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A semi-device-independent approach to quantum simulability

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Quantum statistical models (i.e., families of normalized density matrices) and quantum measurements (i.e., positive operator-valued measures) can be regarded as linear maps: the former, mapping the space of effects to the space of probability distributions; the latter, mapping the space of states to the space of probability distributions. The images of such linear maps are called the testing regions of the corresponding model or measurement. Testing regions are notoriously impractical to treat analytically in the quantum case.

Our first result is to provide an implicit outer approximation of the testing region of any given quantum statistical model or measurement in any finite dimension: namely, a region in probability space that contains the desired image, but is defined implicitly, using a formula that depends only on the given model or measurement. The outer approximation that we construct is minimal among all such outer approximations, and close, in the sense that it becomes the maximal inner approximation up to a constant scaling factor. Finally, we apply our approximation formulas to characterize, in a semi-device independent way, the ability to transform one quantum statistical model or measurement into another.

This presentation is based on:
[1] M. Dall'Arno and F. Buscemi, Tight conic approximation of testing regions for quantum statistical models and measurements, arXiv:2309.16153.
[2] M. Dall'Arno, F. Buscemi, and V. Scarani, Extension of the Alberti-Ulhmann criterion beyond qubit dichotomies, Quantum 4, 233 (2020).

Abstract category

Other

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