

# ANNSIM

Annual Modeling and Simulation Conference 2023

# MAY 23-26, 2023 Mohawk College, Ontario, Canada

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## **Organization Committee**

General Chair: Hamdi Kavak Vice-General Chair: Philippe Giabbanelli Program Chair: Cristina Ruiz Martin Proceedings Chair: Maria Julia Blas Awards Chair: Mamadou Kaba Traore

# Welcome

# <u>Welcome from the</u> <u>ANNSIM '23 Conference Chairs</u>

Welcome to Hamilton!

The organizing committee is delighted and honored to welcome you to the 2023 Annual Modeling and Simulation Conference (ANNSIM'23). Hosted by The Society for Modeling and Simulation International (SCS), ANNSIM is the flagship conference of SCS to cover state-of-the-art developments in Modeling & Simulation (M&S). SCS, the organizing committee, and the track chairs have worked hard to make these three-and-a-half days very exciting and to ensure that ANNSIM continues to establish itself as one of the leading events in the M&S community.

This year marks the second face-to-face meeting of ANNSIM to provide the most engaging experiences possible. In addition, SCS has been carefully selecting conference sites that minimize environmental impact to help build a sustainable future. Mohawk College was selected as the host of ANNSIM'23 because of its sustainability efforts. The 2022 AASHE Campus Sustainability Index lists Mohawk as "Top 3 Performer" among associate colleges in North America. During the conference, Mohawk College will share how it is rising in the ranks of the most sustainable academic campuses.

This year's conference is a great opportunity to learn about the latest research in M&S and to network with other professionals in the field. The program of ANNSIM'23 includes a world-class selection of peer-reviewed original research papers, tutorials, work-in-progress presentations, Ph.D. Colloquium talks, and keynote speeches. Our first keynote will be delivered on the first day of the conference (May 23, 2023) by Prof. Kathleen M. Carley from Carnegie Mellon University, a world-renown expert in social simulation. Prof. Dawn M. Tilbury from the University of Michigan is our second-day (May 24, 2023) keynote speaker, and she is an eminent expert in control systems. Participants will also have the opportunity to enjoy several social events and a rich environment that features vibrant arts and culture scenes in addition to the stunning natural beauty of the Niagara region.

ANNSIM'23 has technical co-sponsorships from both the Association of Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE). ACM is the world's largest educational and scientific computing society, delivering resources that advance computing as a science and a profession. IEEE is the world's largest technical and professional organization dedicated to advancing technology for the benefit of humanity. SCS' co-sponsorship agreements with both ACM and IEEE allow the ANNSIM'23 proceedings papers to be archived in both the ACM Digital Library and the IEEE Xplore digital library.

Our sincere appreciation goes to the track chairs, whose invaluable leadership in their respective areas was key to the success of the overall conference. This year's tracks and chairs are:

# <u>Welcome from the</u> <u>ANNSIM'23 Conference Chairs</u>

- Annual Simulation Symposium (José Luis Risco Martín, Joachim Denil, and Román Cárdenas),

- Cyber Physical Systems (Claudio Gomes and Bentley Oakes),

- Emerging Topic Digital Twins (Guodong (Gordon) Shao and Istvan David),
- Humans, Societies, and Artificial Agents (Taylor Anderson and Alison Heppenstall),
- Machine Learning and Simulation (Joon-Seok Kim and Andreas Züfle),
- Modeling and Simulation in Cyber Security (Sachin Shetty and Danda Rawat),
- Modeling and Simulation in Medicine (Jerzy W. Rozenblit and Michel Audette),

- Theory and Foundations for Modeling and Simulation (Hessam Sarjoughian and Eugene Syriani),

- Symposium on Simulation for Architecture and Urban Design (Nina M. Sharifi, Gabriel Wurzer, and Mohamed Aly Etman),

- Simulation Education and Simulation-Based Learning (Ashkan Negahban and Omar Ashour),

- Symposium on Performance Evaluation of Computer and Telecommunications Systems / Communications and Networking Simulation (Malamati Louta, George Karetsos, Abdolreza Abhari, and Ala'a Al-Habashna),

- Tutorials (Simon Gorecki and Scott Rosen),
- Work-in-Progress (Ali Kucukozyigit), and
- PhD Colloquium (Hoda Khalil)

We extend our appreciation to the technical program committee and reviewers in all tracks for their thorough work and diligence during the rigorous peer review process, which made it possible to set up a program of selected and high-quality presentations. We also express our gratitude to the authors for submitting their work to ANNSIM'23 from all over the world.

ANNSIM would not be possible without the dedication and tireless effort of several individuals, who have supported the organizing committee: Maria Julia Blas (Proceedings Chair), Mamadou Kaba Traore (Awards Chair), and John Richardson (Logistics Chair). Our final thanks go to SCS officers Oletha Darensburg and Carmen Ramirez, and SCS President Charles Macal, for the smooth running of conference coordination activities.

We hope you enjoy ANNSIM'23, and we look forward to your participation in future SCS events.

On behalf of the organizing committee,

Hamdi Kavak Vice-General Chair George Mason University USA Philippe Giabbanelli Vice-General Chair Miami University USA Cristina Ruiz Martin Program Chair Carleton University Canada

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# General Information

# **General Information**

### **Registration**

Your registration for SCS's 2023 Annual Modeling and Simulation Conference (ANNSIM'23) includes morning and afternoon breaks each day, the Tuesday evening reception and access to all sessions, tutorials, posters, (unless otherwise noted).

