Yuguo Yu obtained Ph.D. (2001) in biophysics at Nanjing University. He was trained in Computational/Behavior Neuroscience at Carnegie Mellon University as a Postdoctoral Fellow from 2001 to 2004; and Associate Research Scientist at Department of Neuroscience at Yale University from 2005-2011. Then he became a Full Professor at Fudan University. He was a recipient of the Shanghai Eastern Scholar Professorship (2013). His research interests include cellular mechanisms of cortical spiking dynamics and neural information processing, and brain energetics for normal and disordered brain functions.