AUTONOMOUS SYSTEMS INITIATIVE

ASI Symposium Program
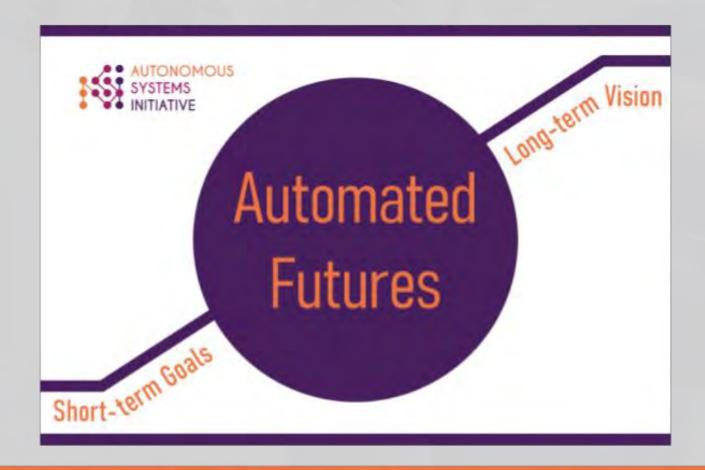
September 14th - 15th, 2023

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AUTONOMOUS SYSTEMS INITIATIVE

Agenda Day 1: Talks

Time & Location	Event	Session Chair & Speakers
8:15-8:45 Donadeo Innovation Centre For Engineering (ICE) Room 8-207	**Breakfast** Join us for a hot breakfast to start the day.	
8:45-9:00 ICE Room 8-207	**Opening Remarks**	**Amina Robinson, PhD** **Vice President, UofA (TBC)** **Simaan AbouRizk, PhD** **Dean of Engineering, UofA (TBC)**
9:00-10:30 ICE Room 8-207	**Session 1: Healthy Communities** *Autonomous and Semi-autonomous Systems for Healthcare Delivery*	Chair: **Mahdi Tavakoli, PhD** Keynote: **Vivian Mushahwar, PhD** Speaker: **Garnette Sutherland, PhD** Speaker: **Hossein Rouhani, PhD** Speaker: **Bin Zheng, PhD** Speaker: **Edmond Lou, PhD**
10:30-12:00 ICE Room 8-207	**Session 2: Mobile Communities** *Connected and Automated Vehicles* *Promoting Mobile, Safer and Sustainable Winter Transportation Through Deep Learning and Geostatistics* *Automated Inspection System for Large Mining Vehicles*	Chair: **Tony Qiu, PhD** Speaker: **Tae Kwon, PhD** Speaker: **Lina Kattan, PhD** Speaker: **Behrouz Far, PhD** Speaker: **Quamrul Huda, PhD**
12:00-1:00 ICE Room 8-207 / Lounge 8A-222	**Lunch Break and Poster Session Viewing** Enjoy a catered lunch and interact with 2023 poster presenters.	

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Time & Location	Event	Session Chair & Speakers
1:00-2:30 ICE Room 8-207	**Session 3: Sustainable Communities** *A Changing Climate in an Increasingly Autonomous Society* *Nonlinear Motion Control of a Drone Suspended Payload System* *Integrating Drones into Emergency Fire Response: Are Drones Actually Useful?* *Towards Smart, Sustainable, and Resilient Cities: Crowdsensing-based Monitoring of Built and Natural Environments (CoMBiNE)* *Integrating GIS & LiDAR Data to Model Fire Hazard - An Urban Empirical Investigation of the City of Edmonton*	Chair: **Karim El-Basyouny, PhD** Keynote: **Stephen Wong, PhD** Speaker: **Alan Lynch, PhD** Speaker: **Jeff Boisvert, PhD** Speaker: **Mustafa Gül, PhD**
2:30-4:00 ICE Room 8-207	**Session 4: Methodologies and Tools** *Control and Monitoring Tools for Complex and Networked Autonomous Systems*	Chair: **Tongwen Chen, PhD** Keynote: **Masoud Abbaszadeh, PhD** Speaker: **Hari Mohan Rao** Speaker: **Qing Zhao, PhD** Speaker: **Petr Musilek, PhD** Speaker: **Marek Reformat, PhD**
4:00-5:30 ICE Room 8-207	**Session 5: Industrial Communities** *Robotization of Industrial Repair and Manufacturing for Alberta: Promises and Pitfalls*	Chair: **André McDonald, PhD** Speaker: **Ehsan Hashemi, PhD** Speaker: **James Hogan, PhD** Speaker: **Wylie Stroberg, PhD** Speaker: **Rafiq Ahmad, PhD** Speaker: **Martin Jagersand, PhD** Speaker: **Tonya Wolfe, PhD**
5:30-5:40 ICE Room 8-207	**Closing Remarks**	**Tony Qiu, PhD** **André McDonald, PhD**

