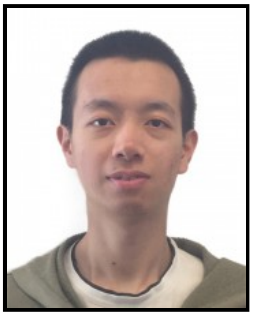

Other

Faster Digital Quantum Simulation by Randomization

Yuan Su, University of Maryland

Ph.D. Candidate

Digital Media Center 1034
November 25, 2019 - 03:00 pm

Abstract:
Simulating the Hamiltonian dynamics of quantum systems is one of the most promising applications of digital quantum computers. In this talk, I will discuss how to speed up digital quantum simulation by using randomness. In the first part, I will use randomness to improve the product-formula algorithm, a straight-forward approach to quantum simulation that has been demonstrated by several experimental groups. I will show that by randomizing how the Hamiltonian terms are ordered, one can prove stronger bounds on the quality of approximation for product formulas, and thereby give more efficient simulations. I will provide further numerical evidence suggesting that the randomized approach has better empirical performance as well. In the second part, I will describe a randomized approach to time-dependent Hamiltonian simulation. I will show that this approach can simulate Hamiltonians with L^1-norm scaling, whereas the best previous results scale with the L^∞ norm. Our approach thus provides an improvement over previous simulation algorithms that can be substantial when the Hamiltonian varies significantly, such as in the semi-classical simulations of scattering processes in quantum chemistry.

This talk is based on joint work with Dominic Berry, Andrew Childs, Aaron Ostrander, Xin Wang, and Nathan Wiebe.

References:
[1] Andrew M. Childs, Aaron Ostrander, Yuan Su, Faster quantum simulation by randomization, Quantum 3, 182 (2019), https://arxiv.org/abs/1805.08385
[2] Dominic W. Berry, Andrew M. Childs, Yuan Su, Xin Wang, and Nathan Wiebe, Time-dependent Hamiltonian simulation with L^1-norm scaling, https://arxiv.org/abs/1906.07115

Speaker's Bio:

Yuan Su is a fifth-year PhD student in Computer Science at the University of Maryland, researching quantum computing under the supervision of Dr. Andrew Childs. He received his bachelor's degree in Computer Science from the Beijing University of Posts and Telecommunications, and his master's degree in Applied Mathematics from Peking University. His research focuses mainly on the theoretical side of quantum simulation, with the purpose of understanding and optimizing the performance of quantum algorithms for simulating quantum physics. He is a recipient of the 2019 Google PhD Fellowship in quantum computing.

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