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INVITED TALK: Approximate Autonomous Quantum Error Correction with Reinforcement Learning

Friday 24 November 2023 11:15 (45 minutes)

Quantum error correction will ultimately empower quantum computers to leverage their full potential. However, substantial device overhead and the need for frequent syndrome measurements, which are themselves error-prone, render the demonstration of logical qubits that significantly surpass break-even still challenging. Autonomous quantum error correction represents a promising alternative, where an engineered environment allows to bypass the syndrome measurements. In this talk, I show how we use reinforcement learning to search for, and find, bosonic code spaces that can surpass break-even under experimentally feasible conditions. Bosonic codes are, for instance, available and utilized in some of the currently most promising and widespread quantum processors based on superconducting qubits. Surprisingly, when we increase the search space by relaxing the constraints on ideal quantum error correction, we find simple and robust code words that significantly surpass break-even while minimizing device overhead. This RL code not only reduces device complexity compared to other proposed encodings, but also outperforms its competitors in terms of its capability to correct errors.

Presenter: Dr GNEITING, Clemens (Riken)