Agenda Day 2: Lab Demonstrations & Workshops

Time & Location	Event	Leads / Contact Persons
8:00-8:30 Engineering Teaching and Learning Complex (ETLC) Lounge 6-059	**Breakfast** Enjoy an assortment of coffee, teas, and pastries to start the day.	
8:30-9:30 Electrical & Computer Engineering Research Facility (ECERF) Room W7-020	**ASI Theme 1: Methodologies and Tools Lab Demonstration** *ELITE Grid Laboratory (see page 26 for details)*	**Petr Musilek, PhD**
8:30-9:30 Natural Resources Engineering Facility (NREF) Room 5-043	**ASI Theme 2: Mobile Communities Lab Demonstration** *ACTIVE Connected Vehicle Laboratory (see page 26 for details)*	**Tony Qiu, PhD**
9:00-9:45 ECERF W7-070/079/081	**ASI Theme 4: Healthy Communities Lab Demonstrations** *Telerobotic and Biorobotic Systems Laboratory (see page 27 for details)*	**Mahdi Tavakoli, PhD**
9:45-10:30 Heritage Medical Research Center (HMRC) Room 162	*Surgical Simulations Laboratory (see page 27 for details)*	**Bin Zheng, PhD**

Time & Location	Event	Leads / Contact Persons
10:30-11:15 **ECERF** **Room W5-050**	*Ultrasound and IoT Laboratory (see page 28 for details)*	**Edmond Lou, PhD**
9:30-10:30 **ECERF** **Room 4-50**	**ASI Theme 3: Sustainable Communities** **Lab Demonstration** *Applied Nonlinear Control Laboratory (see page 28 for details)*	**Alan Lynch, PhD**
10:30-11:00 **Mechanical Engineering (MecE) Room 1-27A**	**ASI Theme 5: Industrial Communities** **Lab Demonstrations** *Thermal Spray Manufacturing, Advanced Heat Transfer and Surface Technologies Laboratory (see page 29 for details)*	**André McDonald, PhD**
11:00-11:30 **MecE Room 6-27**	*High Rate Mechanical Testing and Modelling of Materials and Structures, Centre for Design of Advanced Materials Laboratory (see page 29 for details)*	**James Hogan, PhD**
11:30-1:00	***Lunch Break*** No lunch provided on this day, please feel free to explore the many options available on campus.	
1:00-4:30 **ETLC Room 6-015/025/035**	**ASI Theme 1: Methodologies and Tools** **Workshop** *Student Presentations*	**Tongwen Chen, PhD**
1:00-4:30 **University of Alberta Conference Centre Prairie Room**	**ASI Theme 2: Mobile Communities** **Workshop** *Student Presentations*	**Tony Qiu, PhD**

AUTONOMOUS SYSTEMS INITIATIVE

Time & Location	Event	Leads / Contact Persons
1:00-3:00 University of Alberta Conference Centre Aurora Room	**ASI Theme 3: Sustainable Communities Workshop** *Keynote Speech & ASI Theme 3 Expert Panel Discussion*	Keynote: **Alex Ramirez-Serrano, PhD** **Karim El-Basyouny, PhD** **Stephen Wong, PhD** **Alan Lynch, PhD** **Jeff Boisvert, PhD** **Mustafa Gül, PhD**
1:00-4:30 ETLC Room 6-060	**ASI Theme 4: Healthy Communities Workshop** *Student Presentations*	**Mahdi Tavakoli, PhD**
1:00-1:40 ETLC Room 6-064/68	**ASI Theme 5: Industrial Communities Workshop** *Keynote Speech* *Industry 4.0: Smart Robust Scheduling in Manufacturing Using AI*	Keynote: **Soumya Ranjan Sahoo, PhD** **André McDonald, PhD**
2:00-2:30 ECERF Room 4-40	*Lab Demonstration **(limited to workshop participants only)*** *Field Robotic Arm and Hand Manipulation for Emergency Response and Repair*	**Martin Jagersand, PhD**
3:00-3:30 MecE Room 1-38	*Lab Demonstration **(limited to workshop participants only)*** *Autonomous Robot-Assisted Repair Platform Demo, Sustainable Manufacturing Systems Laboratory (SMART Lab)*	**Rafiq Ahmad, PhD**
4:00-4:30 National Institute of Nanotechnology (NINT) Room 5-002	*Lab Demonstration **(limited to workshop participants only)*** *AI-enabled Manufacturing/Fabrication, Networked Optimization, Diagnosis, and Estimation Laboratory (NODE Lab)*	**Ehsan Hashemi, PhD**

