Preface

The main topic of this book is the Multi-Agent-Based Simulations (MABS) applied to biological and environmental domains. The interdisciplinary character of MABS is an important challenge faced by all researchers, while demanding a difficult interlacement of different theories, methodologies, terminologies and points of view. MABS has provided architectures and platforms for the implementation and simulation of relatively autonomous agents and it has contributed to the establishment of the agent-based computer simulation paradigm. The agent-based approach enhances the potentialities of computer simulation as a tool for theorizing about social scientific issues. In particular, the notion of an extended computational agent, implementing cognitive capabilities, is giving encouragement to the construction and exploration of artificial societies, since it facilitates the modeling of artificial societies of autonomous intelligent agents.

Although it is inherently an interdisciplinary discipline, MABS is a difficult activity. This book brings new insights on the discipline, looking through its challenges. The book presents some current discussions on agent-based simulation and modeling, addressing theoretical, methodological, technical and instrumental issues concerning the areas of Biological and Environmental Systems, and focusing on applications, so offering different kinds of models and tools that can help the reader to face complex developments. The book is divided into 2 sections.

Section 1, “Theoretical Models and Tools,” provides some new agent-based models or tools to advance current research in the theme, to help a better understanding of the area and also assist in the development of new simulations.

Chapter 1, “Ignition of Algorithm Mind: The Role of Energy in Neuronal Assemblies,” by Magessi and Antunes, presents a simple multi-agent model, where we explored the role of energy and respective limits on neuronal assemblies.

Chapter 2, “Ecosystems as Agent Societies: Landscapes as Multi-Societal Agent Systems,” by Rocha Costa, introduces the ecosystems as agent societies and landscapes as multi-societal agent systems approaches to ecosystems and landscapes, together with the core elements of the agent-based architectural models that support such approaches.

Chapter 3, “Morphozoic, Cellular Automata with Nested Neighborhoods as a Metamorphic Representation of Morphogenesis,” by Portegys, Pascualy, Gordon, McGrew and Alicea, presents a cellular automaton model, Morphozoic that may be used to investigate the computational power of morphogenetic fields to foster the development of structures and cell differentiation.

Chapter 4, “A Scalable Multiagent Architecture for Monitoring Biodiversity Scenarios,” by Rocha and Brandão, proposes a scalable architecture that distributes the data aggregation responsibility to the
devices of the boundary of the group, and creates agents to manage groups and the interaction among them, such as merging and splitting.

Chapter 5, “MASE: A Multi-Agent-Based Environmental Simulator,” by Ralha and Abreu, presents research carried out under the MASE project, including the definition of a conceptual model to characterize the behavior of individuals that interact in the dynamics of land-use and cover change. A computational tool for analyzing environmental scenarios of land change was developed, called MASE – Multi-Agent System for Environmental Simulation.

Chapter 6, “Modelling and Simulating Complex Systems in Biology: Introducing NetBioDyn – A Pedagogical and Intuitive Agent-Based Software,” by Ballet, Rivière, Pothet, Theron, Pichavant, Abautret, Fronville and Rodin, presents NetBioDyn, an original software aimed at biologists (students, teachers, researchers) to easily build and simulate complex biological mechanisms observed in multicellular and molecular systems. Thanks to its specific graphical user interface guided by the multi-agent paradigm, this software does not need any prerequisite in computer programming.

Chapter 7, “Agent-Based Modelling in Multicellular Systems Biology,” by Montagna and Omicini, discusses the content of multi-agent based simulation (MABS) applied to computational biology, i.e., to modelling and simulating biological systems by means of computational models, methodologies, and frameworks. MABS is discussed as the source of the most natural and appropriate mechanism for analysing the self-organising behaviour of systems of cells.

Section 2, “Applications in Biological and Environmental Systems,” is the core of the book, presenting applications in the research focus fields, such as chemical contamination, three-dimensional protein structure prediction, air pollution, biodiversity conservation and social inclusion or tuberculosis bacillus growth curve.

Chapter 8, “Architecture with Multi-Agent for Environmental Risk Assessment by Chemical Contamination,” by Andrade and Modesto, describes an architecture of a multi-agent system for environmental risk assessment in areas contaminated as often occur in mining, oil exploration, intensive agriculture and others. Plan multiple points in space-time matrix where each agent carries out exposure assessment and the exchange of information on toxicity, to characterize and classify risk in real time.

Chapter 9, “Microbial Fuel Cells Using Agent-Based Simulation: Review and Basic Modeling,” by Machado, Adamatti and Gonçalves, presents an agent-based model and simulation of Microbial Fuel Cells comparing it with analytical models, to show that this approach could model and simulate these problems with more abstraction.

Chapter 10, “Use SUMO Simulator for the Determination of Light Times in Order to Reduce Pollution: A Case Study in the City Center of Rio Grande, Brazil,” by Born, Souza de Aguiar and Adamatti, proposes a study of the dispersion of pollutants and Genetic Algorithms with simulations performed in Urban Mobility Simulator SUMO (Simulation of Urban Mobility) to calibrate the times of the traffic lights, featuring the finest green light times and the sum of each of the pollutants each simulation cycle.

Chapter 11, “Multi-Agent Systems in Three-Dimensional Protein Structure Prediction,” by Corrêa and Dorn, provides an integrated view and insights about the protein structure prediction area concerned to the usage, application and implementation of multi-agent systems to predict the protein structures or to support and coordinate the existing predictors, as well as it is advantages, issues, needs, and demands.

Chapter 12, “Biomass Variation of Phytoplankton Using Agent-Based Simulation: A Case Study to Estuary of the Patos Lagoon,” by Porcellis, Abreu and Adamatti, simulates the phytoplankton, the main primary producer of aquatic environment - the base the aquatic food chain and tries to demonstrate the
importance of retention time, often caused by hydrological issues, in the variation of phytoplankton biomass in the estuary of the Patos Lagoon (ELP), in Rio Grande/RS.

Chapter 13, “Participatory Management of Protected Areas for Biodiversity Conservation and Social Inclusion: Experience of the SimParc Multi-Agent Based Serious Game,” by Briot, Irving, Vasconcellos Filho, de Melo, Alvarez, Sordoni and Lucena, present their experience in a serious game research project, named SimParc, about multi-agent support for participatory management of protected areas for biodiversity conservation and social inclusion.

Chapter 14, “Using Probability Distributions in Parameters of Variables at Agent-Based Simulations: A Case Study for the TB Bacillus Growth Curve,” by Moraes, Borba, Werhli, von Groll and Adamatti, models the growth curve of Mycobacterium tuberculosis using MABS, aiming to simulate the curve with the minimum possible error when compared to in vitro results.

Finally, I hope this book provides a comprehensive and integrated view of the current discussions and investigations on MABS in the biological and environmental domains.

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