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Variational tensor network operator

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Combining the ideas of the imaginary-time evolution and the variational optimization of trial wave functions, we propose a generic construction of the variational tensor network operators[1] to study the quantum spin systems. We demonstrated that accurate variational ground state wave functions with extremely few tunable parameters can be obtained by applying these operators to some simple initial states. We further showed that this framework can be applied to study spontaneously symmetry breaking, symmetry protected topological, and intrinsic topologically ordered phases, it is found that symmetries of the local tensors associated with these phases can emerge directly after the optimization without any gauge fixing. This provides an universal way to identify quantum phase transitions without prior knowledge of the system.

[1] Yu-Hsueh Chen, Ke Hsu, Wei-Lin Tu, Hyun-Yong Lee, and Ying-Jer Kao.
Variational tensor network operator. Phys. Rev. Res., 4:043153, Nov 2022.

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