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Preface

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Cellular Automata (CA) are one of the oldest and best studied models of computation, introduced by John Von Neumann and Stanislaw Ulam between the 40s and the 50s. CA have been investigated as a theoretical model of (parallel) computation, as discrete-time dynamical systems, and as a tool for modeling natural phenomena.

This special issue collects extended and revised versions of selected papers presented at the 14th International Conference and School "Cellular Automata for Research and Industry" (ACRI 2020) organized by the Faculty of Physics and Applied Informatics of the University of Lodz, Poland. The conference was expected to be held in Łodz, Poland in the fall of 2020, but due to the COVID-19 pandemic, it was held online in the period December 2–4, 2020. The primary goal of the conference was to offer scientists and engineers from academia and industry an opportunity to initiate new collaborations or to strengthen existing collaborations, and to provide a forum for exchanging views on current trends, challenges, and the state-of-the art solutions to problems in various research areas, e.g., biology, computer science, chemistry, ecology, economy, engineering, geology, medicine, physics, and sociology.

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From the collection of 24 full and 3 short contributions presented at the conference and included in the LNCS volume, 10 papers were selected for possible presentation of an extended version in this special issue. After a review process, 7 of them have been accepted for publication.

Two papers presented in this special issue deal with theoretical properties of CA, studied either in a formal way or via heuristic searches.

In "One-Dimensional Pattern Generation by Cellular Automata" Kutrib and Malcher investigate the ability of CA to generate patterns within a given time constraint, a different perspective from the usual one, where CA are used to recognize languages. In particular, they study the generation of unary and non-unary patterns in real-time.

In "Heuristic Search of (Semi-)Bent Functions based on Cellular Automata" by Mariot, Saletta, Leporati, and Manzoni a way to extend functions with good cryptographic properties to "larger" functions is studied. In particular, the authors investigate secondary constructions based on cellular automata with a focus on bent and semi-bent functions.

Three of the presented works deal with the modeling of real-world phenomena, from physics to pedestrian dynamics.

In "MRT-Lattice Boltzmann hybrid model for the double diffusive mixed convection with thermodiffusion effect" by Mhamdi, Bettaibi, Jellouli, and Chafra the thermodiffusion effect is modeled via a combination of the lattice Boltzmann method (for the fluid flow) and the finite difference method (for concentration and temperature).

In "Time discretization in the time-continuous pedestrian dynamics model SigmaEva" Kirik and Vitova study the time-continuous SigmaEva model of pedestrian dynamics. This approach combines both discrete and continuous components trying to have the benefits of both continuous and discrete models without the drawbacks.

In "Cellular Automata Rules Solving the Wireless Sensor Network Coverage Problem" by Hoffmann, Désérable, and Seredyński the authors investigate a probabilistic CA with rules that try to cover a 2D grid with the least possible number of "sensor tiles" in order to solve the problem of covering a surface with the least possible number of wireless sensors.

The effect of the COVID-19 pandemic is reflected in two papers.

In "Estimates of the collective immunity to COVID-19 derived from a stochastic cellular automaton based framework" by Lima and Balbi a stochastic CA is defined to study and model the spread of COVID-19, and to evaluate the effect of different fractions of immune people in the population on the spread of the virus.

In "A GIS-aided Cellular Automata System for Monitoring and Estimating Graph-based Spread of Epidemics" Kyriakou, Georgoudas, Papanikolaou, and Sirakoulis define a model with both a cellular-based structure and a graph representation to model the spread of the COVID-19 epidemics. The model is tested on both the micro and the macro scale with data from the city of Eleftheroupoli in Grece.

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