MAR15-2014-008772

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

A general transfer-function approach to noise filtering in open-loop quantum control[1]

LORENZA VIOLA, Dartmouth College

Hamiltonian engineering via unitary open-loop quantum control provides a versatile and experimentally validated framework for manipulating a broad class of non-Markovian open quantum systems of interest, with applications ranging from dynamical decoupling and dynamically corrected quantum gates, to noise spectroscopy and quantum simulation. In this context, transfer-function techniques directly motivated by control engineering have proved invaluable for obtaining a transparent picture of the controlled dynamics in the frequency domain and for quantitatively analyzing performance. In this talk, I will show how to identify a computationally tractable set of "fundamental filter functions," out of which arbitrary filter functions may be assembled up to arbitrary high order in principle. Besides avoiding the infinite recursive hierarchy of filter functions that arises in general control scenarios, this fundamental set suffices to characterize the error suppression capabilities of the control protocol in both the time and frequency domain. I will show, in particular, how the resulting notion of "filtering order" reveals conceptually distinct, albeit complementary, features of the controlled dynamics as compared to the "cancellation order," traditionally defined in the Magnus sense. Implications for current quantum control experiments will be discussed.

[1]Work supported by the U.S. Army Research Office under contract No. W911NF-14-1-0682.