4th YSM-SPIP in Sendai/Prologue Series IV of FSPIP

Dynamics of the One-Dimensional Ising Model without Detailed Balance Condition

Yuji Sakai, Koji Hukushima
Graduate School of Arts and Sciences, The University of Tokyo

Markov chain Monte Carlo methods enable us to sample from a high-dimensional probability distribution and to estimate an expectation value under the distribution. Although detailed balance condition is widely used in order to ensure correct sampling, it is not always necessary. Recently, several methods without detailed balance have been proposed. We study a Markov chain Monte Carlo method with skew detailed balance condition for a one-dimensional Ising model. In this method, an additive Ising spin ε is introduced. The skew detailed balance condition, where stochastic flow with a single spin flip under $\varepsilon = +1$ balances with the reverse process under $\varepsilon = -1$, is imposed. In addition, the total balance condition is satisfied by introducing a process for ε flip. We determine explicitly several transition probabilities which satisfy the skew detailed balance condition and evaluate analytically the time evolution of the magnetization density for a specific transition probability in a thermodynamic limit. As a result, we find theoretically that the relaxation time of magnetization density is reduced by breaking the detailed balance condition.

References

[1] R. J. Glauber, J Math Phys. **4** (1963) 294 .
[2] K. S. Turitsyn *et al.*, Physica D **240** (2011) 410 .