ICFO

Felicidades al nuevo graduado de doctorado del ICFO

El Dr. Adriano Macarone Palmieri se ha doctorado con una tesis titulada ï¿½Deep learning for boosted quantumstate estimati n and bath parameterextractionï¿½

December 11, 2024

Felicitamos al Dr. Adriano Macarone Palmieri que ha defendido su tesis esta manana en el auditorio del ICFO.

El Dr. Macarone Palmieri obtuvo su Master en Fisica Aplicada por la Universita di Bologna en Italia, antes de unirse al grupo de investigacion de Quantum Optics Theory dirigido por el profesor ICREA en ICFO el Dr. Maciej Lewenstein. Su tesis titulada ï¿½Deep learning f r boosted quantumstate estimation and bath parameterextractionï¿½ha sido supervisada por el Prof. Maciej Lewenstein.

RESUMEN:

The thesis explores the application of supervised deep learning (DL) to mitigate noise in quantum state estimation protocols, to offer a viable tool for quantum technologies

development, that leverages quantum properties, like entanglement. This is vital for quantum information processing and is used in applications like quantum teleportation, quantum key distribution, and superdense coding. However, the practical implementation of these technologies is challenged by noise and errors, making accurate certification of quantum states essential.

Traditionally, state tomography is the best possible desiderata, but it is resource-intensive. Alternative methods with better scaling, such as permutationally invariant states and shadows, have been proposed, though they are limited in scope, because limited to specific classes of states or can estimate some quantum properties only. The thesis specifically investigates whether supervised DL can be used to mitigate noise and achieve full quantum state estimation under various conditions, including limited resources, different noisy sources, and, last, incomplete information.

The research introduces a novel approach using the out-of-distribution paradigm to extend the applicability of supervised deep learning to unknown data distributions, such as noisy quantum states measured with imperfect setups. This study at a higher depth the generalization ability of deep learning protocols while maintaining the simplicity of trained supervised neural networks. In this way, seamless application from synthetic to experimental data is allowed. At the same time, the computational aspect involves analyzing the complexity of different models and their learning abilities, and noise mitigation capabilities, and showcasing transformer-based models in certifying genuine k-body entanglement as superior.

Lastly, the thesis addresses noise characterization using deep learning, particularly how this can infer environmental noise parameters from a single-qubit probe without fixed-time conditions. This contributes to better noise reduction and system control in quantum technologies.

Tribunal de Tesis:

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