Statistics > Computation



# Markov Chain Monte Carlo Based on Deterministic Transformations

Somak Dutta, Sourabh Bhattacharya

*(Submitted on 29 Jun 2011 (v1), last revised 5 Mar 2012 (this version, v2))*

In this article we propose a novel MCMC method based on deterministic transformations T: X x D --> X where X is the state-space and D is some set which may or may not be a subset of X. We refer to our new methodology as Transformation-based Markov chain Monte Carlo (TMCMC). One of the remarkable advantages of our proposal is that even if the underlying target distribution is very high-dimensional, deterministic transformation of a one-dimensional random variable is sufficient to generate an appropriate Markov chain that is guaranteed to converge to the high-dimensional target distribution. Apart from clearly leading to massive computational savings, this idea of deterministically transforming a single random variable very generally leads to excellent acceptance rates, even though all the random variables associated with the high-dimensional target distribution are updated in a single block. Since it is well-known that joint updating of many random variables using Metropolis-Hastings (MH) algorithm generally leads to poor acceptance rates, TMCMC, in this regard, seems to provide a significant advance. We validate our proposal theoretically, establishing the convergence properties. Furthermore, we show that TMCMC can be very effectively adopted for simulating from doubly intractable distributions.
TMCMC is compared with MH using the well-known Challenger data, demonstrating the effectiveness of of the former in the case of highly correlated variables. Moreover, we apply our methodology to a challenging posterior simulation problem associated with the geostatistical model of Diggle et al. (1998), updating 160 unknown parameters jointly, using a deterministic transformation of a one-dimensional random variable. Remarkable computational savings as well as good convergence properties and acceptance rates are the results.

| | |
|---|---|
| Comments: | 38 pages, 3 figures; Longer abstract inside article |
| Subjects: | **Computation (stat.CO)** |
| Cite as: | **arXiv:1106.5850 [stat.CO]** |
| | (or **arXiv:1106.5850v2 [stat.CO]** for this version) |

**Submission history**

From: Somak Dutta [view email]

[v1] Wed, 29 Jun 2011 06:41:42 GMT (289kb,D)
[v2] Mon, 5 Mar 2012 05:39:53 GMT (292kb,D)

*Which authors of this paper are endorsers?*