Practical Applications of Randomness

A mini-workshop at Hiroshima University
広島大学ミニワークショップ 日本OR学会中国四国支部共催

Place : Hiroshima University, Faculty of Science Building B, B707

1-3-1, Kagamiyama, Higashi Hiroshima, JAPAN

Date : 2007 Mar. 26 (Mon.)

15:00–16:10 Pierre L'Ecuyer

"A Practical View of Randomized Quasi-Monte Carlo"

16:20–17:20 Masanori Fushimi

"Parallel pseudo-random number generation with special reference to built-in self-test of VLSI"

A Practical View of Randomized Quasi-Monte Carlo

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Abstract. Quasi-Monte Carlo (QMC) methods are numerical techniques for estimating large-dimensional integrals, usually over the unit hypercube. They can be applied, at least in principle, to any stochastic simulation whose aim is to estimate a mathematical expectation. This covers a wide range of applications. Practical error bounds are hard to obtain with QMC but randomized quasi-Monte Carlo (RQMC) permits one to compute an unbiased estimator of the integral, together with a confidence interval. RQMC can in fact be viewed as a variance-reduction technique.

In this talk, we review some key ideas of RQMC methods and provide concrete examples of their application to simulate systems modeled as Markov chains. We also present a new RQMC method, called array-RQMC, recently introduced to simulate Markov chains over a large number of steps. Our numerical illustrations indicate that properly adapted RQMC methods can dramatically reduce the variance compared with standard Monte Carlo.

The array-RQMC method is joint work with Christian Lécot (Université de Savoie) and Bruno Tuffin (IRISA).

Parallel pseudo-random number generation with special reference to built-in self-test of VLSI

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Abstract.

Parallel computations are often used for large scale Monte Carlo simulations, in which we want to have independent (or at least uncorrelated) streams of (pseudo-)random numbers. Several algorithms for generating independent streams of random numbers have been proposed so far. We briefly review some of them in the first part of this talk.

Independent streams of random numbers are also necessary to test VLSI chips for malfunctions. Since the number of gates of a VLSI chip is more than a million, it is impossible to test a chip by exhaustively checking all the states that the chip can assume, and some mechanism of random sampling of the states is necessary. It is natural to include a testing mechanism into a chip to shorten the time required for test procedures. When we include a random number generator into a VLSI chip, it is desirable to make the area that the generator assumes as compact as possible. Cellular automata are preferable to linear feedback shift registers in this respect. We discuss a method of designing good celullar automata for generating independent substreams of pseudo-random test patterns. Some computational results will be reported.

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