

Mascagni, Michael; Hin, Lin-Yee

Parallel pseudo-random number generators: a derivative pricing perspective with the Heston stochastic volatility model. (English) [Zbl 1273.65006](#)

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Summary: Accuracy and precision of parallel Monte Carlo (MC) simulations may be impaired by the presence of intra-thread and inter-thread correlations depending on the parallel pseudo-random number generators (PPRNGs) used. While necessary, statistical tests alone are insufficient to ensure the absence of these correlations that can manifest as bias and variance to a extent in different applications. Therefore, application-based tests designed to mimic real-life MC scenarios may uncover them in the intended applications. The results of an application-based test simulating the Heston stochastic volatility model, a widely used pricing framework, is reported in order to compare the accuracy and precision profiles among four popular libraries of scalable pseudo-random number generators implementing sequence division (trng and RngSteam), parameterization (sprng) and counter-based (Random123) strategies. All pseudo-random number generators assessed demonstrate similar standard-error of mean profiles. However, the bias profiles are more varied albeit comparable. PPRNGs demonstrating the smallest bias profiles in absolute and relative terms are yarn4 from TRNG, mlf from SPRNG, as well as Threefry2x64 from Random123 for the truncated Euler scheme, and mrg5s from TRNG and lfg from SPRNG for the quadratic exponent scheme. It is recommended that, when selecting a PPRNG for parallel MC simulation from a set of competing PPRNGs with comparable bias and standard error of mean profiles in absolute terms, the PPRNG associated with the smallest parallel-sequential bias difference should be used as it reflects the smallest intra-thread correlation introduced by parallelization.

MSC:

- 65C10 Random number generation in numerical analysis
- 65C05 Monte Carlo methods
- 65Y05 Parallel numerical computation
- 91G60 Numerical methods (including Monte Carlo methods)
- 91G10 Portfolio theory
- 91B25 Asset pricing models (MSC2010)

Keywords:

[parallel computing](#); [pseudo-random number generators](#); [testing random numbers](#); [financial applications](#); [Heston stochastic volatility model](#); [parallel computation](#); [numerical examples](#); [statistical test](#); [pricing](#)

Software:

[dieharder](#); [RngSteam](#); [SPRNG](#); [TestU01](#); [trng](#)

Full Text: [DOI](#)