COMPLEXITY COMMUNITY SHARING SESSION

DECEMBER 2018

04 DEC (TUE)
11:00AM - 1:00PM

VENUE : COMPLEXITY INSTITUTE
ACADEMIC BUILDING NORTH
LEVEL 1, SECTION B, UNIT NO. 7
(ABN-01B-07)

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Applications of Physical and Mathematical Concepts in Transportation and Urban Mobility

The dynamic part of the urban system, consisting of various types of transportation modes and commuters interacting in highly non-trivial ways, is a typical many-body system with both complex and universal behaviours. In this talk, I will present a few approaches in analysing and understanding such complex systems from quantitative, physical points of view, focusing on both the microscopic aspects and emergent phenomena arising from non-linear interactions between different components.

In the first example, I will discuss the spatiotemporal dynamics of the traffic flow and the emergence of traffic congestions. In the second example, I will talk about traffic flow management near road intersections in a decentralised way without the use of traffic lights. For the third example I touch on the dynamics of the taxi systems with and without ride-sharing. I will also introduce some concepts about non-equilibrium phases in driven many-body systems, as well as various techniques including modern machine learning and artificial intelligence for the optimisation and efficient management of the urban transportation system.

Speaker : Dr. YANG Bo

Dr. Yang Bo is an assistant professor at Nanyang Technological University and a research scientist at A*STAR Institute of High Performance Computing (IHPC), Singapore. He received his BS degree in Physics and Mathematics from Stanford University and PhD in Physics from Princeton University, supervised by Prof. Duncan Haldane.

His research interests include classical complex systems, fractional quantum Hall effect and strongly correlated topological systems, and traffic theory.

Optimal Stochastic Modelling with Unitary Quantum Dynamics

Identifying and extracting the past information relevant to the future behaviour of stochastic processes is a central task in the quantitative sciences. Quantum models offer a promising approach to this, allowing for accurate simulation of future trajectories whilst using less past information than any classical counterpart.

Here we introduce a class of phase-enhanced quantum models, representing the most general means of causal simulation with a unitary quantum circuit. In my talk, I will discuss how it has been shown that the resulting constructions can display advantages over previous state-of-art methods – both in the amount of information they need to store about the past, and in the minimal memory dimension they require to store this information. Moreover, we find that these two features are generally competing factors in optimisation – leading to an ambiguity in what constitutes the optimal model – a phenomenon that does not manifest classically. Our results thus simultaneously offer new quantum advantages for stochastic simulation, and illustrate further qualitative differences in behaviour between classical and quantum notions of complexity.

Speaker : LIU Qing

LIU Qing is a PhD student at the School of Physical and Mathematical Sciences, Nanyang Technological University. She got her B.S. in Physics from Beihang University in 2015. She studied at the Institute for Interdisciplinary Information Sciences, Tsinghua University, from 2015 to 2016.

Her research interests include complex systems and quantum information.

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Organiser : Complexity Institute