Fermionic Implementation of PEPS algorithm

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We present an efficient method to simulate finite size fermionic quantum systems by fermionic projected entangled pair states (PEPS) [1, 2], following the fact that the expectation value of an arbitrary parity-preserving operator can be calculated efficiently for a fermionic PEPS state. Using the variational principles we implement [3] the PEPS variational algorithm to simulate ground states in a sign-free way by absorbing all fermionic signs locally. The method is tested on a bi-linear fermionic model on a square lattice for sizes up to ten by ten where good relative accuracy is achieved. Qualitatively good results are also obtained for an interacting fermionic system.

References

[1] F. Verstraete and J. I. Cirac, arXiv: cond-mat/0407066.

[2] C. V. Kraus, N. Schuch, F. Verstraete, and J. I. Cirac, Phys. Rev. A **81** (2010), 052338.

[3] I. Pižorn and F. Verstraete, Phys. Rev. B **81** (2010), 245110.