# Foreword

"*Cellular Automata and Complex Systems. Method for Modeling Life-like Phenomena*" presents ten years of research by Eleonora Bilotta and Pietro Pantano. The book offers an innovative approach to the study of discrete dynamical systems, such as one-dimensional and two-dimensional Cellular Automata (CA). The first section introduces recent work by the authors on the use of Genetic Algorithms to discover complex rules for one-dimensional CA. It goes on to show how these CA can generate novel structures with language-like properties. The second section provides a detailed discussion of two-dimensional Cellular Automata, beginning with von Neumann's initial proposal of an artificial self-replicating system. The authors show that self-replication is a common feature not only of biological but also of computational systems. They go on to show how it is possible to analyze computational self-replicators as if each system were a biological agent with its own genetic code. On this basis, they develop a taxonomy of self-replicators. The third part of the book shows how cellular automata can be used to generate sound and music, rendering some of the beauty of complexity.
The authors present new techniques relevant to many important areas of CA research. More specifically:

1. they show how Genetic Algorithms can be used to detect complex rules both in one-dimensional and two-dimensional systems;

2. they create a formal language providing new insights into emerging CA structures (gliders and regular domains), and use sets of production rules to generate complex behavior;
3. they describe the current state of the art in Boolean CA;
4. they provide a taxonomy of self-reproducing systems accessible to a wide-audience;
5. they demonstrate how cellular automaton can be seen as life-like agents, each with its own genetic code;
6. they evolve populations of complex agents;
7. they translate the output of cellular automata into sounds and music, using media to gain a better understanding of CA behavior;
8. they present a gallery of patterns generated by one and two-dimensional CA.

The end product is a virtual laboratory which the authors use to explore the life-like processes set in motion by specific CA. Their simulations show how it is possible to change CA's form and function by varying their "genome". Their study of the relationship between the genome, structure and function of CA provides new ways of interpreting evolutionary trajectories in CA parameter space and demonstrate CA power as a model of life-like phenomena.

All told, I found this book to be most timely and challenging. Its high level of exposition should appeal to a broad readership. It is a gem to behold and contemplate.

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***Leon Chua**, Ph.D., is a full professor at the Electrical Engineering and Computer Sciences Department of the University of Berkeley. Prof. Chua is the inventor of the Chua circuit (1983) and of Cellular Neural Networks (1988). He has made major contributions to several different fields of research including Cellular Neural/Nonlinear Networks, Nonlinear Circuits and Systems, Nonlinear Dynamics, Bifurcation theory and Chaos theory. His name is included in the ISI list of the most frequently cited authors in engineering. He is the founder and editor of the International Journal of Bifurcation and Chaos and has received numerous awards including several honorary degrees. Recently, a nano-technology research group in HP discovered a memristor (memory resistor), that Prof. Chua predicted in 1973. The discovery has opened interesting prospects for research. Prof. Chua is an expert in Cellular Automata, where he has worked to place the discipline rests on sound mathematical foundations. With World Scientific, he has recently published several books in this area.*