The Annals of Statistics
2006, Vol. 34, No. 4, 1629–1635
DOI: 10.1214/009053606000000498
Main article DOI: 10.1214/009053606000000515

DISCUSSION OF "EQUI-ENERGY SAMPLER" BY KOU, ZHOU AND WONG

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1. Introduction. We first would like to congratulate the authors for their interesting paper on the development of the innovative equi-energy (EE) sampler. The EE sampler provides a solution, which may be better than existing methods, to a challenging MCMC sampling problem, that is, sampling from a multimodal target distribution $\pi(x)$. The EE sampler can be understood as follows. In the equi-energy jump step, (i) points may move within the same mode; or (ii) points may move between two modes; but (iii) points cannot move from one energy ring to another energy ring. In the Metropolis–Hastings (MH) step, points move locally. Although in the MH step, points may not be able to move freely from one mode to another mode, the MH step does help a point to move from one energy ring to another energy ring locally. To maintain certain balance between these two types of operations, an EE jump probability p_{ee} must be specified. Thus, the MH move and the equi-energy jump play distinct roles in the EE sampler. This unique feature makes the EE sampler quite attractive in sampling from a multimodal target distribution.

2. Tuning and "black-box." The performance of the EE sampler depends on the number of energy and temperature levels, K, energy levels $H_0 < H_1 < \cdots < H_K < H_{K+1} = \infty$, temperature ladders $1 = T_0 < T_1 < \cdots < T_k$, the MH proposal distribution, the proposal distribution used in the equi-energy jump step and the equi-energy jump probability p_{ee}. Based on our experience in testing the EE sampler, we felt that the choice of the H_k, the MH proposal and p_{ee} are most crucial for obtaining an efficient EE sampler. In addition, the choice of these parameters is problem-dependent. To achieve fast convergence and good mixing, the EE sampler requires extensive tuning of K, H_k, MH proposal and p_{ee} in particular. A general sampler is designed to be "black box" in the sense that the user need not tune the sampler to the problem. Some attempts have been made for developing such "black-box" samplers in the literature. Neal [4] developed variations on slice sampling that can be used to sample from any continuous distributions and that require little or no tuning. Chen and Schmeiser [2] proposed the random-direction interior-point (RDIP) sampler. RDIP samples from the uniform distribution defined over the region $U = \{(x, y) : 0 < y < \pi(x)\}$ below the curve of the surface defined by $\pi(x)$, which is essentially the same idea used in slice sampling.

Received November 2005.