ANNSIM'23 will take place in both the McKeil School of Business Building (i Wing) and the Joyce Centre for Partnership and Innovation Building (EA Wing).

### **Registration Hours (Joyce Gallery, EA Wing)** •

<b>Tuesday</b> , May 23, 2023	8:00 a.m.—5:00 p.m.
Wednesday, May 24, 2023	8:00 a.m.—5:00 p.m.
<b>Thursday</b> , May 25, 2023	8:00 a.m.—5:00 p.m.
<b>Friday</b> , May 26, 2023	8:00 a.m.—12:00 p.m.
	Tuesday, May 23, 2023 Wednesday, May 24, 2023 Thursday, May 25, 2023 Friday, May 26, 2023

Please note that the Registration Desk will be closed for lunch from Tuesday through Thursday.

### Morning Coffee (Joyce Gallery, EA Wing) ٠

$\diamond$	<b>Tuesday,</b> May 23, 2023	8:30 a.m.—9:00 a.m.
$\diamond$	Wednesday, May 24, 2023	8:30 a.m.—9:00 a.m.
$\diamond$	<b>Thursday,</b> May 25, 2023	8:30 a.m.—9:00 a.m.
$\diamond$	<b>Friday,</b> May 26, 2023	8:30 a.m.—9:00 a.m.

### Coffee Breaks (Joyce Gallery, EA Wing)

$\diamond$	<b>Tuesday,</b> May 23, 2023	10:30 a.m.—11:00 a.m.   3:30 pm.—4:00 p.m.
$\diamond$	Wednesday, May 24, 2023	10:00 a.m.—10:30 a.m.   3:30 pm.—4:00 p.m.
$\diamond$	<b>Thursday,</b> May 25, 2023	10:30 a.m.—11:00 a.m.   3:00 pm.—3:30 p.m.
$\diamond$	<b>Friday,</b> May 26, 2023	10:30 a.m.—11:00 a.m.

### Plenary Session with Keynotes (EA Wing, EA011)

$\diamond$	Tuesday	9:30 a.m.—10:30 a.m.—SCS Keynote: Dr. Kathleen M. Carley
$\diamond$	Wednesdav	9:00 a.m.—10:00 a.m.—SCS Keynote: Dr. Dawn M. Tilbury

Wednesday 9:00 a.m.—10:00 a.m.—SCS Keynote: Dr. Dawn M. Tilbury

# GENERAL INFORMATION

# **General Information**

### **Conference Meetings & Events Summary**

•Tuesday	Welcome, Awards, and Plenary Session with Keynote (9:00 a.m.—10:30 a.m.)
	Technical Sessions (11:00 a.m.—5:30 p.m.)
	Board of Directors Awards and Fellows Luncheon (By Invitation) (12:30 p.m.–2:00 p.m.)
	Tutorial I (4:00 p.m.—5:30 p.m.)
	Welcome Reception (5:30 p.m.—7:00 p.m.); Joyce Gallery (EA Wing). All Conference Attendees Invited
•Wednesday	Plenary Session and Keynote Address; (9:00 a.m.—10:00 a.m.)
	Technical Sessions (10:30 a.m.—5:30 p.m.)
	Tutorial II (4:00 p.m.—5:30 p.m.)
	Simulation Meeting (By Invitation) (5:30 p.m.– 6:30 p.m.)
•Thursday	Technical Sessions (9:00 a.m.—5:00 p.m.)
	Tutorial III (9:00 a.m.—10:30 a.m.)
	Ph.D. Colloquium (11:00 a.m.—12:30 p.m.)
	Ph.D. Colloquium Panel (Lite Lunch for panel participants only) (12:30 p.m.—2:00 p.m.)
	Ph.D. Colloquium Keynote Speaker (2:00 p.m.— 3:00 p.m.)
	Tutorial IV (3:30 p.m.—5:00 p.m.)
•Friday	Tutorial V (9:00 a.m.—10:30 a.m.) Technical Sessions (9:00 a.m.—12:30 p.m.)

# **General Information**

### **Best Paper Award**

The Overall Best Paper Awards for ANNSIM'23 will be presented at Tuesday's Plenary Session.

### Posters

The posters will be on display throughout the week to be viewed. Posters will be presented during the morning and afternoon break on Thursday, May 25, 2023 and in the morning break on Friday, May 26, 2023.

### Wi-Fi

Text (SMS) Keyword: wifievent To Mobile Number: 18333387626 Only Valid On: May 23 – 26, 2023

### **Personal Belongings**

SCS and Mohawk College is not responsible for any items left in the breakout rooms. We recommend that you make sure to take your things before the end of each day.

### SCS Board of Directors Awards

The SCS Board of Directors will honor all recipients of the Board of Directors awards from 2019 to 2022 during the Tuesday welcome address.

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# Keynotes



# <u>Keynote Information</u>

### Simulating Societal Systems: Issues in Linking the Micro and the Macro

### Author: Kathleen M. Carley

### Location: EA Wing, EA011

### Day | Time: May 23, 2023 | 9:30 am—10:30 a.m.

**Abstract:** Long, long ago in the land of simulation, the simulationist would make rules that controlled whether little squares on a giant piece of digital graph paper appeared to be dark or light. At issue was, could micro behavior by these "agents" effect large scale macro behavior for their "society." Rules such as move to an unoccupied square if you are not



near three others like you, resulted in behavior that was "human like" to the observers, that is the squares segregated on the basis of color. Success was declared. Now, fast forward to 2023, and the land of simulation looks very different. However, the foundational micro-macro congruence problem still exists and takes many forms. For example, does accurate micro behavior guarantee realistic macro behavior? Do micro-agents need to gain capabilities to generate more accurate social or macro-behavior? Do human observers believe the simulation macro results more as the micro-agents become more realistic? In this talk, questions regarding the micro-macro linkage in simulation models are addressed using a set of models and results associated with diverse applications. These applications include: threat assessment, pandemic interventions, and the growth of civil violence. It is argued that using simulation fruitfully at the micro and macro level is more impacted by human perception and the modeling of social cognition and emotional cognition than the exact level of realism used in creating congruence.

