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Parallel Tempered Metadynamics

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When approaching the continuum, conventional update algorithms in lattice QCD and other topologically non-trivial theories experience a particularly severe form of critical slowing down that is caused by high action barriers separating the different topological sectors. Previous tests in different theories have shown that Metadynamics can be used to overcome these barriers and reduce the effects of topological freezing by including an additional bias potential that enhances the weight of the barrier regions. However, the required reweighting involved in the method may significantly reduce the effective sample size.

Here, we show that modifications to the bias potential and the combination of Metadynamics with parallel tempering with respect to the bias potential are successful in dealing with this problem. Results from both 2-dimensional U(1) and 4-dimensional SU(3) gauge theories indicate that the new Parallel Tempered Metadynamics algorithm is similarly efficient in reducing autocorrelation times compared to Metadynamics, while at the same time requiring no reweighting and showing no reduction in the effective sample size.

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