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Methods and Applications for Modeling and Simulation of Complex Systems

19th Asia Simulation Conference, AsiaSim 2019
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Preface

The AsiaSim conference is an annual international conference that started in 1999, and has primarily been organized by the three Asian simulation societies: Chinese Association for System Simulation (CASS), Japanese Society for Simulation Technology (JSST), and Korea Society for Simulation (KSS). In 2011, the Federation of Asia Simulation Societies (ASIASIM) was set up to promote the advancement of modeling and simulation in industry, research, and development in Asia and beyond. In 2013, the AsiaSim series finally left the 'Golden Triangle' of China, Japan, and Korea and was held in Singapore for the first time. Then in 2017, it was Malaysia's turn to host the conference.

On behalf of the Organizing Committee of AsiaSim 2019, we are proud to present the 19th edition of the AsiaSim conference series (held in Singapore for the second time).

Asiasim 2019 is organized by the Society of Simulation and Gaming of Singapore, the National University of Singapore, and Nanyang Technological University. The Society of Simulation and Gaming of Singapore is a non-profit professional organization set up to contribute to the development of simulation and gaming in Singapore and the region. It is a focused community for researchers, practitioners, and developers who are keen to further their professional knowledge through learning and working together and promoting the experiential activities to the public.

We received submissions from China, Japan, South Korea, Indonesia, India, Italy, Pakistan, Philippines, Germany, Malaysia, Columbia, and of course Singapore. After an intensive review process by a carefully assembled international Program Committee, where each paper was reviewed by no less than 3 reviewers, we finally accepted 19 full papers and 5 short papers. The following three papers were shortlisted for the best paper award:

- "Digital Twin Technology for Aquaponics: Towards Optimizing Food Production with Dynamic Data Driven Application Systems" by Ayyaz Ahmed, Shahid Zulfiqar, Adam Ghandar, Yang Chen, Masatoshi Hanai, Georgios Theodoropoulos.
- "On Evaluating Rust as a Programming Language for the Future of Massive Agent-based Simulations" by Alessia Antelmi, Gennaro Cordasco, Matteo D'Auria, Daniele De Vinco, Alberto Negro, and Carmine Spagnuolo.
- "Conv-LSTM: Pedestrian Trajectory Prediction in Crowded Scenarios" by Kai Chen, Xiao Song, and Hang Yu.

The accepted papers are consolidated in this volume of the *Communications in Computer and Information Science* series, and are divided into many relevant topics, including Agent Based Simulation, Simulation Methods and Tools, Visualization, Modeling Methodology, and Simulation Applications in Science and Engineering.

The diversity of topics presented at this conference made for a healthy exchange of research ideas and technical exchanges.

We would like to take this opportunity to thank the ASIASIM Federation for allowing us to host AsiaSim 2019 for the second time in Singapore, and we hope that you found the conference enriching and memorable.

We also thank the members of the Program Committee for their valuable effort in the review of the submitted papers. Finally, we would also like to thank our technical co-sponsors and sponsors. Your contributions and support helped to make AsiaSim 2019 a reality and a success.

October 2019

Gary Tan
Axel Lehmann
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Wentong Cai

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Keynote Speakers

Keynote I: The Challenges of Repeatability and Fidelity of Cyber-Physical Digital Twins

David M. Nicol
Franklin W. Woeltge Professor of ECE
University of Illinois, Urbana-Champaign

Director, Information Trust Institute
Director, Advanced Digital Sciences Center
Director, Critical Infrastructure Resilience Institute

Abstract. A digital twin of a cyber-physical system is a simulation whose execution mimics the behavior of both the physical and cyber components of the system. While the idea of co-joining or federating simulations has been considered for quite a long time, the rise in interest of cyber-physical systems, coupled with increased computational power has brought the idea to the forefront under the labeling of 'digital twin'. Uses include exploration of how cyber malfeasance might negatively impact the physical system, how the physical system may react to unusual inputs or boundary conditions, whether a particular control applied to the system will push it into a region of unsafe behavior. Fidelity of digital twins is clearly a desirable attribute, as is repeatability. In the former case we want confidence that the digital twin faithfully (enough) captures the behavior of interest, in the latter case we need to be able to understand, by replying the simulation, how a particular behavior observed in the simulation came to occur. This talk focuses on the challenges of repeatability and fidelity in a cyber-physical digital twin, when that twin combines classical simulation with emulation of executing software.

Biography

David M. Nicol is the Franklin W. Woeltge Professor of Electrical and Computer Engineering at the University of Illinois in Urbana-Champaign, where he also serves as the Director of the Information Trust Institute, and Director of the Advanced Digital Sciences Center (Singapore). He has a B.A. in Mathematics from Carleton College (1979), and M.S. and Ph.D. degrees in Computer Science (1985) from the University of Virginia. Professor Nicol's research interests encompass high performance computing, discrete system modeling and simulation, and end-to-end modeling/analysis of

cyber-security, resilience, and trust in complex systems. He served as Editor-in-Chief of ACM Transactions on Modeling and Computer Simulation (1997-2003) and since 2018 has served as Editor-in-Chief of IEEE's flagship publication on cyber-security, IEEE Security and Privacy. He was elected Fellow of the IEEE in 2003, Fellow of the ACM in 2006, and in 2007 was the inaugural recipient of the ACM SIGSIM Distinguished Contributions award.

Keynote II: Blockchain Safety and Smart Contract Simulation

Jun Furuse
Chief Executive Officer (CEO)
DaiLambda, Inc.

Scientific Director,
Tezos Japan

Abstract. Blockchain is a distributed database in an open network, where anyone can join by running a node without permission. As far as we know, such a system can be maintained only by incentivizing the participants to behave honestly at its resolution of the conflicts. Consequently, blockchain must handle a huge amount of rewards as cryptocurrencies and any bugs may become attack vectors for theft. Therefore, safety is the first concern for blockchain developers.

Smart contracts are programs associated with blockchain accounts and executed at transactions. Since the execution happens on all the nodes, the caller must pay a fee to the network. To estimate the cost, the caller must simulate each transaction before sending it to the network. This simulation is also important to secure the smart contracts along with formally verifying their safety properties, since any bug or misspecification may turn them to automatic stealing machines. Several existing works of this smart contract simulation in Tezos blockchain and its future directions will be discussed.

Biography

Jun is working for Tezos blockchain technology as one of the few Asian core developers since its mainnet launch in September 2019. He is also a scientific director of Tezos Japan, an NPO to promote Tezos technology in Japan to the industry and the academia. Being a researcher of functional programming and its static type system (Ph. D., Université Paris Diderot), his interests are always in applying programming language theory and formal verification methods to provide better security to mission-critical systems. He has started his own company DaiLambda in the last year, after 10 years of career as a quantitative developer for systems for derivative product modeling (LexiFi, Standard Chartered Bank) and high-frequency trading (Jane Street Capital).

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