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In the current developmental phase of quantum computing, noise is generally considered a limiting factor. However, our recent research [1] demonstrates that the intrinsic noise can be strategically utilized to efficiently simulate open quantum systems within the framework of Markovian approximations. This approach distinguishes itself from earlier methodologies by requiring solely the characterization of device-specific noise and the implementation of quantum error mitigation techniques. As a result, it opens the door for a potential exponential speedup in the simulation of open quantum systems when compared to the equivalent closed-system quantum simulations in current noisy quantum devices. We further presented a new methodology for simulating generalized amplitude damping in quantum computers. Importantly, this later approach eliminates the dependence on resource-intensive ancillary qubits or mid-circuit measurements. This work was accepted for publication in PRX Quantum and it was presented by myself in the QCTiP 2023 (Cambridge, UK).

Another previous work of mine consisted of the development of a new quantum algorithm (Quantum TEDOPA) that allows us to simulate non-perturbative dynamics of open systems on current quantum computers using ancilla qubits [2]. This was demonstrated on a 12-qubit quantum simulation on a real IBMQ computer (see [2]).

One other previous work of mine proposes a framework for the deployment of quantum error mitigation techniques in quantum computing [3]. This work was presented at the IEEE International Conference on Quantum Software 2022 (Barcelona, Spain).

My ongoing work consists of optimizing and generalizing of the method of Ref. [1]. This allows the technique [1] to be deployed for large-scale quantum simulations of open systems in current noisy quantum computers. Additionally, it allows for the simulation of perturbative non-Markovian dynamics of open systems without ancilla qubits (paper is expected to be published soon on arXiv).

[1] Guimarães, José D., et al. "Noise-assisted digital quantum simulation of open systems." *arXiv preprint arXiv:2302.14592*(2023).

[2] Guimarães, José D., Mikhail I. Vasilevskiy, and Luís S. Barbosa. "Efficient method to simulate non-perturbative dynamics of an open quantum system using a quantum computer." *arXiv preprint arXiv:2203.14653* (2022).

[3] Guimarães, José D., and Carlos Tavares. "Towards a layered architecture for error mitigation in quantum computation." *2022 IEEE International Conference on Quantum Software (QSW)*. IEEE, 2022.