Optimal control for unitary preparation of many-body states: application to Luttinger liquids[1] ARMIN RAHMANI, CLAUDIO CHAMON, Boston University — Many-body ground states of local Hamiltonians can be prepared via unitary evolution in cold atomic systems. Given the initial state and a fixed time for the evolution, how close can we get to a desired ground state if we can tune the Hamiltonian in time? Here we study this optimal control problem focusing on Luttinger liquids with tunable interactions. We show that the optimal protocol can be obtained using the simulated annealing method. Rather surprisingly, we find that in the Luttinger liquid case the interaction strength in the optimal protocol can have a *non-monotonic* time-dependence. We find a marked difference in the behavior of the system when the ratio τ/L of the preparation time to the system size exceeds a critical value around $1/8$. In this regime, the optimal protocol can prepare the states with almost perfect accuracy. Finally, we argue that the time-scale of the optimal evolution defines a dynamical measure of distance between quantum states.

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