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Clifford-augmented MPS technique for fermionic systems

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Reducing entanglement entropy is a key strategy for improving the efficiency of Matrix Product States (MPS), especially when simulating highly entangled quantum systems. Clifford-augmented MPS (CAMPS) is a recent approach that incorporates Clifford gates into the MPS ansatz to transform the basis in a way that compresses entanglement without altering the physical content of the state. This enhancement enables better classical simulability by exploiting the efficient representation of stabilizer-like structures, while preserving accuracy for non-stabilizer states. In this talk, we develop a fermionic counterpart of CAMPS using Grassmann tensor networks, which naturally encode fermionic statistics. This framework allows us to explore the impact of Clifford transformations on entanglement and computational cost in fermionic systems directly without relying on the fermion-spin transformation. Some benchmark results for the tight-binding model are presented.

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