Tightly integrating a GPU and a QPU for fast calibration of multi-qubit circuits

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Abstract

As quantum processors scale, the need for efficient calibration and real-time optimization of quantum circuits becomes increasingly critical, particularly for quantum error correction (QEC). Integrating scalable and flexible classical computing resources within quantum sequences is essential for maintaining high-fidelity operations.

In this work, we demonstrate a tightly integrated system where a reinforcement learning agent, running on an NVIDIA Grace Hopper superchip, interacts in real time with a superconducting quantum processor. The agent dynamically optimizes circuit drive and readout policies, leading to reduced execution errors in multi-qubit circuits.

Enhancing the fidelity of QEC stabilizer circuits directly translates into exponential reductions in logical qubit errors. This underscores the importance of continuous, real-time calibration on timescales shorter than hardware drift rates. By minimizing the computational overhead of QEC, our approach represents a crucial step toward the realization of large-scale, fault-tolerant quantum computing.