**Biography:** Kathleen M. Carley is a professor in the School of Computer Science in the department – of the Institute for Software Research – at Carnegie Mellon University. She also has courtesy appointments at Engineering and Public Policy Bio, Heinz School Bio, Electrical and Computer Engineering, and GSIA Bio.

She is the director of the Center for Computational Analysis of Social and Organizational Systems (CASOS), a university-wide interdisciplinary center that brings together network analysis, computer science, and organization science (www.casos.ece.cmu.edu). Kathleen M. Carley's research combines cognitive science, social networks, and computer science to address complex social and organizational problems. Her specific research areas are dynamic network analysis, computational social and organization theory, adaptation and evolution, text mining, and the impact of telecommunication technologies and policy on communication, information diffusion, disease contagion, and response within and among groups, particularly in disaster or crisis situations. She and her lab have developed infrastructure tools for analyzing large-scale dynamic networks and various multi-agent simulation systems.

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# <u> Keynote Information (Continued)</u>

The infrastructure tools include ORA, a statistical toolkit for analyzing and visualizing multi-dimensional networks. ORA results are organized into reports that meet various needs such as the management report, the mental model report, and the intelligence report. Another tool is AutoMap, a text-mining system for extracting semantic networks from texts and then cross-classifying them using an organizational ontology into the underlying social, knowledge, resource, and task networks.

Her simulation models meld multi-agent technology with network dynamics and empirical data. Three of the large-scale multi-agent network models she and the CASOS group have developed in the counter-terrorism area are: BioWar a city-scale dynamic-network agent-based model for understanding the spread of disease and illness due to natural epidemics, chemical spills, and weaponized biological attacks; DyNet a model of the change in covert networks, naturally and in response to attacks, under varying levels of information uncertainty; and RTE a model for examining state failure and the escalation of conflict at the city, state, nation, and international as changes occur within and among red, blue, and green forces. Dr. Carley is the director of the Center for Computational Analysis of Social and Organizational Systems (CASOS) which has over 25 members, including students, post-doctoral fellows, research staff, and faculty. She is the founding co-editor of the journal Computational and Mathematical Organization Theory which she now co-edits with Dr. Terrill Frantz. She has co-edited several books in the computational organizations and dynamic network area.

# <u>Keynote Information</u>

### Digital Twins for Manufacturing Systems: Leveraging Real-Time Information through Modeling and Simulation

### Author: Dawn M. Tilbury

### Location: EA Wing, EA011

discussed.

Day | Time: Wednesday, May 24, 2023 | 9:00 a.m.—10:00 a.m.

**Abstract:** Advances in computing and networking technologies have enabled massive amounts of data to be collected from manufacturing plant floors, and stored either



lected from manufacturing plant floors, and stored either locally or in the cloud. Although data quality remains an important challenge, Digital Twins enable this data to be used, together with models of manufacturing processes, to create useful information and advise human operators on recommended actions. Standards for Digital Twins are emerging, and there are opportunities to create different types of Digital Twins that can best utilize the data that exists. In this talk, we will present a requirements framework for Digital Twins in the manufacturing domain, including the important properties of re-usability, interoperability, interchangeability, extensibility and maintainability. Several examples of digital twins that we have created will be presented, with potential outcomes of reduced costs and improved productivity. Future challenges

**Biography:** Dawn M. Tilbury is the inaugural Ronald D. and Regina C. McNeil Department Chair of Robotics at the University of Michigan, and the Herrick Professor of Engineering. She received the B.S. degree in Electrical Engineering from the University of Minnesota, and the M.S. and Ph.D. degrees in Electrical Engineering and Computer Sciences from the University of California, Berkeley. Her research interests lie broadly in the area of control systems, including applications to robotics and manufacturing systems. From 2017 to 2021, she was the Assistant Director for Engineering at the National Science Foundation, where she oversaw a federal budget of nearly \$1 billion annually, while maintaining her position at the University of Michigan. She has published more than 200 articles in refereed journals and conference proceedings. She is a Fellow of IEEE, a Fellow of ASME, and a Life Member of SWE.

and opportunities in the area of Digital Twins for manufacturing systems will also be

# **Tutorials Information**

**Tutorial I:** A Tutorial on Bayesian Sequential Data Assimilation for Dynamic Data-Driven Simulation

Date | Time: Tuesday, May 23, 2023 | 4:00 p.m. –5:30 p.m. Presenter: Xiaolin Hu Location: I Wing, i104

**Tutorial II:** Introductory Tutorial on Agent-Based Modeling and Simulation

Date | Time: Wednesday, May 24, 2023 | 4:00 p.m.– 5:30 p.m. Presenter: Charles Macal Location: I Wing, i224

**Tutorial III:** Defining DEVS and Real-Time DEVS Models Using DEVS-Graphs Online Environment

**Date | Time: Thursday, May 25, 2023 | 9:00 a.m.—10:30 a.m.** Presenters: Cristina Ruiz Martin and Gabriel Wainer Location: I Wing, i104

