Editorial

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Biographical notes: Francesco Longo received his PhD in Mechanical Engineering from the University of Calabria in 2006. He is currently an Assistant Professor at the Mechanical Department of University of Calabria and Director of the Modelling and Simulation Center – Laboratory of Enterprise Solutions (MSC-LES). His research interests include modelling and simulation tools for training procedures in complex environments, supply chain management and security. He has published more than 100 papers in international journals and conferences. He is Associate Editor of the *Simulation: Transactions of the Society for Modelling & Simulation International* and Guest Editor for the *International Journal of Simulation and Process Modelling*. He is Editor-in-Chief for Europe of the SCS *M&S Magazine* and he works as a reviewer for various international journals. He has extensively supported the organisation of the most important international conferences in the area of modelling and simulation. He has served as General co-Chair of EMSS, MAS, SCSC, and SummerSim. He teaches Industrial Plants Management for students in Management Engineering, and Industrial Plants for students in Mechanical Engineering.

"Models and simulations of all kinds are tools for dealing with reality. Humans have always used mental models to better understand the world around them: to make plans, to consider different possibilities, to share ideas with others, to test changes, and to determine whether or not the development of an idea is feasible" (Bossel, 1994). Modelling and Simulation (M&S) is today the best way to go beyond mental models, above all thanks to the possibility of studying a wide variety of real-world complex systems by numerical evaluation using ad-hoc tools designed to imitate systems operations or characteristics over time (Kelton et al., 2003). In effect, real world systems are mostly complex systems; complexity can be attributed to the variety and plurality of features/aspects that must be simultaneously considered; namely many heterogeneous sub-systems, interactions usually difficult to detect and understand, intricate information flows, etc. In addition, the mutual influence between systems and the external environment usually increases the already high dynamic behaviour of real-world complex systems.

All these aspects strongly suggest the need for proper tools and methodologies for complex systems investigation. In particular, approaches based on M&S have proved (over the years) their capability to provide researchers, scientists and practitioners, as well as managers at every level and in every sector, with the possibility to achieve pseudo-empirical results that support cost-effective designs, behaviour analysis, behaviour prediction under changed conditions, performance analyses and evaluation, training and discovery of unexpected features. It is evident that M&S must be considered as a referential paradigm for complex systems modelling, representation and optimisation, above all for its transversality to a number of different fields: numerical analysis, computer science, artificial intelligence, operation research, to cite a few. In addition, during the last years M&S has been also widely applied for the investigation of those systems in which human factors are predominant (i.e., CIMIC, civil and military cooperation). A survey of the literature clearly reveals that M&S is a powerful problem-solving methodology with a wide scope of applicability in industry, logistics, defence and social sciences.

There are numerous examples of M&S research work in a variety of industrial contexts, such as aerospace, manufacturing and process industries (Murphy and Perera, 2002; Parthanadeea and Buddhakulsomsirib, 2010; Berendsa and Rommeb, 2001; Huda and Chung, 2002; and many others). It is demonstrated that in industry M&S has become increasingly sophisticated and used as a key for efficiency; in industries where M&S is a mature technology, it is one of the ways to properly support product development, product improvement, and, in the end, enhancement of competitiveness and incomes margin.

In the manufacturing area (and in larger perspective in the industry sector), the need for the pervasive use of M&S for decision support is stressed in Fowler (2004). The most important challenges in this application area are: magnitude reduction in problem-solving cycles, development of real-time simulation-based problem-solving capabilities, need for true plug-and-play interoperability of simulations and supporting software (Fowler, 2004). On the other side, thanks to its predictable features, simulation holds a great potential for studying the dynamic evolution of supply chains and logistic systems by providing appropriate decision support to address challenges arising from the high variability and stochastic uncertainty (Lendermann et al., 2003). Examples of research works in which M&S approaches are used for manufacturing systems and supply chains analysis and optimisation can be found in Bruzzone et al. (1999), Longo (2010) and Longo (2011).

