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Deep learning stochastic processes with QCD phase transition

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It is non-trivial to recognize phase transitions and track dynamics inside a stochastic process because of itsintrinsic stochasticity. In this paper, we employ the deep learning method to classify the phase orders and predict the damping coefficient of fluctuating systems under Langevin description. As a concrete set-up, we demonstrate this paradigm for the scalar condensation in QCD matter near critical point, in which the order parameter of chiral phase transition can be characterized in a 1+1-dimensional Langevin equation for sigma field. In a supervised learning manner, the Convolutional Neural Networks(CNNs) accurately classify the first-order phase transition and crossover based on sigma field configurations with fluctuations. Noise in the stochastic process does not significantly hinder the performance of the well-trained neural network for phase order recognition. For mixed dynamics with diverse dynamical parameters, we further devise and train the machine to predict the damping coefficients in a broad range. The results show that it is robust to extract the dynamics from the bumpy field configurations.

Collaboration

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