

**Proposition of internship
in the TOSCA project-team (INRIA Nancy-Grand Est)
POPULATION MONTE CARLO METHODS IN FINANCE**

Keywords : Mathematical finance, Monte Carlo methods, population Monte Carlo methods.

The goal of this internship is to study some simulation techniques relying on population Monte Carlo methods with application to financial engineering.

Many problems in simulation in finance or physics relies on the simulation of particles. In finance, the position of the particles can represent the price of a stock or an interest rate for example. The traditional Monte Carlo method consists in simulating the random dynamic of the particles independently.

However, if it is generally simple to implement, the standard Monte Carlo method could be slow and many techniques — called variance reduction techniques — have been provided to improve or speed up the results.

Here, we are interested in the class of Population Monte Carlo methods, where all the particles are simultaneously simulated and for which one may take advantage from an approximation of the density of the particles. In particular, we are interested in importance sampling techniques.

Although we are interested in financial engineering, this kind of method is also commonly used in many other fields (Statistical and quantum physics, Bayesian statistics, ...) where they are known under various names (sequential Monte Carlo, quantum Monte Carlo, ...). This internship is thus not necessarily oriented toward finance.

Prerequisites : Knowledges in Stochastic Differential Equations and Monte Carlo methods, and in programming (C++, ...).

Location and duration : The internship will take place at the Institut Élie Cartan in Nancy, France, under the supervision of Madalina Deaconu¹, Samuel Herrmann² and Antoine Lejay³. Its duration can be 4 or 5 months.

October 2009

¹Madalina.Deaconu@inria.fr

²Samuel.Herrmann@iecn.u-nancy.fr

³Antoine.Lejay@iecn.u-nancy.fr