Generating function for projected entangled-pair state

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In simulating the modern quantum many-body systems many physicists have paid lots of attention to the application of tensor network (TN) ansatz, which is known to be very accurate for gapped systems due to the obedience of area law. In this presentation I will talk about the construction for the excited state using two-dimensional projected entangled-pair state (PEPS). By adopting the generating function approach for tensor network diagrammatic summation, previously proposed in the context of matrix product states [1], the effective excited state ansatz can be efficiently constructed for evaluating some further properties in two dimensions [2]. Our benchmark results for the spin-1/2 transverse field Ising model and Heisenberg model on the square lattice provide a desirable accuracy, showing good agreement with known results. We also show the results of dynamical structure factor for J_1-J_2 model, demonstrating a non-trivial spectrum as $J_2 \approx 0.5$. We envision that the further application of our methodology can be used to gain more understanding for the peculiar states, such as the gapless spin liquid phase.

[1] Wei-Lin Tu, Huan-Kuang Wu, Norbert Schuch, Naoki Kawashima, and Ji-Yao Chen, Phys. Rev. B **103**, 205155 (2021).

[2] Wei-Lin Tu, Laurens Vanderstraeten, Norbert Schuch, Hyun-Yong Lee, Naoki Kawashima, and Ji-Yao Chen, arXiv:2307.08083 (2023).