Preface

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Biographical notes: Francesco Longo is an Assistant Professor at the University of Calabria, Italy, the Director of the Research Laboratory Modeling & Simulation Center – Laboratory of Enterprise Solutions (MSC-LES) and CEO of the spin-off company CAL-TEK Srl. He has worked on both public and private research projects involving manufacturing and logistics systems and has published in the field of industrial plants management, modelling and simulation methodologies and applications, and business process reengineering. He also actively cooperates with many companies and research institutions all over the world, among others DIPTEM, University of Genoa, NASA Kennedy Space Center, NATO CMRE, York University (Canada), and Rutgers University (NJ, USA).

Antonio Padovano is currently working at the University of Calabria. His research interests include the development of interoperable multi-method simulations for decision support and education/training in complex systems in the areas of industry, logistics and defence, with a focus on human modelling. He has participated in various research projects and participated as a speaker at various international conferences. He visited and carried out research activities at the NATO STO CMRE and at the Rutgers University (NJ, USA). He also actively cooperates with University of Genoa, NASA Kennedy Space Center and several other research institutions.

Innovations and improvements are required to react quickly to the new trends of the global economy, as well as to the financial instability taking place in many countries.

Over the years, modelling and simulation (M&S) has proved to be one of the most effective and successful methodologies (and technologies) to investigate and study complex systems belonging to various sectors/areas. Thinking of the increasing competitive pressure, the increasing products/processes/services complexity and variety, the need for a great flexibility and for shorter life cycles, the cost pressure as well as the demands on higher quality standards, it is evident that M&S, meant to be 'the reproduction of a real system with its dynamic processes in a model aimed at reaching transferable findings for the reality', offers substantial benefits. In fact, M&S can support the identification of bottlenecks and hidden potentials, the test of control effectiveness, the evaluation of different planning alternatives as well as the review of management and operational strategies for decision-making. Nevertheless, to take full advantage of this technology there are relevant issues related to the effort needed to deploy simulation tools, the simulation models reliability, the integration within the real system for data acquisition, performance measurement and analysis. These issues keep challenging the researchers towards even more advanced solutions and approaches where emerging and cutting-edge technologies are absorbed into. Continuous hardware and software advances have indeed certainly contributed in making M&S a cutting-edge methodology by enlarging its scope of applicability and potential advantages.

M&S can be therefore used as part of multidisciplinary approaches (where multiple disciplines are concurrently used to pursue well defined objectives) and as strength for evaluating and exploring different options, diagnosing problems, finding out optimal solutions, training managers ad operators and transferring knowledge and results into the real systems (Banks, 1998). Nowadays, M&S is widely and successfully applied in many application domains, ranging from industry to social sciences, from logistics to military, from energy to healthcare; in this sense, M&S provides a multidisciplinary perspective where theory and data from different fields can be used to build models and simulations that provide insights in to the system considered (Del Rio Vilas et al., 2012).

Apart from the number and types of discipline involved in the development of a simulation model, M&S continues to receive research attention mainly because it can be used for a wide range of purposes, namely decision making, optimisation (when combined with artificial intelligence techniques), education and training (from education in universities to training in real complex systems including cooperative and multidisciplinary training) (Bruzzone et al., 2007; Bruzzone and Longo, 2013). The success of the so-called simulation-based optimisation relies on the concrete possibility to detect a variety of solutions and test them under different constraints and objectives. The spread

of M&S-based training tools, instead, has been encouraged by the great variety of situations and contexts where training of inexperienced people in the real system would be dangerous and expensive. In this case, the main advantages of the simulation-based training rely on the possibility for the operators to be immediately aware about the consequences of their actions in a visual manner while experiencing a variety of possible scenarios (that cannot be recreated in the real system) and avoiding the potential dangers that may occur when real tools and equipment are used. Further advantages include the strong reduction of the training costs (both direct and indirect costs) and the possibility to collect and store data for after action review and monitoring of the trainees performances evolution (Wilson et al., 1998; Bruzzone and Longo, 2010; Bruzzone et al., 2010).