**Tutorial IV:** Tools and Applications using Cosys-AirSim: A Real-Time Simulation Framework Expanded for Complex Industrial Applications

**Date | Time: Thursday, May 25, 2023 | 3:30 p.m.– 5:00 p.m.** Presenters: Jean-Edouard Blanquart, Erik Verreycken, Wouter Jansen, Anthony Schenck, Nico Huebel, Connor Verhulst and Jan Steckel Location: I Wing, i104

**Tutorial V:** A Tutorial Introduction to Colored Petri Nets (CPNs) Based Modeling and Simulation

Date | Time: Friday, May 26, 2023 | 9:00 a.m.—10:30 a.m. Presenter: Vijay Gehlot Location: I Wing, i104

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# <u>Mohawk College</u> <u>Fennell Campus</u>



# Agenda at a Glance

# ANNSIM'23 Ses

		ANSS	SPECTS/CNS	MLS	MSM
Tuesday 23-May-23					
9:00 a.m.—10:30 a.m.	SCS Plenary				
10:30 a.m.—11:00 a.m.	Break				-
11:00 a.m.—12:30 p.m.	Session Block I				
12:30 p.m.—2:00 p.m.	Lunch	•			-
2:00 p.m.—3:30 p.m.	Session Block II				
3:30 p.m.—4:00 p.m.	Break	•			
4:00 p.m.—5:30 p.m.	Session Block III				
Wednesday 24-May-2	3				
9:00 a.m.—10:00 a.m.	SCS Plenary				
10:00 a.m.—10:30 a.m.	Break				
10:30 a.m.—12:00 p.m.	Session Block V				i126
12:00 p.m.—1:30 p.m.	Lunch				
1:30 p.m.—3:30 p.m.	Session Block VI	Session Block VI			
3:30 p.m.—4:00 p.m.	Break				
4:00 p.m.—5:30 p.m.	Session Block VII				i126
Thursday 25-May-23					
9:00 a.m.—10:30 a.m.	Session Block VIII	i126	i125		
10:30 a.m.—11:00 a.m.	Break				-
11:00 a.m.—12:30 p.m.	Session Block IX				
12:30 p.m.—2:00 p.m.	Lunch				
2:00 p.m.—3:00 p.m.	Session Block X				
3:00 p.m.—3:30 p.m.	Break				
3:30 p.m.—5:30 p.m.	Session Block XI i126				
Friday 26-May-23					
9:00 a.m.—10:30 a.m.	Session Block XII	k XII <b>i126</b>			
10:30 a.m.—11:00 a.m.	Break				
11:00 a.m.—12:30 p.m.	Session Block XIII	i126		i125	

# sions at a Glance

TMS	SimAUD	SimEd	MSCS	CPS	ET-DT	HSAA	WIP
			Γ	Γ	Γ		
i104	i125					i126	
	1405			14.0.4		:400	
	1125			1104		1126	
	1125					i126	
	1120					1120	
	i125				i104		
					i104		
	1125				104		
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		i125	i125				
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							i125

# **Daily Agendas**

# **Tuesday**

### Agenda

### Tuesday, May 23, 2023

### Simulation of Architectural and Urban Design (SimAUD)

### Session I 11:00 a.m.—12:30 p.m. Room: I Wing, i125

*Micro-Scale Urban Simulation of Pedestrian Heat Stress: A Case Study of Cardiff, Wales, UK* by Jianxiang Huang, Xu Tang and Phil Jones

Modeling and Calibrating Digital Twin of Automatic Garbage Collection System in Sejong City by Tae-Sub Yun, Minsang Park and Il-Chul Moon

*UrbanFlow: Designing Comfortable Outdoor Areas* by Daoming Liu, Florian Rist and Dominik Michels

### Session II 2:00 p.m.—3:30 p.m. Room: I Wing, i125

*Communication Patterns* by Saqib Aziz, Giovaani Betti, Felix Deiters, Iris Inokhosa and Markus Jacobi

Integrating Conditional Shape Embedding with Generative Adversarial Network to Assess Raster Format Architectural Sketch by Han Tu, Yichao Shi and Meng Xu

Sensing Behavior Framework: Acquisition and Communication of Occupancy Behavior Data by Panagiota Pouliou, Martin Tamke, Paul Nicholas and Kare Stockholm Poulsgaard

### Session III 4:00 p.m.—5:30 p.m. Room: I Wing, i125

*Game Engines as a Performance-Aware Participatory and Interactive Design Platform: A Prototypical Workflow* by Arman Khalilbeigi Khameneh and Alicia Nahmad Vazquez

*Algorithms for Voxel-based Architectural Space Analysis* by Rhys Goldstein, Kean Walmsley, Nigel Morris and Alexander Tessier

Aesthetics as a Criterion: Navigating Solution Spaces Utilizing Computer Vision, the Aesthetic Measure, and Artificial Neural Networks by Victor Sardenberg and Mirco Becker

### Agenda

### Tuesday, May 23, 2023

### Humans, Societies and Artificial Agents (HSAA)

Session I 11:00 a.m.—12:30 p.m.

