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Practical characterization of quantum devices without tomography OLIVIER LANDON-CARDINAL, U. de Sherbrooke, STEVEN FLAMMIA, IQI, Caltech, MARCUS SILVA, Raytheon BBN Technologies, YI-KAI LIU, NIST, DAVID POULIN, U. de Sherbrooke — Quantum tomography is the main method used to assess the quality of quantum information processing devices, but its complexity presents a major obstacle for the characterization of even moderately large systems. Part of the reason for this complexity is that tomography generates much more information than is usually sought. Taking a more targeted approach, we develop schemes that enable (i) estimating the ?delity of an experiment to a theoretical ideal description, (ii) learning which description within a reduced subset best matches the experimental data. Both these approaches yield a signi?cant reduction in resources compared to tomography. In particular, we show how to estimate the ?delity between a predicted pure state and an arbitrary experimental state using only a constant number of Pauli expectation values selected at random according to an importance-weighting rule. In addition, we propose methods for certifying quantum circuits and learning continuous-time quantum dynamics that are described by local Hamiltonians or Lindbladians.

Olivier Landon-Cardinal
Raytheon BBN Technologies

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