Editorial

Guest editor's introduction: Special issue on agent-based modelling and simulation

Agent-based modelling (and simulation) is not a brand new approach since it is based on concepts firstly introduced in the late 1940s. Even if in the 1990s and 2000s the agent-based methodologies have become widespread, in the last years the interest for them and their diffusion has not faded. Furthermore, many research fields that are not strictly engineering, such as computational social sciences, have demonstrated the benefits that can be provided by the agent-based modelling and simulation.

The scope of this special issue is to present the state-of-the-art research covering a variety of concepts on: agent-based modelling, agent-based simulation and engineering of agent-based systems. Furthermore, it also aims to provide future trends and directions on the many interactions between the usage of agents and simulation-based techniques. For example, the design, implementation and performance analysis of agent-based simulators that run on top of large-scale cloud infrastructures and GPU/multi-core/many-core execution units.

Thirteen papers are selected from more than seventy submissions; all of them have been reviewed by qualified anonymous referees according to the practices of this journal. These papers cover a variety of important and challenging topics in the areas of agent-based modelling and simulation.

Mozhgan K. Chimeh et al. present an extension to the FLAME GPU framework which addresses the divergence problem (i.e. the challenge of executing the behaviour of non-homogeneous individuals on vectorised GPU processors). More specifically they introduce a new modelling methodology which exposes inherent parallelism within the model that can be exploited by the framework, thus permitting high levels of concurrent simulation execution.

Marcus Guimaraes et al. present an agent-based simulation for motivation and ability axis formation, threshold line and triggers positioning of the Fogg behavior model. This is a model that can be primarily used for the evaluation of persuasive technology based process. In other words, the main contribution is a theoretical support on the persuasive technology evaluation process.

Fumiyasu Makinoshimaa et al. propose a simplified force-based evacuation simulation model and an easy-to-implement parallelization strategy for a large-scale microscopic tsunami evacuation simulation and demonstrate its applications in an actual urban environment.

Philippe Mathieu et al. describe in their paper four design patterns that aim at the systematization and simplification of the modelling and the implementation of multi-level agent-based simulations. In practice, they aim to propose a precise conceptual and operational framework for the designers of multi-level simulations.

Victorino Sanz et al. describe the representation of agent-based models in the Modelica modelling language. Firstly, the authors analyse the conceptual requirements to describe agent-based models in Modelica and secondly they develop a prototype implementation based on the previous analysis.

Grażyna Skiba et al. describe a new simulation framework, based on asynchronous communication, and its implementation oriented to distributed environments. Such framework, that is based on the Akka actor platform, supports concurrent, distributed and resilient message-driven simulations. An iterated prisoner's dilemma case study is used to exemplify the usage of the framework.

Franco Cicirelli et al. propose an agent-based and control-centric methodology for the development of complex cyber physical systems. This novel approach supports model continuity which enables the use of a unique model along all the development stages of a system ranging from analysis, by simulation, down to real-time implementation and execution.

Michele Carillo et al. present a new framework (i.e. simulation optimization and exploration framework in the cloud) which exploits the computing power of a cloud computational environment in order to carry out effective and efficient

simulation optimization strategies. The tool, that is distributed under the terms of an open source license, has been tested and validated on several private platforms such as a dedicated cluster of workstations as well as on public platforms.

Laura A. Ripamonti et al. present a study in the field of massively multiplayer online games and more specifically the multiplayer online battle arenas (that are also known as action real-time strategy games). They present a simulative study that is based on agent-based model techniques on of the effects of the adoption of different looting systems on heterogeneous player bases. The main purpose of this study is to provide guidelines and hints about the design of looting systems to game designers.

Fatemeh Golpayegani et al. propose a solution for on-demand participant selection for short-term collaboration in open multi-agent systems. The model captures the agent's most recent dependency structure of goals and policies with its neighbouring agents. Furthermore, it enables them to identify and select a qualified non-conflicting set of participants.

Fernando Santos et al. propose a model-driven development approach, composed of a modeling language and model-to-code transformations for producing runnable simulations automatically. More specifically, this paper studies the use of model-driven development for agent-based modeling and simulation in the adaptive traffic signal control domain, in which autonomous agents are in charge of managing traffic light indicators to optimize the traffic flow.

Peter Heywood et al. describe a GPU accelerated agent based microsimulation model of a road network transport system. In order to utilise GPU architectures effectively, the paper describes an approach for graph traversal of neighbouring information. High speed-ups are demonstrated with increased performance scaling behaviour.

Richard A. Williams describes his experiences in modelling complex dynamical systems using agent-based models. This work reinforces the view that this kind of models can be useful for answering questions of the real-world domain through predictive modelling but emphasises that all modellers must make a concerted effort to adopt robust methods and techniques for constructing, validating and analysing their models.

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