Feedback-based quantum algorithm inspired by Counterdiabatic Driving

The feedback-based quantum algorithm is a ``fully quantum" algorithm that uses a quantum control method to design quantum circuits to prepare the ground state of a quantum many-body system as well as solve combinatorial optimization problems. Such a quantum circuit is built iteratively via measurements of a operators that determines the quantum control. A feedback-based circuit has similarity to that of Quantum approximate optimization algorithm (QAOA), in the sense that the circuit is built using alternate usage of unitaries obtained from the problem Hamiltonian as well as an additional Hamiltonian. Here, we propose that by including one additional control parameter inspired by counterdiabatic driving, one can accelerate the population transfer to the low-energy states within a shorter time scale compared to a single control parameter. We apply our algorithm to various one-dimensional Ising Hamiltonians. We find that the population transfer is much faster with an additional control parameter inspired by counterdiabatic drive.