



Channing Network Science Seminar

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Network control principles unveil neuronal roles in *C. elegans* nervous system

Abstract: Recent advances on the controllability of complex systems have offered a powerful mathematical framework to systematically explore the structure-function relationship in various biological, social and technological networks. Despite the theoretical advances, we lack direct experimental proof of the validity of these widely used control principles. In this talk, we fill this gap by applying the control framework to the connectome of the nematode *C. elegans*, allowing us to predict the role of each neuron in the locomotor response to touch stimuli. We predict that the control of locomotion requires twelve neuronal classes, which include all previous experimental results based on laser ablation of specific neuronal groups. Importantly, control principles implicate one novel neuron, unveiling its previously unknown role in *C. elegans* locomotion. Counterintuitively, control principles predict that, for example, within a six-neuron class, the ablation of three individual neurons should not affect locomotion, but the individual ablation of other three neurons are sufficient to impair *C. elegans* locomotion. All these predictions are confirmed by new ablation experiments and worm tracker analyses. We find that our predictions are robust to missing and rewired connections in the current connectome, indicating the potential applicability of the developed analytical framework to larger and less-characterised connectomes.

Bio: Gang Yan is a professor in School of Physics Science and Engineering, Tongji University, Shanghai, China. He received his B.Sc. and Ph.D. degree at University of Science and Technology of China (USTC) in 2005 and 2010 respectively. During 2007-09, he was a visiting PhD student in the Centre for Chaos and Complex Networks at City University of Hong Kong. Prior to joining Tongji, he was research scientist in the Temasek Laboratories at National University of Singapore, Singapore; and postdoctoral researcher in the Center for Complex Network Research at Northeastern University, Boston, USA. He is a recipient of the Thousand Young Talents Plan (2016).

Hosted by Yang-Yu Liu