

Parallel Quantum Simulation of Large Systems on Small Noisy Intermediate-Scale Quantum Computers

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Tensor networks permit computational and entanglement resources to be concentrated in interesting regions of Hilbert space. Implemented on NISQ machines they allow simulation of quantum systems that are much larger than the computational machine itself. This is achieved by parallelising the quantum simulation. Here, we demonstrate this in the simplest case; an infinite, translationally invariant quantum spin chain. We provide Cirq and Qiskit code that translate infinite, translationally invariant matrix product state (iMPS) algorithms to finite-depth quantum circuit machines, allowing the representation, optimisation and evolution arbitrary one-dimensional systems. Illustrative simulated output of these codes for achievable circuit sizes is given.