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Quantum Control and Fault-tolerance GERARDO PAZ SILVA, JASON DOMINY, DANIEL LIDAR, University of Southern California — Quantum control (QC) and the methods of fault-tolerant quantum computing (FTQC) are two of the cornerstones on which the hope for a quantum computer rests. However QC methods do not generally scale well with the size of the system, and it is not known how their performance is hindered when integration with FTQC methods, especially considering these demand a large system size overhead, is attempted under realistic noise models. Here we study this problem using dynamical decoupling in the bang-bang limit as a toy model, with a non-Markovian noise where interactions decay with distance, and show that there exists a regime of the norms of the relevant Hamiltonians, in which dynamical decoupling protected gates provide an advantage over the bare gate implementation. This is a first step towards showing that QC protocols designed for a small set of qubits can be extended to larger sets without a significant loss of performance, as long as the noise model behaves reasonably well.

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