Room: I Wing, i126

Room: I Wing, i126

Room: I Wing, i126

### **Opening Talk**

(WiP) Using Agent Based Modelling and Participatory Systems Modelling to Create Serious Games with an Artificial Intelligence Simulating Component by David Wurster, Elisabeth Späth, Blanca Luque-Capellas, Petra Ahrweiler, Massimo Rusconi and Jesús Siqueiros

*(WiP) Challenges of Using a Microsimulation-based Model for the Cost of Living Crises* by Kashif Zia, Andreas Hoehn, Corinna Elsenbroich and Alison Heppenstall

(WiP) Coordination Failure As Barrier To Economic Development by Isaak Mengesha

### Session II 2:00 p.m.—3:30 p.m.

*Binary Opinion Dynamics with Mesophilic Agents* by Patrick Shepherd, Anh Ngo, Said Maalim and Isaac Gray

*An Agent-based Modeling of Mobs Using Theoretical Constructs of Collective Action* by Samer Al-khateeb, Jack Burright, Nitin Agarwal and Rebecca Murray

*The Effect of Empathy on Happiness in Social Networks: An Agent-Based Simulation Study* by Nicholas Bishop and Hamdi Kavak

### Session III 4:00 p.m.—5:30 p.m.

*Developing a Large-Scale Agent-Based Model Using the Spiral Software Development Process* by Maxim Malikov, Fahad A. Aloraini, Andrew Crooks, Hamdi Kavak and William Kennedy

Identifying the Building Blocks of Social Simulation Models: A Qualitative Analysis Using Open-Source Codes in NetLogo by Shannon Cheng, Philippe Giabbanelli and Zaiyi Kuang

*Firm-level Propagation of the Effect of Disruption of International Trade through Domestic Supply Chains* by Hiroyasu Inoue and Yasuyuki Todo

### Agenda

**Tuesday, May 23, 2023** 

### 16th Theory and Foundations of Modeling & Simulation (TMS)

### Session I 11:00 a.m.—12:30 p.m. Room: I Wing, i104

*Facilitating the Interoperability and Reuse of Extensions of Fuzzy Cognitive Maps* by Ryan Schuerkamp, Philippe Giabbanelli and Nicolas Daclin

*Energy and Power Evaluation of Parallel DEVS Simulations on Multicore Architectures* by Guillermo Trabes, Veronica Gil Costa and Gabriel Wainer

A New Family of xDEVS Simulators for Enhanced Performance by Roman Cardenas, Patricia Arroba and Jose L. Risco-Martin

### Cyber Physical Systems (CPS)

Session II 2:00 p.m.—3:30 p.m.

Room: I Wing, i104

Formalizing Cyber-Physical System Interfaces Using DEVS by Gabriel Wainer and Rishabh Jiresal

*Synthesizing Orchestration Algorithms for FMI 3.0* by Simon Hansen, Claudio Gomes and Zahra Kazemi

*Development Of QSS and PID Control Algorithm inside RT-DEVS Framework* by Mahya Shahmohammadimehrjardi and Gabriel Wainer

# Wednesday

### Agenda

### Wednesday May 24, 2023

### Simulation of Architectural and Urban Design (SimAUD)

### Session V 10:30 a.m.—12:00 p.m.

A Case Study on Generating Eco-Conscious Office Buildings Using a Data-Informed Optimization Framework by Gen Karoji

*Urban Design Optimizer: A Comparative User Interface Study for a Web-Embedded Tool* by F. Peter Ortner, Anna Claudia Yenardi and Jing Zhi Tay

*Comparing Apartment Balcony Design Options in Toronto for Useability, Healthy Lighting, and Daylight Availability* by Fion Ouyang, Terri Peters, Alstan Jakubiec and Ted Kesik

### Session VII 4:00 p.m.—5:30 p.m.

Room: I Wing, i125

Room: I Wing, i125

Stochastic Assessment for Model-Predictive Control of a Variable Refrigerant Flow System by Seo-Hee Choi, Seongkwon Cho and Cheol Soo Park

Uncertainty Quantification of Overall Heat Transfer Coefficient (U-Value) for a Glazing System with External Venetian Blind by JeongYun Lee and Cheol-Soo Park

(WiP) Generative Design for a Complete Community Park by Samah Kamalmaz, Sara Diamond, Jeremy Bowes, Greg Van Alstyne, Robert Wright, Matthew Roorda, Sara Wagner, Rhys Goldstein and Jacky Bibliowicz

(WiP) Comparing Results of Measured and Simulated Glare in Learning Environments by Julia Di Giorgio and Terri Peters

### Agenda

### Wednesday May 24, 2023

### **Modeling and Simulation in Medicine (MSM)**

### Session V 10:30 a.m.—12:00 p.m.

Room: I Wing, i126

Room: I Wing, i126

### Healthcare Simulation and Neural Networks

Study on Mild Cognitive Impairment and Alzheimer's Disease Classification using a New Ontogenic Neural Architecture, the Supervised Reconfigurable Growing Neural Gas by Ylermi Cabrera-León, Patricio García Báez, Pablo Fernández-López and Carmen Paz Suarez-Araujo

*On the Necessity of Human Decision-making Errors to Explain Vaccination Rates for COVID-19: An Agent-based Modeling Study* by Philippe Giabbanelli, Jack T. Beerman and Gwendal G. Beaumont

*Vaccination Accessibility Analysis: Modeling Historical Patterns of Redlining and Access to Healthcare Services* by Suncica Milosevic and Ajla Aksamija

### Session VI 1:30 p.m.—3:30 p.m.

### **Computer-Assisted Therapy and Physiology Simulation**

*Towards a Patient-Specific Obstetric Simulator Through Opensim Musculoskeletal and Bash Skinned Human Modeling* by Bahador Dodge, Hunter J. Bennett, Oleksandr Kravchenko, Von Jamora, Marco Parente, Renato Natal Jorge, Dulce Oliveira, Marlies Nitschke, Anne D. Koelewijn, Andrew Moore, Menachem Miodovnik and Michel Audette

*Multi-Material, Approach-Guided, Controlled-Resolution Breast Meshing for Fe-Based Interactive Surgery Simulation* by Motaz Alqaoud, John Plemmons, Eric Feliberti, Krishnanand Kaipa, Gabor Fichtinger, Yiming Xiao, Tanweer Rashid and Michel Audette

*Design and Implementation of a Generic Circuit Solver for Physiological Lumped-Parameter Modeling* by Jeffrey Webb, Aaron Bray and Rachel Clipp

*Elucidating the Role of the His-Purkinje System during Long QT Mediated Arrhythmias* by Anthony Owusu-Mensah, Omer Berenfeld and Michel Audette

Session VII 4:00 p.m.—5:30 p.m.