Also the military sector has a long and rich history in the use of M&S owing to the need to have more effective and economical means to train personnel, to support decision and for weapon systems acquisition (Dahmann et al., 1998). These needs have driven numerous research works mainly devoted to support virtual, live and constructive simulations where distributed real and virtual participants can interact with each other as if they are in the actual combat situation (Davis, 1995). The development of simulations based training (SBT) has provided solutions to a number of growing problems in defence-related training activities concerning costs, impracticalities and political and social issues (including civil disorders, riots or terrorist actions). SBT is proved to be less expensive than the real hardware and, in addition, it allows to overcome many difficulties/ costs that are typical of live training exercises (Wilcox et al., 2000). The application of M&S in the military field for training purposes has also prompted the use of simulation as a training tool in many other application areas where simulations can provide a safe environment that allows to collect feedback on specific cognitive or psychomotor tasks. Examples of applications can be found in Lin et al. (2002), Brambilla and Manca (2011), Jayanthi et al. (2011), Bessiris et al. (2011).

It is worth saying that the wide diffusion of M&S based approaches has been strongly supported, not only by information technology advances, but, above all, by the different types of available simulation. In fact, a number of simulation types are currently available and can be used according to the main objective of the simulation study (i.e., stand-alone, parallel/distributed, web-based, deterministic, stochastic, man in the loop, object oriented, discrete event, continuous, combined, hybrid, agent-based, etc.). Among others, parallel/distributed, object oriented and agent-based simulations play a critical role for their capability of providing high computational performances, high interoperability levels and high modelling flexibility even when system behaviour is governed by complex interactions due to the presence of multiple interacting entities.

Parallel simulation involves the execution of a single simulation program on a collection of tightly coupled processors while distributed simulation involves the execution of a single simulation program on a collection of loosely coupled processors (Fujimoto, 2000). Numerous methodological and practical approaches for distributed system simulation have appeared in the literature, see foe example Borshchev et al. (2002), Uygun et al. (2009), Bruzzone et al. (2011a). Technical architectures for distributed simulation are currently available, namely the High-Level Architecture (HLA), the Distributed Interactive Simulation (DIS), the Common and Training Instrumentation Architecture (CTIA), the Test and Training Enabling Architecture (TENA).

The object-oriented simulation approach is based on the idea to decompose the real-world system into a set of different objects that can be separately modelled and then linked to form the final simulation model; therefore, as stated in Banks (1998), an object-oriented simulation models the behaviour of interacting objects over time. Easier usability and maintenance, and higher degree of reuse are, among others, the benefits that are achieved when using object-oriented concepts. However, a modelling effort is usually required to come up with rules of synthesis, which would permit linking the separated simulated objects into the final simulation model. Examples of applications can be found in Yun et al. (1999), Ninios et al. (1995), Rhee and Park (1997), Lorek and Sonnenschein (1998) and many others.

For real-world complex adaptive systems, which usually include multiple and heterogeneous interacting entities that may behave independently, agent-based simulation has proven to be a powerful tool to recreate systems evolution over the time, where conventional simulation approaches, such as object-oriented simulation, discrete event simulation, and dynamic micro-simulation, are normally limited in reflecting diversity, individuality and the complex interactions that usually characterise such systems. Agent-based simulation is a paradigm that can be based on parallel and distributed simulation or object-oriented simulation and compared with conventional approaches it has some interesting advantages: it preserves system structure, simulates proactive behaviours, supports parallel computations and allows the simulation of multiple/ dynamic scenarios. Therefore, agent-based simulation can be profitably used where human factors are predominant, such as in social sciences (Torrens and Benenson, 2005; Xie et al., 2007; Tianfield and Tian, 2008; Liu et al., 2010) and business systems (Langdon, 2005). Agent-based models are also widely used in the resource management field, such as fisheries management (Bousquet et al., 1993), agricultural land management (Dean et al., 2000), and forest management. Further applications of agent-based simulation are discussed in Davidsson et al. (2007).

The brief survey of the state of the art proposed above clearly highlights that industry, defence and logistics still provide simulationists with challenging problems that require specific research efforts mainly devoted to identify innovative ways to use M&S based approaches or to define innovative M&S based methodologies, tools and applications. This special issue aims at capturing the state of some interesting and scientifically relevant researches not only in terms of surveys of the current state of the art (Castilla et al., 2011) but also in terms of applications in different industries (Cimino and Mirabelli, 2011; Guasch et al., 2011), defence (Bruzzone et al., 2011b) and logistics (Schindlbacher et al., 2011; Bockholt et al., 2011; García-Fernández et al., 2011) areas, highlighting the capability of simulation-based approaches to continuously meet the needs of different sectors/problems (sustainability of simulation based approaches). In the sequel a brief description of all the papers included in the special issue is reported.

