

Qubit tomography with limited resources of continuous weak measurement and qubit controls

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We investigate a new method for qubit state tomography [1] based on limited resources of continuous weak measurement [2] and qubit controls. As in many qubit experiments, such as in superconducting circuits, the qubit measurement could practically be done with only a few observables, e.g., continuously measuring σ_z observable of a superconducting qubit [3]. To determine a full density matrix of a qubit system, one needs to add unitary controls in order to transfer information about other parameters of the qubit's state to the measured observable. In this work, we use only a continuous σ_z measurement of a qubit with arbitrary (weak) strength and a fixed-axis Rabi oscillation control. We use the Bayesian mean estimation to construct the qubit states from measurement records. We also investigate the information transfer during the continuous measurement, and how the information of different qubit coordinates are transferred to the measured observable by considering the Fisher information. Our results show that we can get the state estimators with high fidelity using a small strength of measurement, along with qubit rotation about the Rabi axis making an $\pi/4$ with the x -axis, y -axis and z -axis. In addition, the variance of the estimators shows similar trend as those under fluctuation of many iterations.

References

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