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Equivariant Diffusion-based Sampling for Lattice Field Theory

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Recent advances in deep generative modeling have enabled accelerated approaches to sampling complicated probability distributions. In this work, we develop symmetry-equivariant diffusion models to generate lattice field configurations. We build score networks that are equivariant to a range of group transformations and train them using an augmented score matching scheme. By reweighting generated samples, we produce unbiased estimates for observables in scalar ϕ^4 theory and $\mathrm{U}(1)$ gauge theory. We extend our framework to sample $\mathrm{SU}(N)$ degrees of freedom by adapting the score matching technique and the reverse diffusion process to the group manifolds. Our trained models faithfully reproduce the target densities for several toy $\mathrm{SU}(2)$ theories, which marks a step towards simulating full $\mathrm{SU}(N)$ gauge theory on the lattice.

Special requests

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