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Optimal estimation of quantum Markov chains using coherent absorbers and displaced-null measurements

jeudi 14 mars 2024 11:00 (1 heure)

In this presentation I will discuss the problem of estimating dynamical parameters of a quantum Markov chain. The key tool will be the use of a coherent quantum absorber which transforms the problem into a simpler one pertaining to a system with a pure stationary state at a reference parameter value. Motivated by the proposal in [1] I will consider counting output measurements and show how the statistics of the counts can be used to compute a simple, asymptotically optimal estimator of the unknown parameter. For this, I will introduce translationally invariant modes (TIMs) of the output and show that these modes are Gaussian in the limit of large times and capture the entire quantum Fisher information of the output. Moreover, the counting measurement provides an effective joint measurement of the TIMs number operators. The unknown parameter is estimated using a two stage estimation procedure. A rough estimator is first computed using a simple measurement, and is used to set the absorber parameter. Due to non-identifiability issues of the counting measurement the reference parameter needs to be shifted away from the initial rough estimator, as shown in the displaced-null measurements theory [2]. Finally, an optimal estimator is computed in terms of the total number of excitations of the TIMs, avoiding the need for expensive estimation procedures.

[1] D. Yang, S. F. Huelga, and M. B. Plenio PRX Quantum 13, 031012 (2023)
[2] F. Girotti, A. Godley and M. Guta, arXiv: 2310.06767

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