Editorial

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Biographical notes: Massimo Cossentino obtained his Master's degree in Electronics Engineering and his PhD in Computer Science Engineering from the University of Palermo. He is a Researcher of the Italian National Research Council from 2001. In 2007 he was an invited Associate Professor at the University of Belfort-Montbelliard (UTBM). He is currently researching on agent-oriented software engineering, more specifically on the composition of design methodologies, agent meta-models and agent patterns. He is the author of several papers for scientific journals, conferences and workshops. He chaired the FIPA Methodology Technical Committee, the Agentlink III AOSE Technical Forum Group and other scientific events.

Giancarlo Fortino is an Associate Professor of Computer Science at the Department of Electronics, Informatics and Systems (DEIS) of the University of Calabria, Rende (CS), Italy. He received his Laurea degree in Computer Science Engineering from the University of Calabria in 1995 and a PhD in Computer Science and Systems Engineering from the same institution in 2001. In 1997 and 1999 he was Visiting Researcher at the International Computer Science Institute (ICSI), Berkeley (CA), USA. His current research interests are agent-based systems, agent-oriented software engineering, streaming content distribution networks, wireless sensor networks, distributed multimedia systems and GRID systems. He is the author of more than 80 papers in international journals, books and conferences.

Wilma Russo received her Laurea degree in Physics from the University of Naples (Italy). She then moved to the University of Calabria (Italy), where she held the position of Associate Professor of Computer Science starting 1986. After a period with the University of Salerno, she returned to the University of Calabria, where she is now full Professor of Computer Science at the Department of Electronics, Informatics and Systems (DEIS). Her current research interests are mainly focused on parallel and distributed computing and systems, agent oriented software engineering, agent based modeling and simulation, internet computing and content distribution networks. She is the author of more than 80 papers in international journals, books and conferences.

Multiagent Systems (MASs) provide powerful models for representing both real-world environments and synthetic systems by using an adequate degree of complexity and dynamism. Several industrial and academic experiences have already shown that the use of a MAS offers valuable advantages in manufacturing processes, e-commerce, network management, complex software systems, *etc.* As in such contexts MASs are to be tested before their actual deployment and execution, methodologies that support validation through simulation (*e.g.*, discrete-event simulation) of the MAS being developed are highly required. In fact, the simulation of a MAS not only demonstrates that a MAS correctly behaves according to its functional and nonfunctional specifications, but also supports the analysis of emergent properties of the MAS being tested.

In this special issue we aim to show very recent enhancements in the combined exploitation of MASs and simulation, mostly in the context of Agent-Oriented Software Engineering (AOSE), and, in particular, how the simulation can effectively support both the development of MAS-based software systems at different stages (analysis, design, testing) and the evaluation of MAS-based models of complex systems.

This special issue presents five papers: three papers are extended and revised versions of some of the best papers presented at the first edition of the *International Workshop on Multi-Agent Systems and Simulation (MAS&S)*, which took place at the *4th Annual Industrial Simulation Conference 2006 (ISC'06)* in Palermo, Italy, in June 2006; and two more papers were selected through an open call.

The papers, which were fully peer-reviewed according to the practice of this journal, offer a very interesting and broad range of views on agent-oriented methodologies for the development of MASs and on modelling and evaluation of complex systems through MASs and simulation. Although this research area is still young in the AOSE context, some of the selected papers already present new simulation-based, agent-oriented methodologies for MAS development, discuss formal-driven approaches for MAS prototyping, and provide toolkits for the simulation of complex systems.

The paper by Cossentino *et al.* presents PASSIM, a simulation-based development process covering the entire MAS development life cycle. PASSIM was obtained through an experiment of situational method engineering, which allowed the integration of the well-known and established PASSI methodology and a Statecharts-based simulation methodology supporting functional and nonfunctional validation of the MAS under development. The effectiveness of PASSIM is exemplified through a case study that involves the analysis, design and simulation of a complex mobile agent-based e-marketplace.

Gardelli *et al.* propose a methodological approach for tackling the early design stages of self-organising MASs. In their approach the authors adopt an architectural pattern based on the agents and artefacts metamodel; then, in order to deal with the complexity of self-organisation mechanisms, they develop a three-stage design approach with modelling, simulation and tuning, so as to identify a suitable design of environmental agents and their interaction with artefacts.

Pavon *et al.* present the use of a graphical agent-oriented language for the specification of the social simulation model. This language is conceived to support the automatic transformation of the designed social simulation models into code for the Repast agent-based simulation toolkit. This allows a social scientist to prepare social models in a more convenient way and execute model simulations on existing simulation

toolkits, getting back results about the model. This framework is based on the INGENIAS Development Kit (IDK), which provides a customisable model editor and modules for automatic code generation.

Montagna *et al.* adopt the A&A (agents and artefacts) metamodel and discuss how this impacts the modelling and simulation of biological systems. After specialising their metamodel within the System Biology context, the authors show a possible operational model based on the TuCSoN agent coordination infrastructure, upon which the simulation framework is implemented. In particular, agents representing active biological components such as proteins interact by means of artefacts built upon TuCSoN tuple centres, which represent the biochemical environment that enables, mediates and governs the interaction of biological components within workspaces representing different spatial regions, like cell compartments. The paper presents a case study about glycolysis as well as some results of the simulation.

Hilaire *et al.* present a formal-driven prototyping approach for MASs which aims at bridging the gap between the abstract and the concrete levels by means of a prototyping process. This process provides support for incremental specification leading to an executable model of the system being designed; the process is based on a formal organisational framework describing the key organisational concepts (Role, Interaction and Organisation) with the OZS formal notation, which is the result of the combination of Object-Z and Statecharts. The process is illustrated through the specification of a multiagent architecture that has been used in several applications.

The quality and variety of the topics covered by the presented papers reflect the vitality of this research area. We hope these papers will be a valuable source of information for researchers who want to become familiar with the field of simulation-based methodologies and techniques for designing and validating MASs.