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Optimizing quantum gate fidelities using energy-optimal control[1]

SONIA SCHIRMER, Univ. of Cambridge — Optimal control theory offers a promising framework for optimizing essential tasks in quantum computing from quantum state preparation to the implementation of quantum gates. It is applicable to a wide variety of systems from atoms and ions to quantum dots, different control mechanisms from all-optical to all-electronic, and allows implementation constraints and dissipation to be accommodated. Most existing approaches focus on the exact implementation of (unitary) quantum gates in a particular model and aim to optimize gate operation times subject to certain assumptions such as arbitrarily fast local operations, weak (inter-qubit) coupling and decoherence, etc. We consider a different paradigm for optimal control focussing on optimizing the overall gate fidelity for a desired gate and fixed gate operation time subject to physical and experimental contraints (including dissipative effects), which may be more appropriate for some systems such as electronically-controlled systems with non-weak, always-on inter-qubit coupling. We discuss the basic framework and illustrate the results using calculations for model systems.

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