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Hyperaccuracy and Error Scaling in Gate Set Tomography[1] KENNETH RUDINGER, ERIK NIELSEN, JOHN KING GAMBLE, ROBIN BLUME-KOHOUT, Sandia National Laboratories — Standard quantum tomographic procedures are limited in their usefulness by errors in the prior knowledge of the implemented POVMs and prepared states. Gate set tomography (GST) is a tomographic framework introduced to solve this problem of self-referential calibration [arXiv:1310.4492]. GST seeks to simultaneously and self-consistently characterize the set of implemented gates, prepared states, and POVMs. This talk will provide detailed analysis of imperfections in GST-based estimations. From simulations, we establish 1) lower bounds on the experimental resources required to ensure that GST will provide a reliable and useful estimate of the gates, and 2) the scaling of GST's accuracy with number of samples per experiment, maximum length of experiment, and rate of incoherent error. These results demonstrate that GST can be far more accurate than standard tomography. Lastly we show (from both simulations and experiments) that experiment-by-experiment χ^2 tests are extremely effective at diagnosing inconsistencies in the model caused by non-Markovian noise.

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