Protecting coherence in optimal control theory

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Optimal control theory is developed for the task of obtaining an objective in a subspace of the Hilbert space while avoiding population transfer to other subspaces of the Hilbert space. The objective, a unitary transformation or a state-to-state transition, is carried out without loss of coherence, provided the system in the allowed subspace is decoupled from its environment.
A new optimization functional is introduced which leads to monotonic convergence of the algorithm. This approach becomes necessary if the system under consideration is subject to processes implying loss of coherence. In the subspaces corresponding to lossy channels, controllability is hampered or even completely lost. A functional constraint which depends on the state of the system at each instant in time keeps the system out of the lossy channels. I will outline the resulting new algorithm and discuss its convergence properties. The functionality of the algorithm is demonstrated for the example of a state-to-state transition and of a unitary transformation for a model of cold Rb_2. A new class of solutions is found which is robust not only with respect to decay in the forbidden subspace but also with respect to noise in the allowed subspace.