

# Séminaire de Probabilités et Statistiques

Mardi 08 Décembre à 14h  
Salle de Conférences

**Gilles Pagès**  
(LPMA-UPMC)

*Estimateurs Multilevel à poids : de Métropolis-Ulam à  
Langevin Monte Carlo*

(issu de travaux avec V. Lemaire (LPMA-UPMC) et F. Panloup (Toulouse))

We present a simple weighted multilevel estimator, called *Multilevel Richardson-Romberg extrapolation* (ML2R) which combines the Multilevel Monte Carlo (MLMC) paradigm introduced by M. Giles in '08 with a multistep Richardson-Romberg extrapolation in order to take advantage of the existence of a higher orders expansion of the weak error, combined with the usual quadratic convergence rate assumption. When applied to (1-marginal Borel) functions of the Euler scheme of hypo-elliptic Brownian diffusions with smooth enough coefficients, its complexity grows as  $O(\log(\frac{1}{\varepsilon})\varepsilon^{-2})$  for a prescribed mean square error  $\varepsilon^2$  *i.e.*  $\log(\frac{1}{\varepsilon})$  times slower than with a regular MLMC estimator. This gain factor reaches  $e^{O(\sqrt{\log(\frac{1}{\varepsilon})})}$  when the quadratic convergence rate of the functional of the scheme is worse (like for digital or path-dependent barrier options in finance for example).

These ML2R estimators have also been successfully implemented and analyzed for nested Monte Carlo simulations in both smooth and singular settings, using a higher order extension of Gordy-Juneja's expansion result for quantiles.

Finally, we will show how to adapt this ML2R approach to Langevin (ergodic) Monte Carlo simulation in order to compute expectations of functionals of stationary ergodic diffusions satisfying a strong confluence assumption.