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Guest Editorial
Introduction to the Special Issue on Agent-Directed Simulation

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Agent-directed simulation is comprehensive in the integration of agent and simulation technologies, by including models that use agents to develop domain specific simulation, i.e., agent simulation (this is also referred to as agent-based simulation, when the other two aspects of the synergy are not taken into consideration), and by also including the use of agent technology to develop simulation techniques and toolkits that are subsequently applied, either with or without agents. Therefore agent-directed simulation fills a gap in the agent community as well as the simulation community.

This special issue presents a collection of 11 papers. Two of them are original research papers and nine are extended papers that were selected from the proceedings of the Agent-Directed Simulation Symposium in the 2009 Spring Simulation Multiconference. These papers investigate different research domains in agent-directed simulation such as the theory of agent-directed simulation, bioinformatics, spatial modeling, organization study, digital public goods, social network and information cascade, tactic decision-making in military domain, and agent training system via virtualization. We believe that this special issue provides the most recent developments in these selected topics and will be an important source of information for researchers in the area of agent-directed simulation.

The first paper by Ören and Yilmaz is a lead paper that defines agent-directed simulation and elaborates on the evolution of the synergy of modeling and simulation and agent systems, their applications to various domains, and the future of the use of agents in simulation as well as simulation for agents. This paper sets the context for the remaining papers. It can be also used as a comprehensive survey of agent-directed simulation within a larger paradigm of innovation processes in technical communities.

The paper by Barry, Koehler, McMahon and Tivnan propose agent directed simulation as a methodology for improving systems of systems (SoS) systems engineering (SE) in general and SoS human complex systems (HCS) SE in particular. In order to support this, they propose a proof of concept system called the Infrastructure for Complex-systems Engineering (ICE). Moreover, they implement ICE in the design of a system designed to defend a stadium from terrorist attacks, and they show and explain several experimental results obtained in this application.

The paper by Sheikh-Bahaei, Kim, Sheikhbahaei and Hunt uses game theory and reinforcement learning to create a agent-based model to simulate the hepatic toxin elimination processes to explore plausible causes of hepatic functional zonation. The model consists of a group of agents that, similar to hepatocytes, cooperate to protect a common wealth against toxic intruders. The agents use Q-learning to minimize their long-term discounted costs. Their simulation shows that the emergent, collective behaviors of these agents are similar to those of hepatic cells in terms of xenobiotic clearance.

The same group of authors, Kim, Sheikh-Bahaei and Hunt, presents another agent-based model of cultured lung alveolar type II (AT II) cells and simulation results. The cell agent model is heuristic-based, and includes a cell's individual "decision-making" for attachment to neighboring cells and movement within clusters. This model provides early insight into generative principles underpinning alveolar morphogenesis in 3D cell cultures.

The paper by Kennedy, Lane, Arifin, Fuentes, Hollocher and Madey presents methods and recommendations on including GIS data in a complex simulation model. This paper provides a useful state of the art centered on GIS and ABS coupling. An application to an advanced epidemiological model is used as the example. The epidemiological model demonstrates a nice tradeoff between the complexity of GIS data and the large amount of agents.

The paper by Sierhuis, Jonker, van Riemsdijk and Hindriks is a layout of a generic framework for agent-based simulation that enables agents to be aware of the organizations they are part of so the agents can automatically follow the policies and norms of the organization. This is characterized by a clear separation of the organization in terms of a structural and behavioral specification, and the agents without which the organization can't exist. The framework is built up in the agent-based simulation environment Brahms. The framework is illustrated in a case study of a soccer team.

The paper by Radtke and Janssen accomplishes the task of providing a formal model in defining the quality of digital public goods. The formal model is defined in supporting the social phenomena that higher-quality digital public goods attract more participants and therefore benefit

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the larger area of the society. Their results show that the characteristics of producer-oriented metrics more closely match real work phenomena, indicating that public goods are driven by producer, and not consumer, interests. This work contributes to the field of agent-based modeling in digital public goods, such as open source projects and online encyclopedia articles.