Furthermore, it is worth mentioning that during the last years both the healthcare and the sustainable development (for energy and environment) sectors have become important application areas for M&S.

The objective of this special issue is to provide the reader with some of the latest 'New trends of simulation and process modelling in multiple domains: from business and production to healthcare, defence and environmental sustainability'. It includes a selection of the best papers published in the Proceedings of the International Multidisciplinary Modeling and Simulation Multiconference (I3M 2015) made according to a multidisciplinary perspective. This special issue welcomes geographically dispersed high-level scientific contributions, from Italy to Russia, from the USA to Argentina and Brazil, from Latvia to France and Germany.

In broad outline, there are two high-level contributions in the field of logistics and supply chains:

- In the paper 'Supply chains efficiency increasing based on the modelling of logistics operations' by Valery Lukinskiy, Vladislav Lukinskiy, and Yuri Merkuryev, a critical analysis of the existing approaches to the total logistics cost evaluation and supply chain reliability and an algorithm based on simulation is presented.
- In 'TRIP-based transport travel demand model for intelligent transport system measure evaluation based on micro simulation' by Nadezhda Zenina, Yuri Merkuryev and Andrejs Romanovs, an example of transport management solutions based on transport microscopic modelling is proposed and illustrated for the Latvian city of Adazi.

The domain related to production systems and technologies benefits here from three contributions:

- The first one is the work 'Hybridisation effect on operating costs and optimal sizing of components for hybrid electric vehicles' by Mauro G. Carignano, Norberto M. Nigro, Sergio Junco and Pedro Orbaiz, which provides models and a methodology to address the sizing of components of a HEV. Both methodology and model presented are applied in a case study of a real hybrid electric bus operating in the urban transport system of the city of Buenos Aires.
- The second one is 'Linear stability analysis for severe slugging: sensitivity to void fraction and friction pressure drop correlations' by Gabriel Romualdo de Azevedo and Jorge Luis Baliño and Karl Peter Burr, which proposes a numerical linear stability with a mathematical model for the two-phase flow in a pipeline-riser system.
- The third one is 'Experimental development and bond graph dynamic modelling of a brazed plate heat exchanger' by Mohamed Kebdani, Geneviève Dauphin-Tanguy, Antoine Dazin, and Patrick Dupont, which proposes a presentation of the heat exchanger technology, a state-of-the-art summary about BPHE modelling, heat transfer and pressure drop correlations and a detailed mathematical description of an original dynamic model with a description of the experimental test rig and the performed validation tests.

Simulation can also be coupled with optimisation algorithms for different purposes: for example, in 'Game-theoretic methods for locating camera towers and scheduling surveillance' by Javier Salmeron and R. Kevin Wood, a game-theoretic technique to optimise the locations and surveillance scheduling of tower-mounted camera systems used by a military force in an urban setting is presented.

Cutting-edge disciplines are also investigated. For example:

- 'A conversive hidden non-Markovian model based structure for discriminating spatio-temporal movement trajectories' by Tim Dittmar, Claudia Krull and Graham Horton presents a new modelling approach for spatio-temporal movement trajectories that is based on the stochastic model class called conversive hidden non-Markovian models (CHnMMs).
- In the study 'Factors affecting the human error: representations of mental models for emergency management' by Antonella Petrillo, Fabio De Felice, Francesco Longo, and Agostino Bruzzone, various aspects of human behaviour that can influence operator reliability are investigated and a new model based on an integration of fuzzy cognitive maps techniques and analytic hierarchy process (AHP) is presented.

Considering the role of simulation as training tool, 'Motivation and research in architectural intelligent tutoring' by Keith Brawner, Anne M. Sinatra and Robert Sottilare illustrate the work carried out to investigate, standardise, componentise, and commodise the processes and functions of the various tutoring system aspects.

Last but not least, 'DEv-PROMELA: an extension of PROMELA for the modelling, simulation and verification of discrete-event systems' by Aznam Yacoub, Maamar el

Amine Hamri, Claudia Frydman, Chungman Seo and Bernard P. Zeigler proposes a new extension of PROMELA for the modelling, verification and validation of discrete-event systems.

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