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An efficient quantum algorithm for dissipative nonlinear partial differential equations and related models

Monday, November 14, 2022 | 12:30–1:30pm | 3301 Exploratory Hall | Zoom

Abstract

Nonlinear differential equations appear in many domains and are notoriously difficult to solve. Whereas previous quantum algorithms for general nonlinear differential equations have complexity exponential in the evolution time, we give the first quantum algorithm for dissipative nonlinear differential equations that is efficient provided the dissipation is sufficiently strong relative to nonlinear and forcing terms and the solution does not decay too rapidly. We also establish a lower bound showing that differential equations with sufficiently weak dissipation have worst-case complexity exponential in time, giving an almost tight classification of the quantum complexity of simulating nonlinear dynamics. Furthermore, numerical results for the Burgers equation suggest that our algorithm may potentially address complex nonlinear phenomena even in regimes with weaker dissipation. Applications in fluid dynamics and epidemiology are at the center of the investigation. Further advances in the area involving linear and nonlinear models will also be discussed.

The article ``Efficient quantum algorithm for dissipative nonlinear partial differential equations'' appeared recently in the Proceedings of the National Academy of Sciences (PNAS 2021).

Speaker's Bio: Dr. Konstantina Trivisa is the Director of the Institute for Physical Science and Technology. She is an applied mathematician holding a joint position at the Department of Mathematics, the Institute for Physical Science and Technology and the Center for Scientific Computation and Mathematical Modeling at the University of Maryland. Her research lies on the interface between nonlinear partial differential equations and continuum physics and focuses on applications in fluid dynamics, multiphase flows, continuum mechanics, materials science and math biology.

Meeting Information: https://go.gmu.edu/qcseminar

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