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Fourier Acceleration of SU(3) Pure Gauge Theory at Weak Coupling

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In the hybrid Monte Carlo simulation of $\mathrm{SU}(3)$ pure gauge theory, we explore a Fourier acceleration algorithm to reduce critical slowing down. By introducing a soft-gauge-fixing term in the action, we can identify the eigenmodes in the weak-coupling expansion of the action and eliminate the differences in their evolution frequencies. A special unit-link boundary, in which the links lying in the boundary faces are fixed to be unit matrices, is also proposed to eliminate the $\mathbb{Z}_3$ symmetry and the tunneling between $\mathbb{Z}_3$ phases in which is not of interest here. We present the theoretical details and the numerical implementation of this algorithm, compare the autocorrelation times of certain observables with the usual hybrid Monte Carlo algorithm to show its acceleration effect for weak coupling and examine its potential application to physically relevant lattice spacings.

Topical area

Algorithms and Artificial Intelligence

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