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Applying the Triad network representation to four-dimensional ATRG method

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Anisotropic Tensor Renormalization Group (ATRG) is a powerful algorithm for four-dimensional tensor network calculations. However, the larger bond dimensions are known to be difficult to achieve in practice due to the higher computational cost. Adopting the methods of the minimally-decomposed TRG and its Triad prescriptions, we construct a Triad representation of the 4D ATRG by decomposing the unit cell tensor. We observe that this combining approach can significantly improve the computational cost even with maintaining the convergence accuracy of the free energy in the 4D Ising model. In addition, we also show that a further improvement can be achieved in terms of the computational cost when our proposed approach is implemented in parallel on GPUs.

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