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Using randomness for coherent quantum control LEA SANTOS, LORENZA VIOLA, Dartmouth College — Dynamical decoupling methods consist of repetitive sequences of control operations, whose net effect is to coherently modify the natural target dynamics to a desired one. A general framework for investigating randomized decoupling schemes has been recently introduced by Viola and Knill [Phys. Rev. Lett. **94**, 060502 (2005)], based on designing the control propagator according to a random rather than deterministic path. General bounds on worst-case error probability indicate that random decoupling schemes may outperform their cyclic counterpart in situations where a large number of elementary control operations are required or when the interactions to be removed are fast fluctuating. A quantitative analysis of this new technique is developed in the simplest control scenario of a single qubit. We compare the performance of random and deterministic methods in switching off unwanted phase evolution and decoherence. A variety of dynamical regimes, including semiclassical and quantum decoherence models are considered, and different control protocols are examined. Besides providing a physical picture of random decoupling, our analysis identifies situations where randomization may be advantageous over deterministic design.

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