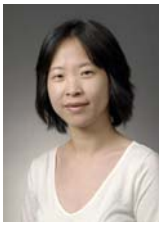
The paper by Zhang, Wu and Hu focuses on the area of social network and information cascade. The paper proposes an *iterative cascade model* that allows activated nodes to receive more than a one-time chance to activate their neighbors. They formally define a deterministic model for calculating the probability of activity for any arbitrary node at any arbitrary time in the iterative cascade model. They also perform an extensive empirical study on this model under different network settings and topological structures. Their simulation has showed its power to observe and explain the emergent phenomena in the macro level when changing parameters in the micro level.

The paper by Zhao, Yen, Ngamassi, Maitland and Tapia investigate how non-governmental organizations (NGOs) influence each other in coalitions when they are prioritizing and selecting projects to support. The authors investigate both public and private network influences and they propose a model to model the social influences of each of the NGOs on each other NGO. The work reported in this paper focuses specifically on modeling influence in a network and it is intended to be part of a larger framework that will model NGOs as heterogeneous and self-interested agents.

The paper by McGraw, Shao and Mumme develops a distributed agent-based toolbox known as the Course of Action Analysis with Radio Effects Toolbox (CARET). CARET provides a variety of agents that can interact with multiple data sources including databases and real-time sensors, drive and calibrate multiple simulation environments, and apply various analysis techniques to guide signal planners in planning and reconfiguring networks on-the-fly. CARET agents are applied as Signal Operations Planners in analyzing and diagnosing issues with MANETs (mobile ad hoc networks) as operations are underway.

The paper by Baydogan, Belfore, and Mazumdar provides a simulation architecture for virtual operating room training. The architecture covers the speech recognition component that agents can interact with trainees, and the simulation engine that can update the internal state of each participant including both agents and persons. The proposed practical architecture can be a useful resource for researchers in the area of operation training via agent virtual worlds.

Finally we would like to thank the reviewers of the Agent-Directed Simulation Symposium in the 2009 Spring Simulation Multiconference for reviewing the initial version of the nine papers in this special issue.



Yu Zhang received her Ph.D. in Computer Science at Texas A&M University in 2005. She is currently Assistant Professor in the Department of Computer Science at Trinity University and Director of the Laboratory for Distributed Intelligent Agent Systems. Dr. Zhang's research falls within Agent-Based Modeling and Simulation. Her research is currently supported by three NSF grants. She is in the editorial board for five journals including The Transaction of Simulation, and IEEE Transactions on Systems, Man, and Cybernetics (SMC), Part C: Applications and Reviews, and in program committee for over 10 conferences and technical groups, such as Autonomous Agents and Multi-Agent Systems. She has regularly reviewed proposals for federal agencies. She is Program Co-Chair of Agent Directed Simulation of SCS SpringSim 2010. She is in the organizing committee of IEEE SMC 2009 and SCS SpringSim 2009. She is Program Chair of IEEE Women In Engineering Central Texas Chapter (CTC), Program Chair of IEEE SMC Society CTC, and Vice Chair of IEEE Computer Society CTC. She received 2008 Trinity Distinguish Junior Faculty Award, 2007 IEEE CTC Service Award, and Best Paper Award of 2005 International Conference on Knowledge-Based & Intelligent Information & Engineering Systems.

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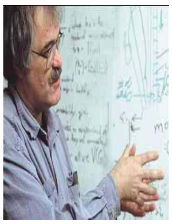
Levent Yilmaz is Associate Professor of Computer Science and Software Engineering and Industrial and Systems Engineering at Auburn University. He received his B.S. degree in Computer Engineering and Information Sciences from Bilkent University and the M.S. and Ph.D. degrees from Virginia Tech. His research focuses on Agent-directed Simulation and Complex Adaptive Systems with applications in (1) advancing the theory and methodology of modeling and simulation via novel formalisms (e.g., generative multisimulation, autonomic introspective simulation, symbiotic adaptive multisimulation) and their use in decision/ creativity support and (2) exploring and understanding complex adaptive socio-technical/cognitive/cultural systems. Dr. Yilmaz is a member of ACM, IEEE Computer Society, Society for Computer Simulation International, and Upsilon Pi Epsilon.



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