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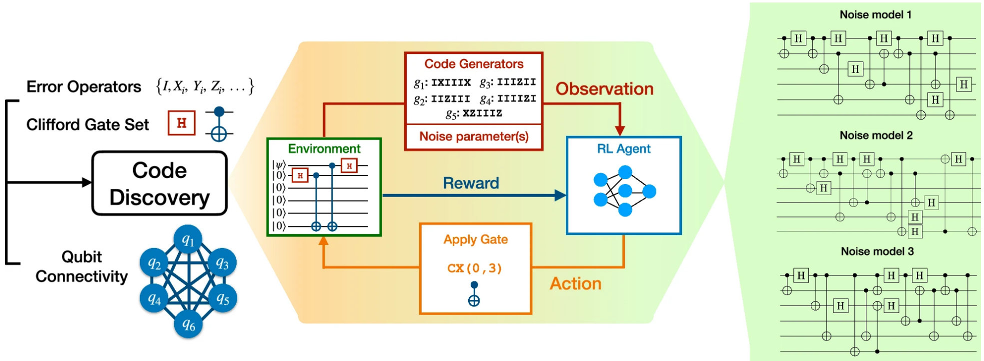
NTU Q

SIMULTANEOUS DISCOVERY OF QUANTUM ERROR CORRECTION CODES AND ENCODERS WITH A NOISE-AWARE REINFORCEMENT LEARNING AGENT

Quantum computing and communication hold immense potential, but their success hinges on effective quantum error correction (QEC) to safeguard fragile quantum information. QEC encodes logical qubits into multiple physical qubits, enabling the detection and correction of errors caused by noise.



Source: npj Quantum Inf

Traditionally, designing QEC codes and encoding circuits has been manual and hardware-agnostic, often limited by scalability and inefficiency. In a groundbreaking study, researchers have introduced a reinforcement learning (RL)-based approach to simultaneously discover QEC codes and their corresponding encoding circuits, tailored to specific hardware and noise models.

This innovative framework leverages RL's ability to optimize high-dimensional problems autonomously. At its core, it trains a noise-aware agent capable of designing error correction strategies for a variety of hardware settings and noise types. A major advancement of this work is using a reward system based on the Knill-Laflamme error correction conditions, which guides the RL agent toward efficient solutions. The team also developed a high-performance Clifford simulator optimized for GPU acceleration, enabling fast and scalable simulations of QEC circuits.

This study exemplifies the transformative role of AI in quantum technologies. By automating the discovery of QEC codes and encoding strategies, the proposed RL framework bridges a critical gap between theoretical advancements and experimental implementations, marking a significant step toward the practical realization of quantum computing's full potential.

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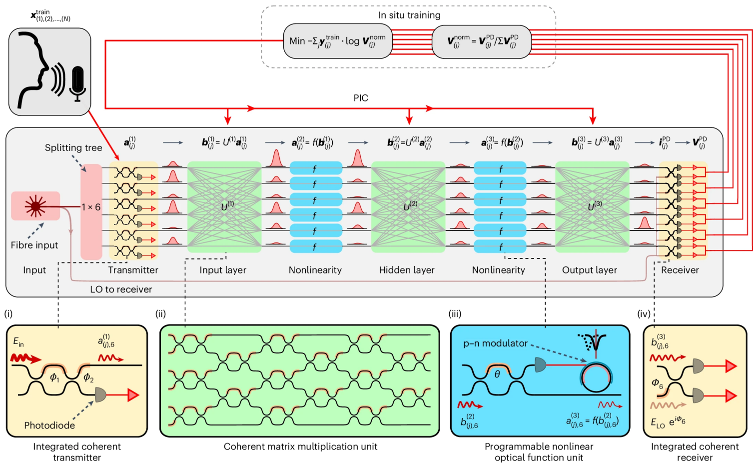
MIT RESEARCHERS UNVEIL PHOTONIC PROCESSOR FOR FASTER, ENERGY-EFFICIENT AI

MIT researchers have developed a photonic chip that performs deep neural network operations using light, enabling faster and more energy-efficient AI computations. This chip integrates optics and electronics to perform nonlinear operations directly on the chip, reducing the need for external processors and significantly lowering energy consumption.

As machine learning models become increasingly complex, traditional processors struggle to meet the rising energy and computational demands. MIT's photonic processor addresses this by using light instead of electricity to process data. The chip achieves performance comparable to conventional processors but consumes less energy and completes computations in less than half a nanosecond.



Source: nature photonics

A key innovation is the creation of "nonlinear optical function units" (NOFUs), which convert a portion of light into electrical signals to perform nonlinear calculations without the need for external amplifiers. The chip is fabricated using commercial manufacturing techniques similar to those used for traditional CMOS chips, making it possible to scale up production. This could lead to its integration into everyday devices like cameras, lidar systems, and telecommunications networks. The research team aims to scale the chip's capabilities to handle more complex tasks and integrate it with existing electronics. They are also exploring algorithms specifically designed for optical systems to further improve training speed and energy efficiency. Collaborators included experts from MIT, NTT Research, and institutions specializing in quantum photonics and artificial intelligence. This development opens the door to a new era of computing based on optical systems, offering solutions for applications that require rapid computations, such as particle physics research and high-speed data transmission.

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