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Abstracts & Biographies

ASI Theme 4: Healthy Communities
Advancing Healthcare through Autonomous Systems

Abstract

Enhancing surgical, therapeutic, diagnostic, and rehabilitative procedures is achievable through computer-integrated autonomous systems. These systems possess real-time decision-making abilities and can be operated directly by medical professionals (such as surgeons, therapists, and physicians), either in a shared control capacity or under their supervisory control. By introducing appropriate levels of autonomy into healthcare systems, the burdens on clinicians, both mentally and physically, can be reduced. Simultaneously, machine autonomy improves the dependability, accuracy, and safety of interventions for patients. For example, an autonomous system can help to build computerized models of medical interventions and transfer the learned skills to robots that provide intelligent assistance to surgeons or therapists. In this session, researchers explore diverse applications of robotics, wearables, and other biomedical autonomous systems. They delve into associated challenges and propose solutions that harness the synergies between human abilities and the rapid, precise decision-making capabilities of machines.

Keynote Speaker: Vivian Mushahwar, PhD
Professor, Division of Physical Medicine & Rehabilitation, University of Alberta

Dr. Vivian Mushahwar is a Professor in the Division of Physical Medicine and Rehabilitation. An engineer by training (electrical), Dr. Mushahwar obtained her Ph.D. in biomedical engineering from the University of Utah. Research in the Mushahwar lab focuses on many aspects such as the restoration of standing and walking after spinal cord injury and the detection and prevention of deep tissue pressure sores using functional electrical stimulation (FES) techniques. The Mushahwar lab is working with other groups of the Project SMART team to develop implantable devices that utilize intraspinal microstimulation (ISMS) to stimulate the "control centre" for standing and stepping in the spinal cord and thereby restore this ability after spinal cord injury. In addition, in collaboration with researchers in the Stein, Chan, and Dukelow research groups, Mushahwar's lab is developing a garment to detect and prevent the onset of pressure sores in wheelchair and bed ridden patients.

Session Chair: Dr. Mahdi Tavakoli
Professor, Department of Electrical and Computer Engineering, University of Alberta. Theme 4 Lead, ASI

Dr. Mahdi Tavakoli is a Professor in the Department of Electrical and Computer Engineering, University of Alberta, Canada. He received his BSc and MSc degrees in Electrical Engineering from Ferdowsi University and K.N. Toosi University, Iran, in 1996 and 1999, respectively. He received his PhD degree in Electrical and Computer Engineering from the University of Western Ontario, Canada, in 2005. In 2006, he was a post-doctoral researcher at Canadian Surgical Technologies and Advanced Robotics (CSTAR), Canada. In 2007-2008, he was an NSERC Post-Doctoral Fellow at Harvard University, USA. Dr. Tavakoli's research interests broadly involve the areas of robotics and systems control. Specifically, his research focuses on haptics and teleoperation control, medical robotics, and image-guided surgery. Dr. Tavakoli is the lead author of Haptics for Teleoperated Surgical Robotic Systems (World Scientific, 2008). He is a Senior Member of IEEE, Specialty Chief Editor for Frontiers in Robotics and AI (Robot Design Section), and an Associate Editor for the International Journal of Robotics Research, IEEE Transactions on Medical Robotics and Bionics, IEEE Robotics and Automation Letters, IEEE TMECH/AIM Emerging Topics Focused Section, and Journal of Medical Robotics Research.

