
Editorial

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Biographical notes: Agostino G. Bruzzone is the General Director of M&S Net, member of the McLeod Institute of Simulation Science, Founder and member of the Board of MIMOS, and President of the Simulation Team. He serves in the DIME at the University of Genoa as a Full Professor and he is active in the field of simulator-based applications for defence and industrial applications, coordinating many R&D projects involving innovative modelling and simulation, intelligent agents, artificial intelligence and design of experiments. He has written more than 200 scientific papers plus reports in partnerships with major companies (e.g., IBM, ENI, Contship, Solvay) and agencies (e.g., NASA, European Defence Agency, NATO, Italian MoD, DGA, DoD). He teaches project management, M&S and HLA, and he is the President of the MIPET (International Master Program in Industrial Plant Engineering and Technologies) of the Genoa University. He is currently serving as an M&S Project Leader for NATO STO Center for Maritime Research and Experimentation (CMRE).

Letizia Nicoletti was CEO at the CAL-TEK Srl where she is currently a Senior Manager. She has followed, as Scientific Responsible, many research projects in different areas, including logistics and distribution, defence, and cultural heritage in collaboration with international research centres (e.g., NATO STO CMRE). She is the author of more than 50 scientific papers and has been actively involved in the organisation of the International Multidisciplinary Modelling and Simulation Multi-conference (I3M), one of the major events in the field of modelling and simulation worldwide. She is an expert in software development and modelling and simulation methodologies, including distributed real time simulation.

In all domains, complex systems are studied through increasingly large amounts of data and methodological and technological advances, thus stimulating more and more revolutionary scientific breakthroughs. Also, many new and fundamental theoretical questions occur across the domains of physical and human science, making it essential to develop the new science of complex systems in an interdisciplinary way.

Simulation modelling has accumulated a large number of success stories in a wide and diverse range of application areas (transportations, healthcare, manufacturing, military systems, pollution, public service, communications, etc.). Modelling and simulation (M&S) is starting to play a primary role in many fields and is increasingly becoming a central methodology for the design of new complex systems (e.g., simulation-based design) as well as for the analysis and improvement of existing complex systems (e.g.,

decision making, training, education, etc.). As new modelling methods and technologies emerge and computer power grows, you can expect simulation modelling to enter an ever-larger number of areas.

The number of businesses using simulation is increasing rapidly. Many managers are realising the benefits of using simulation and incorporating it in their daily operations on an increasingly regular basis. For most companies, the benefits of using simulation go beyond simply providing a look into the future: it is one of the most effective problem-solving methodologies. M&S has indeed proved its effectiveness as a tool for planning and experimentation supporting what-if analysis and the search for optimal solutions to be implemented. In this regard, M&S has improved the functionalities of decision support systems because it can capture the dynamic nature of the problem under study and add additional capabilities such as

optimisation, predictions, and estimates. Simulation allows taking into account uncertainties in a quantitative way so as to provide a valuable support when evaluating the outcomes and the consequences of a particular choice. Therefore, substantial benefits can be achieved when it is applied to ongoing operations for supporting decision making at different levels. This is particularly true when dealing with large multi-scale and multi-domain systems where complex interactions occur. In such cases simulation can act as an integrated framework that allows its users to gain a better understanding and to improve and speed up decision-making processes.

On the other side, simulation-based training grounded in virtual environments and/or serious gaming has demonstrated high potentials drawing the interest of the military, industry, logistics, academia and various agencies in pursuit of improving training and enhancing training effectiveness. Thanks to simulation, training becomes a fully interactive, structured and often immersive experience where the substantial aspects of the real world are replicated; trainees can develop professional knowledge, skills and attitudes in a riskless environment while managers can benefit from reduced training costs and increased training effectiveness.

In both cases, it implies conceptualisation and implementation or, in other words, it is crucial to have both a formal specification with assumptions and constraints capturing the essence of the particular domain being considered and their translation in a computer executable. Needless to say that all the advantages and the potentials that M&S approaches rely on the ability to carry out conceptualisation and implementation activities as well as testing and experimentation. To this end, M&S theory and practice is endlessly enhanced with new paradigms, standards, approaches and solutions thanks to the continuous efforts of researchers to deal with even more complex and challenging applications.

In this perspective, the special issue on integrating modelling and simulation tools and methodologies in real-world complex systems for solving multidisciplinary problems collects high quality and relevant contributions that focus both on theoretical-related aspects of M&S and on applications of this groundbreaking methodology in several domains. The issue then paves the way for further developments and new trends in M&S. Moreover, the papers that are part of this issue are extended versions of the best papers published in the Proceedings of the International Multidisciplinary Modelling and Simulation Multi-conference (I3M 2015), a timely opportunity for researchers and scientists to let their work be known and discuss with each other.

Here below a brief overview of the papers published in this special issue is given:

- The first article ‘Computer aided support for the temperature control in buildings’, by Zupančič proposes a physical model of a control system for the harmonisation of thermal flows in buildings that has

been implemented as a Modelica (Dymola) block in MATLAB-Simulink environment.

- The second article ‘A divide and conquer approach for simulating an airport system’, by Scala et al. presents a modular simulation model that takes into account both airspace and ground operations.
- Then, the article ‘Extending Sim# for simulation-based optimisation of semi-automated machinery’, by Karder et al. describes specific custom simulation extensions that have been implemented and used to create a simulation model of real world machinery as an application of Sim# in combination with HeuristicLab to optimise semi-automated machinery.
- Innovative multi-device applications based on the concept of intelligent serious games (ISG) are proposed in ‘An intelligent serious game for a multi-device cultural heritage experience’, by Longo et al. The combination of the educational potential of serious games (SG) with intelligent agents (IA) creates new patterns and promotes new strategies for cultural content dissemination and fruition.
- The article ‘Modular construction of compact Petri net models’, by Latorre-Biel et al. describes how the formalism of the alternatives aggregation Petri net may help in the development of compact and efficient models that may reduce the use of scarce computer resources.
- The article entitled ‘The industrial internet of things and technological innovation in its applications for resources optimisation’, by Neto et al. investigates the use of the industrial internet of things (IIoT), specifically in the current Brazilian industry context, its basic differences from the internet of things (IoT) and its expansion possibilities, pointing out some challenges related to a new approach within industry.
- In the last article, entitled ‘An empirical investigation of comparative performance of approximate and exact corrections of the bias in Croston’s method in forecasting lumpy demand’, by Solis et al. empirically investigate whether or not there are improvements in statistical forecast accuracy as well as inventory control performance obtained by applying the approximate or exact correction when forecasting lumpy demand.

This special issue is the final result of a joint effort carried out by authors, reviewers and journal managers who have worked hard to improve the quality and the scientific relevance of the papers. Therefore, the guest editors would like to thank all of them for their contribution; special thanks go to the journal Editor-in-Chief Prof. Feng Qiao and to Richard Sharp for the support they gave. As has happened from 2008 they always believe in the scientific relevance and importance of the *IJSPM* special issue based on best papers of the I3M multi-conference.