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Environment expansion for MPS time evolution

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In the time evolution following a quench of a low-entropy quantum state, the entanglement will generically grow with time. In a tensor network simulation of the time evolution, the bond dimension will thus need to grow if we want to accurately represent the time-evolved state. In this talk, we shall discuss optimized techniques for expanding the bond dimension in the time-dependent variational principle (TDVP) algorithm for matrix product states, following the methods proposed for the density matrix renormalization group algorithm in arXiv:2403.00562. We use the randomized singular value decomposition to construct two schemes, pre-expansion and post-expansion, being essentially optimized versions of two-site TDVP and subspace expansion, respectively. By combining these expansion routines with a truncation each time step, we can efficiently grow the bond dimension while keeping the error controlled, which we demonstrate through benchmark calculations.

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