# Numerical Validation with the Discrete Stochastic Arithmetic on New Architectures

Jean-Luc Lamotte[1]
[1] Laboratoire d'Informatique de Paris 6, UPMC, CRNS UMR7606.
Jean-Luc.Lamotte@lip6.fr

*Keywords: discrete stochastic arithmetic, CADNA, performance, new architecture*

Now Scientists are facing up to a new age. Power of computer enables us to perform experiences *in silicio*. Modelisations are enough accurate to obtain results closed to reality, although they sometimes fail. Several reasons can be given: the modelisation is not close enough to reality, the model is unstable, etc. One reason is often forgotten: errors coming from computers. Indeed, numerical computations are based on floating point number representation which is only an approximation of real numbers. Each operation generates a very small error that can propagate and cause the computed result to become completely different than the expected one. Several methods are well known to study the round-off errors propagation.

The talk will focus on the DSA (discrete stochastic arithmetic) and its implementation: the CADNA software. The DSA allows us to study the round-off error propagation in all codes written in Fortran, C or C++ with few code modifications. This method is powerful but a bottleneck is the increase of the over-cost in computation time. Explanations and a solution will be given. In a second part, an overview of the CADNA implementation on multicore, distributed systems and GPU will be developed.

## References

[1] Université Pierre et Marie Curie, Paris, F.: CADNA: Control of Accuracy and Debugging for Numerical Applications (2010), http://www.lip6.fr/cadna.

[2] J.-L. Lamotte, J.-M. Chesneaux, F. Jézéquel, *CADNA_C: A version of CADNA for use with C or C programs*, Computer Physics Communications, vol. 181 (11), pp. 1925-1926 (2010)

[3] Vignes, J., *Discrete stochastic arithmetic for validating results of numerical soft- ware*. Num. Algo. 37(1-4) (2004) 377-390