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Variational neural network ansatz for steady-states in open quantum systems

The state of a Markovian open quantum system is completely determined by its density matrix which evolves according to a Lindblad master equation. When the system is composed by many interacting particles, the complexity arising from the many-body problem merges with the necessity to represent mixed states. In this work we exploit a variational ansatz described by a neural network to represent a generic nonequilibrium density matrix. By deriving a variational principle, we show that it is possible to define an iterative procedure where the network parameters are varied in order to minimize a cost function quantifying the distance from the asymptotic steady-state. Such a procedure, similar in spirit to supervised learning, can be performed efficiently by means of a Montecarlo sampling of the cost function. As a first application and proof-of-principle, we apply the method to the dissipative quantum transverse Ising model.

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