VOL 67 MAR 2026

NTU Q

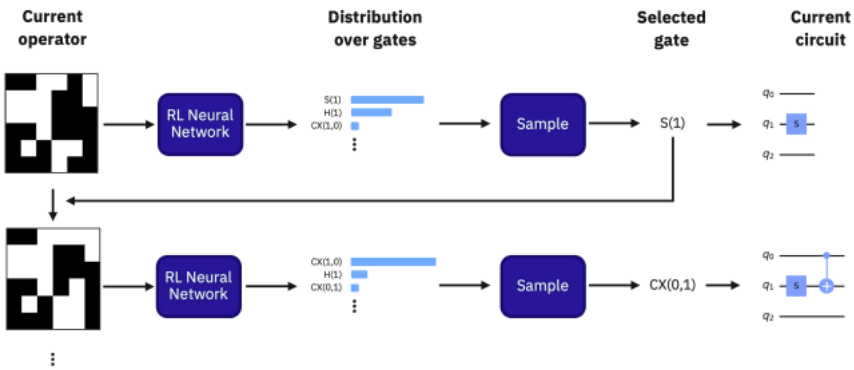
HIGHLIGHTING NEWS

PRACTICAL AND EFFICIENT QUANTUM CIRCUIT SYNTHESIS AND TRANSPILING WITH REINFORCEMENT LEARNING

This paper introduces a reinforcement learning-based approach to improve quantum circuit synthesis and routing in quantum transpilation workflows. The method is capable of synthesizing various quantum circuits, including Clifford, Linear Function, and Permutation circuits.

Experimental results show that the RL-based approach can generate near-optimal circuits compatible with the native instruction set of the device, such that the resulting circuit does not require further transpilation when executed on real hardware.

In benchmarks, the method runs faster than SAT solvers, reduces two-qubit gate counts and circuit depth compared to heuristic routing algorithms like SABRE, and achieves 50% less SWAP layers over Qiskit SDK's TokenSwapper algorithm.



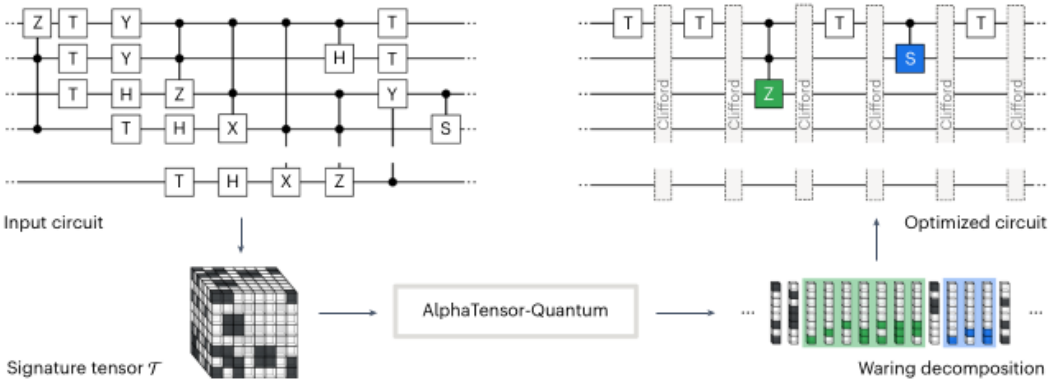
READMORE (Paper)

QUANTUM CIRCUIT OPTIMIZATION WITH ALPHA TENSOR

This paper introduces AlphaTensor-Quantum (AT-Q), a deep reinforcement learning-based method that optimizes quantum circuits by reducing the number of T gates, a type of non-Clifford gate that requires “magic state” distillation to be implemented in a fault-tolerant way.

AlphaTensor-Quantum frames the problem of T gate minimization as a tensor decomposition problem by converting quantum circuits into symmetric binary tensors and using deep reinforcement learning to search for low-rank tensor decompositions (factors) that correspond to more efficient circuit implementations.

On a benchmark of arithmetic primitives, AT-Q outperforms existing T-count optimization methods. For problems such as multiplication in finite fields, AT-Q finds an efficient quantum algorithm with complexity similar to the classical Karatsuba algorithm.



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