A quantum optical neuromorphic network

Sanjib Ghosh*, and Timothy C. H. Liew
[1] *School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore*
*Corresponding author: *sanjib.ghosh@ntu.edu.ag*

We introduce *quantum reservoir processing* as a platform for quantum information processing developed on the principle of a neural network. A quantum reservoir processor can efficiently perform qualitative quantum tasks like recognising entangled states or quantitative quantum tasks like estimating entropy, purity and negativity (see Ref[1, 2] for more details). This platform can be implemented in a variety of systems, e.g., arrays of semiconductor quantum dots, superconducting qubits, cold atoms and NV centres in diamond. Exciton-polaritons in semiconducting microcavities are yet another promising alternative system which are recently shown to operate in the quantum regime [3, 4].

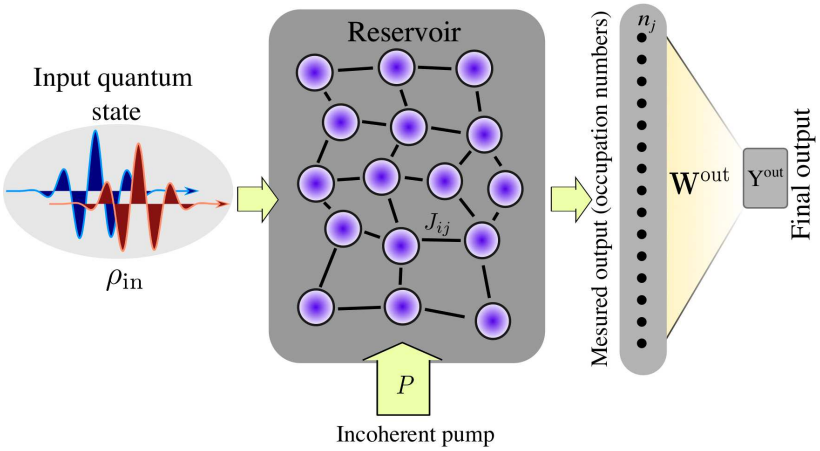

Figure 1: Schematic representation of a quantum reservoir processor. A quantum state in the form of an optical field excites a lattice with random coupling J_{ij} in an effective Hubbard model. The occupation numbers of the sites are extracted and combined to give a final output. This generic architecture can perform various tasks, such as identifying a quantum state and simultaneously estimating its various properties.

Reference:

(1) S. Ghosh, A. Opala, M. Matuszewski, T. Paterek & T. C. H. Liew. npj Quantum Info. (2019).

(2) A. Opala, S. Ghosh, M. Matuszewski, T. Paterek & T. C. H. Liew. Phys. Rev. Applied (2019).

(3) A. Delteil, T. Fink, A. Schade, S. Höfling, C. Schneider & A. İmamoğlu. Nat. Mater. (2019).
See also A. Delteil et al. arXiv:1904.02515 (2019).

(4) A. Cuevas et al. Sci. Adv. (2018).