北京大学前沿计算研究中心
Center on Frontiers of Computing Studies, Peking University

静园5号院
青 年 讲 座

Commutation and anticommutation in Hamiltonian simulation

Dr. Qi Zhao

Assistant Professor
the University of Hongkong

Host：袁骁 助理教授
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Abstract

Simulating Hamiltonian dynamics on a quantum computer lies at the heart of quantum information processing. In this talk, I will talk about the roles of commutation and anticommutation in Hamiltonian simulation. In trotter algorithms, the worst-case algorithmic error is shown to be related to the spectral norm of nested commutators of the Hamiltonian summands. Our recent work [PRL 129.270502] shows that the average-case performance of Hamiltonian simulation is related to the Frobenius norm of nested commutators. In order to deal with the trotter error in commutators, we propose Hamiltonian simulation algorithms using LCU to compensate Trotter error, which enjoy both of their advantages [arXiv: 2212.04566]. Anti-commutation is always seen as a hindrance, which makes the simulation much harder and costs extra resources to achieve the desired simulation accuracy. In our recent work [Quantum 5, 534 (2021)], we find that anti-commutation could provide advantages in LCU type of Hamiltonian simulation algorithms. Based on an anti-commutative cancellation, we reduce the algorithmic error and propose modified truncated Taylor series algorithm.

Biography

Dr. Qi Zhao is an Assistant Professor in the Department of Computer Science, the University of Hongkong (HKU). His research interests include quantum simulation, quantum computing, resource theory, self-testing quantum information, and entanglement detection. He received his PhD degree from Tsinghua University in Dec. 2018. Then he became a postdoctoral researcher at the University of Science and Technology, China from Jan. 2019 to Oct. 2019. In Dec. 2019, he joined the University of Maryland QuICS as a Hartree Postdoctoral Fellow in quantum information science.