Speaker: Garnette Sutherland, PhD
Professor, Department of Clinical Neurosciences, University of Calgary

Dr. Garnette Sutherland completed his residency in Neurosurgery at the University of Western Ontario. His first appointment was at the University of Manitoba, in both the Departments of Surgery and Pharmacology. There, in addition to his clinical work, he established an experimental laboratory, one of the first of its kind, for the study of neurological disease using MR imaging and spectroscopy. In 1993, Sutherland was appointed the head of Division of Neurosurgery at the University of Calgary. In collaboration with NRC-Canada, he developed the world's first intraoperative MRI system based on a moveable l.5T magnet. With MDA, Sutherland also developed neuroArm, an image-guided MR-compatible robotic system. In 2004, Dr. Sutherland received the Manning Award of Distinction for this work, in 2007, the Alberta Science and Technology Leadership Foundation award and in 2008, the City of Calgary Signature Award. He was awarded the Queen Elizabeth Diamond Jubilee medal 2012 and in 2013, the American Astronautical Society and NASA for the earth applications of space technology. He received the CIHR-CMAJ Top Achievements in Health Research Award in 2013 for his scientific accomplishments. He has given over 260 national and international lectures and published 190 manuscripts, 15 patents and 29 book excerpts. In 2011, Sutherland was appointed to the Order of Canada for his lifetime achievement in healthcare innovation and in 2014, was inducted into

the Space Technology Hall of Fame for neuroArm. In July 2015, Dr. Sutherland was awarded with the NASA Highest Technology Achievement Medal for his work on neuroArm.

Speaker: Hossein Rouhani, PhD
Associate Professor, Department of Mechanical Engineering, University of Alberta

Dr. Hossein Rouhani is an Associate Professor in the departments of Mechanical Engineering and Biomedical Engineering at the University of Alberta, and a Research Affiliate at the Glenrose Rehabilitation Hospital (Edmonton) since 2015. He is also the director of the Neuromuscular Control & Biomechanical Laboratory (www.ncbl.ualberta.ca). He received a PhD degree in Biotechnology and Bioengineering from the Swiss Federal Institute of Technology in Lausanne (EPFL). Dr. Rouhani was then a Postdoctoral Fellow in the Institute of Biomaterials and Biomedical Engineering at the University of Toronto. Dr. Rouhani's fields of research are (1) in-field health monitoring using innovative wearable technologies, (2) rehabilitative and assistive technology development, and (3) athletic and performance assessment. Within his translational research program, Dr. Rouhani has had several collaborative research projects with several university hospitals in Canada where he has implemented his developed wearable technologies in clinical research. He is also an author of 78 journal papers and an associate or academic editor of several journals. Dr. Rouhani was a co-chair of the Alberta Biomedical Engineering Conference (2017-2019) and the congress chair of the 2022 International Congress of the Canadian Society of Mechanical Engineering in Edmonton.

Speaker: Bin Zheng, PhD
Associate Professor, Department of Surgery, University of Alberta

Unlike most medical research that focuses on patients and their health problems, Dr. Bin Zheng puts the surgeon under the spotlight. Dr. Zheng studies the performance and cognition of surgeons during surgery, especially in robotic surgery. As an engineer with full training in medicine, Dr. Zheng attempts new ways to understand surgeons' eye-hand coordination, skills acquisition, and decision-making under stressful environments, and also designs the operation systems to support surgeons' performance. Dr. Zheng completed his MD training from China and his PhD training from Simon Fraser University in 2005. Currently, Dr. Zheng is an Associate Professor in Surgery and holds the Endowed Research Chair in Surgical Simulation in the Department of Surgery of the University of Alberta.

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Speaker: Edmond Lou, PhD
Professor, Department of Electrical and Computer Engineering, University of Alberta

Dr. Edmond Lou is a Professor in the Department of Electrical and Computer Engineering and an Adjunct Professor in the Departments of Surgery, Radiology and Diagnostic Imaging, and Biomedical Engineering at the University of Alberta. He has been the head research scientist of the Edmonton Scoliosis Research Group since 2008, and the principal investigator of the Artificial Intelligence Supercomputing Hub at the University of Alberta since 2018. Dr. Lou has been highly productive in research outputs with 150 peer refereed journal articles and 200 conference proceeding papers. He was granted 7 US patents for his inventions. His research is interested in the areas of low-power wireless embedded systems, instrumentation, sensors, IoT, ultrasound imaging and Artificial Intelligence.