- In 'Java for Parallel Discrete Event Simulation: a survey', by Ivan Castilla, Rosa Maria Aguilar and Yeray Callero, the authors surveys the evolution of Java as one of the most widespread programming languages. The authors show how Discrete Event Simulation (DES) and also Parallel Discrete Event Simulation (PDES) have attracted more and more Java-based projects and present a survey on the tools and facilities that make Java such an attractive option for parallel simulation developers. Nevertheless, several drawbacks and lacks of the language are also exposed.
- In 'Industrial workstations design: a real case study', by Antonio Cimino and Giovanni Mirabelli, the authors propose an approach based on the integration of M&S tools, several ergonomic standards and the most known work measurement tools for effective workstation design. The effective design of the workstations is achieved by using virtual environments and human models simulation for comparing multiple workstations alternative configurations. Such comparison allows to choose the workstations' final configurations.
- In 'New developments in simulation-based harbour crane training', by Ignacio García-Fernández, Marta Pla-Castells, Miguel A. Gamón and Rafael J. Martínez-Durá, the authors focus on two main research lines in the field of harbour training simulators. The first research line concerns the improvement of complex physical systems involved in the simulation and the analysis of hardware architecture solutions (i.e., cable-based hoist systems and bulk materials). The second research line mainly focuses on simulator devices selection based on the analysis of different available approaches and simulators architectures.
- In 'Automatic warehouse modelling and simulation', by Antoni Guasch, Miquel Angel Piera and Jaume Figueras, the authors analyse the impact of using a second translevator on the performance of a printing plant's automatic warehouse with the aim to avoid delivery delays to the printing press through an approach based on M&S. In this paper the authors use simulation to investigate (at the printing plant level) the newspaper production/distribution problem (NDP).
- In 'Logistic Assistance Systems for collaborative supply chain planning', by Felix Bockholt, Wolfgang Raabe and Michael Toth, the authors introduce Logistic Assistance Systems (LAS) for planning and decision support in supply chains. LAS focus on logistic planning processes and integrate selected methods for data management, information processing and supply chain planning, trying to achieve an effective planning and control following various objectives like costs reduction, reliability, flexibility and ecological targets.
- In 'Intelligent agents driving computer generated forces for simulating human behaviour in urban riots', by Agostino Bruzzone, Alberto Tremori, Federico Tarone and Francesca Madeo, the authors discuss the use of early testing procedures in the application of intelligent agents with human behavioural models to anticipate results before the VV&A phase. Human behaviour is a very complex phenomenon to be simulated and the early testing activities become very important to get consistent models in order to simulate critical situations such as managing civil disorders, riots or terrorist actions.
- In 'Multi-agent simulation for analysing the robustness of inland container terminal networks' by Edith Schindlbacher, Manfred Gronalt and Hans Häuslmayer, the authors perform network flow analyses of intermodal load units in case of unforeseen disturbances using a multi-agent system; the system represents the nodes in the network of the Austrian inland container terminals and uses a system dynamics approach to depict the terminals internal structures and processes in an aggregate manner. Several risk scenarios have been defined considering comprehensive case studies of disturbances and irregularities in the flow of goods in the Austrian container transport chains and transport systems. These scenarios are used to simulate and investigate the robustness of the network. The simulation results show that the network under consideration has enough capacities to handle the effects of the implemented disruptions and regain initial conditions within a reasonable period of time.

This special issue is the result of roughly two years of work; special thanks go to the authors and reviewers for their invaluable work in improving the scientific relevance of the articles. Special thanks go also to the former Editor-in-Chief of the IJSPM journal Prof. Nuno Melao and to the Inderscience Editor-in-Chief Dr. M.A. Dorgham. Finally a sincere thank you goes to Richard Sharp that during the last two years has supported this special issue from the beginning of the journey until the final publication.

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