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Experimental Demonstration of Self-Guided Quantum Tomography ROBERT J. CHAPMAN, School of Electrical and Computer Engineering, RMIT University, CHRISTOPHER FERRIE, EQuS, School of Physics, University of Sydney, ALBERTO PERUZZO, School of Electrical and Computer Engineering, RMIT University — Robust and precise quantum state characterization is critical for future quantum experiments and technologies, and yet is a fundamentally challenging task. Standard and adaptive quantum tomography procedures are impractical for systems being prepared today due to the exponential scaling of quantum state space. These techniques are sensitive to statistical noise and require highly precise measurement settings. We present an experimental demonstration of autonomous and robust self-guided quantum tomography. Self-guided quantum tomography iteratively learns a quantum state using a stochastic gradient ascent algorithm. As a result it is robust against statistical noise and measurement errors. In addition, self-guided quantum tomography does not require any computationally expensive optimization, necessary for adaptive quantum tomography, or post-processing, required for standard quantum tomography. We demonstrate the robustness of self-guided quantum tomography by engineering the level of statistical noise and experimental errors, achieving measurement fidelities greater than standard quantum tomography in a range of one- and two-qubit experiments. Our demonstration opens pathways towards robust quantum state characterization in current and near-future experiments, where standard techniques are already impractical.

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