Room: I Wing, i126

MSM Panel

# Annual Modeling and Simulation Conference 2023 Agenda Wednesday May 24, 2023 Emerging Topic—Digital Twirs (ET-DT) Session V 10:30 a.m.—12:00 p.m. Room: I Wing, i104

### Foundations

*Modeling and Synchronizing Digital Twin Environments* by Juan Alberto Llopis, Paula Munoz, Javier Criado, Javier Troya, Luis Iribarne and Antonio Vallecillo

Formal Approach to Digital Twin Specification by Mama Diakité and Mamadou Traore

*Examining Model Qualities and Their Impact on Digital Twins* by Bentley Oakes, Claudio Gomes, Joachim Denil, Julien Deantoni, João Cambeiro, John Fitzgerald and Peter Gorm Larsen

Session VI 1:30 p.m.—3:30 p.m. Room: I Wing, i104

### **Invited Talk & Panel**

*Invited Talk: A DEVS-based Engine for Building Digital Quadruplets* Presenter: Gabriel Wainer

Panel: Interoperability of Digital Twins

Panelists: Claudio Gomes (Aarhus University, Denmark) – Academia, Guodong Shao (NIST, US) – Government, Dawn Tilbury (University of Michigan, US) – Academia, Bassam Zarkout (IGnPower Inc., Canada) – Industry

### Session VII 4:00 p.m.—5:45 p.m.

Room: I Wing, i104

### Applications & CPS II

Digital Twin and Agent-Based Simulation: Co-Simulation to Support Intelligent Navigation of Healthcare Mobile Robot by Ginikachi Anyene, Anthony Nepomuceno, Celeste Schultz and Inki Kim

*Building A Digital Twin of an Automated Robot Workcell* by Deogratias Kibira, Guodong Shao and Rishabh Ventekesh

A Statechart Template Library for IoT System Modelling by Clyde Rempillo and Sadaf Mustafiz

*(WiP) Co-Simulation For Controlled Environment Agriculture* by Pascal Archambault, Istvan David, Eugene Syriani and Houari Sahraoui

# Thursday

### Agenda

### Thursday May 25, 2023

### **Communications and Network Simulation (CNS)**

### 26th Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS)

### Session VIII 9:00 a.m.—10:30 a.m. Room: I Wing, i125

Machine Learning Models for Channel Status Classification in M-MIMO Systems Using Limited CSI Feedback by Benjamin Earle, Ala'a Al-Habashna, Gabriel Wainer, Xingliang Li and Guoqiang Xue

*PO-MAC: A Software Defined Performance-Optimized MAC Strategy for Optical Data Center Networks* by David Georgantas and Peristera Baziana

(WiP) Human-out-of-the-Loop Swarm-Based IoT Network Penetration Testing by IoT Devices by Thomas Schiller and Sean Mondesire

(*WiP*) Attachable IoT-based Digital Twin Construction for Face Mask Production Line by Byeong Soo Kim, Bong Gu Kang, Taehoon Kim and Jungmin Yun

### Simulation Education and Simulation-Based Learning (SimEd)

### Session XI 3:30 p.m.—4:30 p.m.

Room: I Wing, i125

An Open Source Video Analytics Tool for Analyzing Learner Navigation in Immersive Simulated Environment by Noah Soriano, Ashkan Negahban, Sabahattin Gokhan Ozden and Omar Ashour

A Project-Based Approach for Teaching Numerical Integration in Continuous Simulation by Yuzhong Shen and Masha Sosonkina

### Modeling & Simulation in Cyber Security (MSCS)

### Session XI

4:30 p.m.—5:30 p.m.

Room: I Wing, i125

Modeling and Simulation of the Human Firewall against Phishing Attacks in Small and Medium-Sized Businesses by Jeongkeun Shin, Geoffrey B. Dobson, L. Richard Carley, and Kathleen M. Carley.

*GreenThread – Blockchain, Non-Fungible Token (NFT), Model Cards, Self-Sovereign Identity, and IPFS enabled Sustainable Circular Fashion Platform* by Eranga Bandara, Nadini Sahabandu, Sachin

### Agenda

### Thursday May 25, 2023

### **55th Annual Simulation Symposium (ANSS)**

Session VIII 9:00 a.m.—10:30 a.m.

Room: I Wing, i126

### **Methods and Tools**

Agent-Based Model Output Analysis – A Comprehensive Statistical Framework by Janani Venugopalan, Gaurav Deshkar, Jayanta Kshirsagar, Divye Singh, Justin Jose and Harshal Hayatnagarkar

*Modeling Forced Migration: A System Dynamic Approach* by Troy Curry, Arie Croitoru and Andrew Crooks

*Hybrid Agent-Based and Discrete Event Simulation in MASON* by Giuseppe D'Ambrosio and Sean Luke

Session XI 3:30 p.m.—5:00 p.m.

