Second-order correlation estimation of quantum states using quantum reservoir computing

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Estimation of the second order correlation function $g^{(2)}$ of light is an important practical task as it allows to detect quantum statistics. However, it usually requires a complicated interferometric setup. We propose to measure the second-order correlation function via intensity measurements only, using a quantum neural network based on the concept of quantum reservoir processing [1]. Our method utilizes quantum reservoir processor, which involves a fermionic lattice as a reservoir with random inter-node couplings, excited by an incoming quantum state represented by an optical field. The input quantum states we consider include mixed states (such as Fock, coherent, and thermal states), photon-added squeezed states, polariton source, and emission from a bosonic mode and a two-level system, superposed using a beam splitter. For the training procedure, we use various classical machine learning methods, such as echo state network and random forest regressor, etc. Our results indicate that, despite the lack of a direct dependency between the reservoir density and $g^{(2)}$, our model is capable of predicting the results with high accuracy.

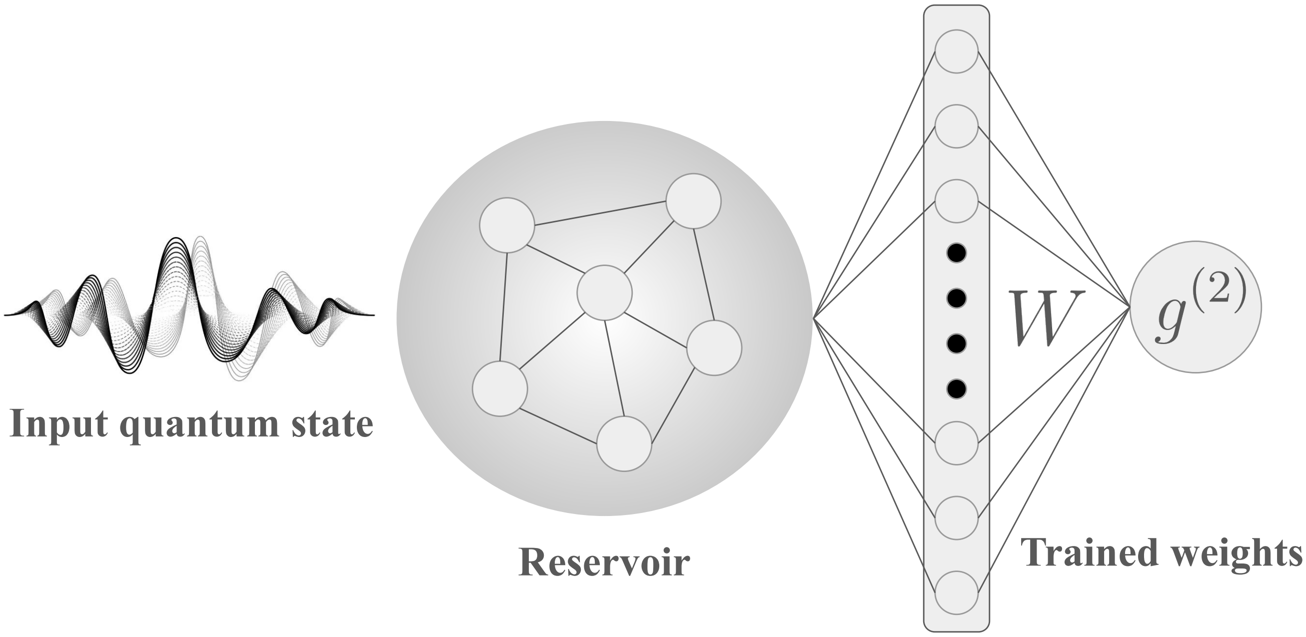

Figure 1: The reservoir is made up of randomly connected nodes. It receives the quantum input state and transforms the inputs into a high-dimensional space. The outputs of the reservoir are then trained by a fully connected linear layer.

References

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