Approximate counterdiabatic driving protocols for quantum non-integrable systems

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Due to noise and decoherence from environment, the application of adiabatic protocols in quantum technologies is intensely limited. Counterdiabatic (CD) driving protocols, which also go under the name of shortcuts-to-adiabaticity, provide a powerful alternative for controlling a quantum system. These protocols allow us to change Hamiltonian parameters rapidly while still mimicking adiabatic dynamics. They have been shown to work well for a wide variety of systems but it's exponentially hard to find exact CD protocols for non-integrable quantum many-body systems. We study a method to approximate CD protocol which avoids exponential sensitivity to perturbations of the Hamiltonian. Our finite-size scaling of counterdiabatic Hamiltonian reveals remarkable difference between quantum integrable and non-integrable systems. We numerically identify different scaling regimes and show how they arise from the eigenstate thermalization hypothesis.