Room: I Wing, i126

### **Methods and Tools**

Simulation and Optimization Techniques for Mitigation of Disruptions to Supply Chains by Rajhersh Patel, Abhisekh Rana, Sean Luke, Carlotta Domeniconi, Andrew Crooks, Hamdi Kavak and James Jones

*Error Estimators for Adaptive Scheduling Algorithm for Serial Co-simulation* by Emin Oguz Inci, Claudio Gomes, Jan Croes and Wim Desmet

*Decision Support Framework for Automating the Optimization ff Edge Computing Federations* by Antonio F. Rodríguez-Liria, Román Cárdenas, Patricia Arroba, José M. Moya, José L. Risco-Martín and Gabriel Wainer

### Agenda

### Thursday May 25, 2023

### Ph.D. Colloquium

### Session IX 11:00 a.m.—12:30 p.m.

### Ph.D. Colloquium

*Co-Optimization of Cyber-Physical Systems: Leveraging Domain Knowledge in Multi-domain System Development Processes* by Yon Vanommeslaeghe

Accelerating the Training of Artificial Neural Networks Using Data Parallelization and CPU Affinity on CPUS and GPUS by Jorge Lopez

An Agent-Based Model and Simulation to Explore Possible Solutions to Food and Nutrition Insecurity for College Students in the United States by Candace Sapp

A High-Performance DEVS Simulator for Multi-GPU Platforms by Guillermo Trabes

*Electrical Distribution System Resilience Improvements Via Customer Preference for Bidirectional Charging Electric Vehicles* by Clark Petri

Deep ABM for Agent Actions and Interaction for Southwest Border Interdictions by Chris Prather

### 12:30 p.m.—2:00 p.m.

Room: I Wing, i126

Room: I Wing, i126

### Ph.D. Colloquium Panel (Over Lunch)

Session X 2:00 p.m.—3:00 p.m.

### Room: I Wing, i126

### Ph.D. Colloquium Keynote

Baher Abdulhai, Ph.D., P.Eng.

Talk: Mindset Transformation from a Ph.D. Grad to Professorship – Dream Big

Professor and Director, Toronto Intelligent Transportation Systems Centre Co Director, iCity Centre for Automated and Transformative Transportation Systems – iCity CATTS. Department of Civil and Mineral Engineering, University of Toronto 35 St. George St., #105, Toronto, Ontario, Canada M5S 1A4 Email Website

YouTube: The traffic game – can traffic lights learn to be smart? Baher Abdulhai at TEDxUTSC

Baher Abdulhai has been a professor at the University of Toronto since 1998. Born in Cairo, Egypt in 1966, and earned his Ph.D. in engineering from the University of California Irvine, Irvine, California, USA, in 1996.

# **Friday**

### Agenda

### Friday May 26, 2023

### Work in Progress (WIP)

Session XII 9:00 a.m.—10:30 a.m. Room: I Wing, i125

*Modeling Multimodal CO2 Transportation for Carbon Capture, Utilization, and Storage* by Robin J. Clark, Majbah Uddin, Michael R. Hilliard, Josh Thompson, Matthew H. Langholtz and Erin Webb

A Multiplayer Human-in-the-Loop Autonomous Driving Simulation Framework with Virtual Reality Technology by Defu Cui and Yuzhong Shen

*Towards a Digital Twin of a Retail Loyalty Scheme* by James Battye, Peter Baudains and Jonathan A. Ward

### **Machine Learning and Simulation (MLS)**

**Session XIII** 

11:00 a.m.—12:30 p.m.

Room: I Wing, i125

A Simulation Environment for Reducing Food Waste Via Reinforcement Learning by Sebastian Pilarski, Aman Sidhu and Daniel Varro

Preserving Simulation Insight while Removing Data: Verification of Compressed Simulation Traces Via Machine Learning by My Nguyen, Duc Vu, Anh Vo, Luke Liang and Philippe Giabbanelli

### Agenda

### Friday May 26, 2023

### **55th Annual Simulation Symposium (ANSS)**

Session XII 9:00 a.m.-

9:00 a.m.—10:30 a.m.

Room: I Wing, i126

### **Real World Applications**

*Predictive Modeling and Simulation System for the Management of Harmful Cyanobacteria Blooms* by Beatriz Herguedas, José L. Risco-Martín, Segundo Esteban, José A. López-Orozco and Eva Besada-Portas

A Survey of Visualization Capabilities for Simulation Environments by Bruno St-Aubin and Gabriel Wainer

A Generic Modeling Approach Towards Simulating an Urban Primary And Secondary Healthcare Facility Network by Najiya Fatma and Varun Ramamohan

Session XIII 11:00 a.m.—12:30 p.m. Room: I Wing, i126

### **Real World Applications**

*Cosys-AirSim: A Real-Time Simulation Framework Expanded for Complex Industrial Applications* by Wouter Jansen, Erik Verreycken, Anthony Schenck, Jean-Edouard Blanquart, Connor Verhulst, Nico Huebel and Jan Steckel

*Model-based Systems Engineering and Simulation of a Molten Salt Reactor Power Plant for Requirements Analysis* by Stephen Pair and Michael Jones

*DEVS-Based Modeling and Simulation of Data-Driven Exploration Algorithms of Lentic Water Bodies with an ASV* by Samuel Ferrero-Losada, Eva Besada-Portas, José L. Risco-Martín and José A. López Orozco

# The City of Hamilton

# Things to Do in Hamilton

### **Canadian Warplane Heritage Museum**

9280 Airport Road, Mount Hope, ON LOR 1WO

Phone: +1 905-679-4183 https://www.warplane.com/

A collection of over forty aircraft has grown through the friendship of Dennis Bradley and Alan Ness. Their love of aviation and their desire to maintain and preserve Canada's aviation history saw restoration projects that were not only great pieces of workmanship but airworthy examples.

