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Iterative Time Ordering for Optimal Control of Open Quantum Systems

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An explicit time-dependence of the Hamiltonian, for example due to an external driving field, introduces an additional challenge for dynamical simulations. The most commonly used propagation approaches usually rely on dividing the overall propagation time into small steps, in which the time-dependence of the Hamiltonian is approximately constant and the time evolution operator becomes a matrix exponential. This inevitably introduces inaccuracies due to neglection of time ordering. In contrast, the iterative time ordering (ITO) approach al- lows to fully account for any explicit time-dependence of the Hamiltonian. It was originally constructed for numerically exact propagation in Hilbert space for state vectors. Here, we generalize it to density matrices and use the driven quantum harmonic oscillator for bench- marking. Furthermore we discuss the combination of this algorithm with quantum optimal control theory and apply it to a strongly driven superconducting circuit.

Keywords:
propagation scheme, optimal control, quantum dynamics

Primary authors: KOCH, Christiane P. (Institut für Physik, Universität Kassel); MARDER, Lutz (Institut für Physik, Universität Kassel)

Presenter: MARDER, Lutz (Institut für Physik, Universität Kassel)

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