Title:	Efficient experimental characterization of quantum processes via compressed sensing on an NMR quantum processor
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Abstract:	We employ the compressed sensing (CS) algorithm and a heavily reduced data set to experimentally perform true quantum process tomography (QPT) on an NMR quantum processor. We obtain the estimate of the process matrix χ corresponding to various two- and three-qubit quantum gates with a high fidelity. The CS algorithm is implemented using two different operator bases, namely the standard Pauli basis and the Pauli-error basis. We experimentally demonstrate that the performance of the CS algorithm is significantly better in the Pauli-error basis, where the constructed χ matrix is maximally sparse. We compare the standard least square (LS) optimization QPT method with the CS-QPT method and observe that, provided an appropriate basis is chosen, the CS-QPT method performs significantly better as compared to the LS-QPT method. In all the cases considered, we obtained experimental fidelities greater than 0.9 from a reduced data set, which was approximately 5–6 times smaller in size than a full data set. We also experimentally characterized the reduced dynamics of a two-qubit subsystem embedded in a three-qubit system and used the CS-QPT method to characterize processes corresponding to the evolution of two-qubit states under various J-coupling interactions.
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