

Discussion of the Read Paper by Girolami and Calderhead “Riemann manifold Langevin and Hamiltonian Monte Carlo methods” read to the Society on October 13th, 2010

Jean-Michel Marin and Christian P. Robert

*Université de Montpellier 2, I3M, Université Paris–Dauphine, CEREMADE, and
CREST, Paris*

This paper is a welcome addition to the recent MCMC literature and the authors are to be congratulated for linking together the two threads that are the Langevin modification of the random walk Metropolis–Hastings algorithm and the Hamiltonian acceleration. Overall, trying to take advantage of second order properties of the target density $\pi(\theta)$, just like the Langevin improvement takes advantage of the first order (Roberts and Tweedie, 1995, Stramer and Tweedie, 1999a,b) is a natural idea which, when implementable, can obviously speed up convergence. This is the Langevin part, which may use a fixed metric \mathbf{M} or a local metric defining a Riemann manifold, $\mathbf{G}(\theta)$. Obviously, this requires that the derivation of an appropriate (observed or expected) information matrix $\mathbf{G}(\theta)$ is feasible up to some approximation level. Or else that authoritative enough directions are given about the choice of an alternative $\mathbf{G}(\theta)$.

While the logistic example used in the paper mostly is a toy problem (where importance sampling works extremely well, as shown in Marin and Robert, 2010), the stochastic volatility model is more challenging and the fact that the Hamiltonian scheme applies to the missing data (volatility) as well as to the three parameters of the model is quite interesting. We would thus welcome more details on the implementation of the algorithm in such a large dimension space. We however wonder at the appeal of this involved scheme when considering that the full conditional distribution of the volatility can be simulated exactly.

References

- MARIN, J. and ROBERT, C. (2010). Importance sampling methods for Bayesian discrimination between embedded models. In *Frontiers of Statistical Decision Making and Bayesian Analysis* (M.-H. Chen, D. Dey, P. Müller, D. Sun and K. Ye, eds.). Springer-Verlag, New York. To appear.
- ROBERTS, G. and TWEEDIE, R. (1995). Exponential convergence for Langevin diffusions and their discrete approximations. Tech. rep., Statistics Laboratory, Univ. of Cambridge.

- STRAMER, O. and TWEEDIE, R. (1999a). Langevin-type models I: diffusions with given stationary distributions, and their discretizations. *Methodology and Computing in Applied Probability*, **1** 283–306.
- STRAMER, O. and TWEEDIE, R. (1999b). Langevin-type models II: Self-targeting candidates for Hastings-Metropolis algorithms. *Methodology and Computing in Applied Probability*, **1** 307–328.