### Dundurn Castle

610 York Blvd, Hamilton, Ontario L8R 3H1

Phone: +1 905-521-3168 https://www.hamilton.ca/things-do/hamilton-civic-museums/dundurn-national-historic-site

Experience a guided tour of this 40-room Italianate-style villa built in the 1830's on Burlington Heights; the former site of a fortified military encampment established by the British during the War of 1812. Once home to Sir Allan Napier MacNab, railway magnate, lawyer and Premier of the United Canadas (1854-1856) and his family, today Dundurn Castle tells the story of the family who lived above stairs and the servants who lived and worked below stairs. Her Majesty, The Queen Consort is the museum's Patron and the great, great granddaughter of Sir Allan MacNab.

### **HMCS Haida National Historic Site**

Pier 9, 658 Catharine St N, Hamilton, ON L8L 8K4

Phone: +1 905-526-6742 https://parks.canada.ca/lhn-nhs/on/haida

The last Tribal Destroyer in the world, HMCS HAIDA is Canada's most famous warship. She inspires countless adults and children and draw visitors from Ontario, across North America and from around the globe. This WWII Tribal Class destroyer is now a floating memorial and naval museum.

### **Bayfront Park**

200 Harbour Front Drive Bay at Strachan, Hamilton, ON L8L 1C8

Phone: +1 905-546-2489 https://www.hamilton.ca/things-do/parks-green-space/parks-trails/ parkfinder

Bayfront Park is a 16-hectare park found in the West-end of Hamilton Harbour in the North End neighbourhood of Hamilton, Ontario, Canada. Over \$9 million transformed formerly vacant land into a versatile green space, with 1,800 metres of shoreline integrating fish habitat, native vegetation and facilities.

# <u>Things to Do in Hamilton</u>

### Westfield Heritage Village

1049 Kirkwall Road Rockton, Hamilton, ON LOR 1X0

Phone: +1 519-621-8851 https://westfieldheritage.ca/

Westfield Heritage Village Conservation Area is located just outside of the village of Rockton, Ontario. The site is open daily from 8:00 am to 8:00 pm for walking, hiking and bird-watching. The historical buildings are only open on special program days. Check the website for further information.

### Albion Falls

885 Mountain Brow Blvd, Hamilton, ON L8W 1R6

Phone: +1 905-546-2666 https://tourismhamilton.com/albion-falls/

Albion Falls is one of the most picturesque waterfalls in the region and one of the city's most popular. The Red Hill Creek in the east end's King's Forest tumbles over rock that's been formed over time into steps and shelves, fanning outwards into a beautiful cascade of rushing water. Albion Falls is a stepped jewel, classified as a cascade as it ripples over the Niagara Escarpment. It is almost as wide (18 metres) as it is tall (19 metres). It is visible from two viewing platforms, but there is currently no access to the bottom. Rocks from around the falls were used in the construction of Hamilton's famous Rock Garden, a National Historic Site at Hamilton's Royal Botanical Gardens.

### Hamilton Museum of Steam & Technology

900 Woodward Ave, Hamilton, ON L8H 7N2

Phone: +1 905-521-3168 https://www.hamilton.ca/things-do/hamilton-civic-museums/hamiltonmuseum-steam-technology-national-historic-site

This National Historic Site is recognized as a civil and power engineering landmark. Today the museum preserves two massive steam-powered beam engines, which pumped water in Hamilton from 1859 to 1910, as well as a collection of artifacts relating Hamilton's industrial past. The museum interprets Hamilton's relationship with water, steam power, and industrialization.

### Little Rays Nature Centre

869 Barton St E, Hamilton, ON L8L 3B4

Phone: +1 613-822-8924 https://littlerays.org/

Meet and interact with our rescue animals and learn about conservation at one of our 4 Nature Centers. Found in Ottawa, Hamilton, Edmonton and Syracuse. We offer general admission and private tours and more. Little Ray's offers nature centers, exhibits and animal encounters that are hands on, educational and always lots of fun! We are the largest exotic animal rescue in North America and a proud member of Canada's Accredited Zoos and Aquariums (CAZA).

# Conference Award Recipients

### Conference Award Recipients

### **Best Paper Award:**

HSAA Track Paper Title: Binary Opinion Dynamics with Mesophilic Agents Authors: Patrick Shepherd, Anh Ngo, Said Maalim, and Isaac Gray

### **Runner Up Paper Award:**

ANSS Track

Paper Title: Error Estimators for Adaptive Scheduling Algorithm for Serial Co-simulation

Authors: Emin Oguz Inci, Claudio Gomes, Jan Croes, and Wim Desmet

### **Outstanding Reviewers:**

Lynne Serre Defence Research and Development Canada

Yon Vanommeslaeghe University of Antwerp

Christian Lopez Lafayette College

Brandon Haworth University of Victoria

# SCS Board of Directors Award Recipients

# SCS Board of Directors Award Recipients

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Invara	2021 Lin Zhang
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Young Simulation Scientist	2019 Philippe Giabbanelli
	2020 Cristina Ruiz Martin
	2021 Hamdi Kavak
	2022 Maria Julia Blas
	2022 Christopher Lynch
Outstanding Service Award	2020 Gabriel Wainer
	2022 Rodrigo Castro
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Distinguished Service Award	2020 Adelinde Uhrmacher
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