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Quadratically faster state tomography using single-step adaptation DYLAN MAHLER, LEE ROZEMA, ARDAVAN DARABI, Centre for Quantum Information & Quantum Control and Institute for Optical Sciences, Dept. of Physics, 60 St. George St., University of Toronto, CHRISTOPHER FERRIE, Institute for Quantum Computing and Department of Applied Mathematics, University of Waterloo, ROBIN BLUME-KOHOUT, Sandia National Laboratories, AEPHRAIM STEINBERG, Centre for Quantum Information & Quantum Control and Institute for Optical Sciences, Dept. of Physics, 60 St. George St., University of Toronto — In quantum state tomography, an informationally complete set of measurements is made on N identically prepared quantum systems and from these measurements the quantum state can be determined. In the limit as $N \to \infty$ the estimate of the state converges on the true state. The rate at which this convergence occurs depends on both the state and the measurements used to probe the state. On the one hand, since nothing is known a priori about the state being probed, a set of maximally unbiased measurements should be made. On the other hand, if something was known about the state being measured a set of biased measurements would yield a more accurate estimate. It has been shown[1,2] that by adaptively choosing measurements optimal accuracy in the state estimate can be obtained regardless of the state being measured. Here we present an experimental demonstration of one-qubit adaptive tomography that achieves a rate of convergence of $1 - O(\frac{1}{N})$ in the quantum state fidelity with only a single adaptive step and local measurements, as compared to $1 - O(\frac{1}{\sqrt{(N)}})$ for standard tomography. Furthermore, we show how this protocol generalizes to arbitrarily entangled two-qubit systems. [1] Phys. Rev. Lett. 97, 130501 (2006) [2] Phys. Rev. A 85, 052120 (2012)

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