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# Calibrating Cellular Automata models through Genetic Algorithms

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Cellular Automata (CA) are discrete non-linear systems. They can be usefully applied for modeling and simulating complex natural processes. CA overall global dynamics emerges from simultaneous application of local rules to each cell.

Di Gregorio and Serra [1] developed a CA-based empirical approach for modelling macroscopic natural phenomena, which was successfully applied to complex non-linear phenomena, such as lava-flows and debris-flows. In this approach, CA usually depend on many global parameters, which have to be provided, through an appropriate calibration phase (in general, manually performed).

An alternative, automated method for calibrating CA parameters, based on Genetic Algorithms (GA) [2], is presented. GA are general-purpose search algorithms, inspired from genetics and natural selection. Sequential GAs are commonly able to find "good" solutions in a reasonable amount of time. Nevertheless, Parallel Computing can advantageously be employed to strongly speed up the execution time.

Results of a "Master-Slave Parallel Genetic Algorithm" (MS-PGA) search technique for investigating optimal CA parameters are discussed. Experiments have been carried out for the optimization of two well known CA models for modelling lava flows and debris flows (SCIARA and SCIDDICA, respectively – cfr. these proceedings). In both cases, results confirmed the validity and reliability of the adopted technique of calibration. Accordingly, more accurate and consistent simulations could be obtained, which may be profitably utilised for hazard mapping and risk evaluations.

Keywords: Genetic Algorithms; Cellular Automata; Simulation; Calibration; Lava flows; Debris flows.

## References

[1] S. Di Gregorio, R. Serra, *Future Generation Computer Systems* **16/2-3**, 259 (1999).

[2] J.H., Holland, Adaptation in Natural and Artificial Systems, 2nd edn. MIT Press, Cambridge, Massachusetts, 211 (1992).