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Optimal control for quantum information processing and quantum simulations

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Adiabatic evolution is central to many near-term approaches to information processing and quantum-assisted simulations (e.g., quantum annealing for computational optimization and braiding of non-Abelian anyons for topological quantum computing). However, slower processes needed for adiabaticity require longer time scales, over which the system may decohere or suffer noise-induced antiadiabaticity. Fast optimally controlled nonadiabatic dynamics, based on the Pontryagins minimum principle, can help overcome these difficulties. Here, we discuss novel applications of optimal control to variational quantum algorithms, quantum optimization algorithms, simulation of many-body ground states, and braiding noisy Majorana zero modes.