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Nonparametric estimation of quantum states, processes and measurements PAVEL LOUGOVSKI, RYAN BENNINK, Oak Ridge National Lab — Quantum state, process, and measurement estimation methods traditionally use parametric models, in which the number and role of relevant parameters is assumed to be known. When such an assumption cannot be justified, a common approach in many disciplines is to fit the experimental data to multiple models with different sets of parameters and utilize an information criterion to select the best fitting model. However, it is not always possible to assume a model with a finite (countable) number of parameters. This typically happens when there are unobserved variables that stem from hidden correlations that can only be unveiled after collecting experimental data. How does one perform quantum characterization in this situation? We present a novel nonparametric method of experimental quantum system characterization based on the Dirichlet Process (DP) that addresses this problem. Using DP as a prior in conjunction with Bayesian estimation methods allows us to increase model complexity (number of parameters) adaptively as the number of experimental observations grows. We illustrate our approach for the one-qubit case and show how a probability density function for an unknown quantum process can be estimated.

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