中国科学院数学与系统科学研究院

量子论与信息论

学术报告

报告题目： Minimal Clifford Shadow Estimation

by Mutually Unbiased Bases

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摘　　要： Predicting properties of large-scale quantum systems is crucial for the development of quantum science and technology. Shadow estimation is an efficient method for this task based on randomized measurements, where many-qubit random Clifford circuits are used for estimating global properties like quantum fidelity. Here we introduce the minimal Clifford measurement (MCM) to reduce the number of possible random circuits to the minimum, while keeping the effective post-processing channel in shadow estimation. In particular, we show that MCM requires 2^n+1 distinct Clifford circuits, and it can be realized by Mutually Unbiased Bases (MUB), with n as the total qubit number. By applying the Z-Tableau formalism, this ensemble of circuits can be synthesized to the -S-CZ-H- structure, which can be decomposed to 2n-1 fixed circuit modules, and the total circuit depth is at most n+1. Compared to the original Clifford measurements, our MCM significantly reduces the circuit complexity and the compilation costs. In addition, we find the sampling advantage of MCM on estimating off-diagonal operators, and extend this observation to the biased-MCM scheme to enhance the sampling improvement further. (https://arxiv.org/abs/2310.18749)