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Parameter estimation from quantum-jump data using neural networks

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Estimating unknown parameters of open quantum systems is an important task that is common to many branches of quantum technologies, from metrology to computing. When open quantum systems are monitored and a signal is continuously acquired, this signal can be used to efficiently extract information about the interactions in the system. Previous works have demonstrated a Bayesian framework for the inference of the parameters of a model Hamiltonian for the monitored system, where the posterior distribution over the unknown parameters can be obtained from the data signal. While this Bayesian framework is optimal in the sense of information retrieval, it can be numerically expensive and it relies on the modeling assumptions entering the definition of the likelihood function. In this paper, we introduce a fast and reliable inference method based on artificial neural networks. We compare this new parameter inference method with the Bayesian framework with extensive numerical experiments on a two-level quantum system. The precision of artificial neural networks is comparable to Bayesian posterior estimation, while being computationally much cheaper in inference (after a training phase).
Reference: A preprint of this work is available at this arxiv link

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