

Bond-weighting method for the Grassmann tensor renormalization group

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Recently, the tensor network description with bond weights on its edges has been proposed as a novel improvement for the tensor renormalization group (TRG). The bond weight is controlled by a single hyperparameter, whose optimal value is estimated in the original work via the numerical computation of the two-dimensional critical Ising model. We develop this bond-weighted TRG algorithm to make it applicable to the fermionic system, benchmarking with the two-dimensional massless Wilson fermion. We show that the accuracy with the fixed bond dimension is improved also in the fermionic system and provide numerical evidence that the optimal choice of the hyperparameter is not affected by whether the system is bosonic or fermionic. In addition, by monitoring the singular value spectrum, we find that the scale-invariant structure of the renormalized Grassmann tensor is successfully kept by the bond-weighting technique.

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