Solving Partial Differential Equations in Polar Coordinates Using the Quantic Tensor Train Representation

Hao-Ti Hung[1,2] and Ying-Jer Kao[1,2]

[1]Department of Physics, National Taiwan University, Taipei 10617, Taiwan
[2]Center for Theoretical Physics, National Taiwan University, Taipei 10617, Taiwan

This poster presents a tensor-network-based framework for solving partial differential equations (PDEs) in polar coordinates using the *quantics tensor train* (QTT) representation. We will present how the density matrix renormalization group (DMRG) and imaginary time-dependent variational principle (TDVP) algorithms can be employed to obtain the ground states of the Schrödinger and Gross–Pitaevskii (GP) equations, respectively. The excited states of the Schrödinger equation are further computed through matrix product operator–matrix product state operations. Additionally, we simulate real-time dynamics of the GP equation using the real-time TDVP algorithm. The proposed QTT-based method provides a tensor-network formulation for solving PDEs in curvilinear coordinates with potential applications for nonlinear systems.