

## **Cellular Automata: Theory and Application in Artificial Intelligence**

### **Foreword**

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Cellular automata provide new means for doing computation efficiently in terms of speed, cost, power dissipation, information storage, and solution quality. They have been proposed to study the general phenomenological aspects, including communication, computation, construction, growth, reproduction, competition, and evolution. They also provide an excellent tool for modeling physical phenomena by reducing them to their basic, elemental laws.

Interesting computational properties of the cellular automaton model have inspired us to investigate new research area. The development of theoretical and practical issues of cellular automata has also been impressive. To reflect the current main trends in the domain of cellular automata, a special session on **Cellular Automata and their Applications in AI** was held in India in December 2007, within the **3rd Indian International Conference on Artificial Intelligence, IICAI-07**. After the successful conference, a special issue of **Fundamenta Informaticae** on **Cellular Automata: Theory and Application in Artificial Intelligence** was launched. This issue contains one invited and six contributory papers selected after the corresponding call for paper.

First two contributions of this special issue are on the theoretical development of cellular automata. While the first contribution is on the development of an analytical framework to characterize the cyclic vector subspaces of an additive cellular automaton, second contribution presents a new optimum-time algorithm for synchronizing two-dimensional cellular automata. Next two contributions are related to the theoretical development of fuzzy cellular automata. A novel way called radial representation is introduced in the third contribution to visualize the evolution of a particular class of continuous cellular automata called fuzzy cellular automata. The new visualization method reveals interesting dynamics and proposes an empirical classification of fuzzy cellular automata. A special type of fuzzy cellular automata is investigated in next contribution that computes effect due to both interaction of neighboring cells and external disturbance on the cells, which is very useful for computing growth in evolutionary systems. In last three contributions, the applications of cellular automata in diverse fields are presented. A general framework is proposed to automatically generate rules that produce given spatial patterns in complex systems and the results on a 3-values, 6-neighbors,  $k$ -totalistic cellular automata rule called the burning paper rule are presented. Also, a graceful application of hierarchical cellular automata is reported to address an important design problem of civil engineering. Finally, a hybrid technique based on two dimensional cellular automata and parallel master-slave genetic algorithms is presented for modeling lava flows on Mt Etna volcano, Italy. As a whole, this special issue witnesses the vitality of the domain of cellular automata.

Finally, I take this occasion to especially thank Andrzej Skowron, editor-in-chief of *Fundamenta Informaticae*, for giving me a new occasion to witness the vitality of cellular automata as a field of computer science. I am also very thankful to Andrew Adamatzky, Bastien Chopard, Bhanu Prasad, Biplab K. Sikdar, Debashis Sen, Donato D'Ambrosio, Hiroshi Umeo, Kuntal Ghosh, Leonardo Vanneschi, Martin Kutrib, Niloy Ganguly, Paola Flocchini, Pabitra Pal Chaudhuri, Parimal Pal Chaudhuri, Samira El Yacoubi, Stefania Bandini, and William Spataro, for their important and valuable reviews. They greatly contributed by their remarks and suggestions to improve the quality of the papers and the whole issue. Finally, it is my pleasure to thank the authors for their interesting and valuable contributions.

**Guest Editor**

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