Theme 2: Mobile Communities

Wireless Communication-enabled Connected and Automated Transportation

Abstract

This discussion will outline the current research activity of Theme 2, investigating future transportation infrastructure by using advanced telecommunication technology to improve both vehicle and infrastructure performance of information interaction, message processing and early warning systems. There is a particular focus on solving the problems of real-time acquisition and processing and distribution of intersection information in complex traffic environments.

Session Chair: Tony Qiu, PhD
Professor, Department of Civil and Environmental Engineering, University of Alberta
Scientific Director, ASI
Theme 2 Lead, ASI

Dr. Tony Z. Qiu is a Professor in the Department of Civil and Environmental Engineering at the University of Alberta (U of A) and holds both the Canada Research Chair in Cooperative Transportation Systems and the NSERC Industrial Research Chair in Intelligent Transportation Systems. After joining the U of A in 2009, Dr. Qiu founded the Intelligent Transportation Systems (ITS) research lab, now called the Centre for Smart Transportation (CST). He is also the Scientific Director for the Autonomous Systems Initiative (ASI), a multi-million dollar Campus Alberta research program focused on developing Artificial Intelligence and automated systems. Dr. Qiu received his Ph.D. from the University of Wisconsin-Madison in 2007 and his BSc. and MSc. from Tsinghua University of China in 2001 and 2003, respectively. From 2008-2009, he worked as a postdoctoral researcher in the California PATH Program at the University of California, Berkeley. His research aims to enhance our understanding of roadway traffic operation and control. He has collaborated with organizations across the public and private sectors on projects related to intelligent transportation systems, wireless sensor networks for traffic data collection and analysis, advanced traffic management systems, advanced traveller information systems, and other new technologies and practices.

Promoting Mobile, Safer and Sustainable Winter Transportation Through Deep Learning and Geostatistics

Speaker: Tae Kwon, PhD
Associate Professor, Department of Civil and Environmental Engineering, University of Alberta

Dr. Tae J. Kwon is an Associate Professor in the Department of Civil and Environmental Engineering at the University of Alberta. He started his faculty career in 2016 after receiving his PhD from the University of Waterloo with the prestigious doctoral dissertation award. Dr. Kwon's current research focuses on the location and system optimization of intelligent transportation system facilities, winter road maintenance, geomatics applications in transportation, and spatiotemporal analyses of road traffic and safety using geostatistics and deep learning. During his tenure at the University of Alberta, he has published more than 70 papers including peer-reviewed journal and conference papers, project reports and book chapters. In 2019, Dr. Kwon was awarded the 2019 Great Supervisor Award by the Faculty of Graduate Studies and Research for his excellent supervisory and scholarly contributions. More recently in 2020, Dr. Kwon was selected as the sole recipient of the 2020 Faculty of Engineering Early-Career Research Award in recognition of excellence in research and his influence at both national and international levels. Dr. Kwon's research has been supported by many organizations including NSERC Discovery and Alliance Grants, US State Department of Transportation, Alberta EcoTrust, Alberta Transportation, State of Iowa, State of Maine, Aurora, City of Edmonton, CIMA+, and many others.

Speaker: Lina Kattan, PhD
Professor, Department of Civil Engineering, University of Calgary

Dr. Lina Kattan is a Professor of Civil Engineering at the Schulich School of Engineering, University of Calgary. She is currently the Director of the NSERC CREATE program in Integrated Infrastructure for Sustainable Cities (IISC), which focuses on finding systematic solutions to understand the multifaceted needs of tomorrow's cities. Lina is a member of the College of Scholars, Artists and Scientists of the Royal Society of Canada. She also sits on the Royal Society of Canada Council. Lina is also the recipient of the 2014 Killam Emerging Research Leader Award – NSERC category. Her research program focuses on developing solutions to urban transportation problems with a special focus on Intelligent Transportation Systems, Emerging Vehicular Technologies, Connected and Autonomous Vehicle; Equity and Fairness in transportation, traffic flow theory and control; optimization of transportation

network; Public transport operation; Dynamic Demand Modelling; and Traveller's Behavioural response to Emerging Transportation Technologies.

Speaker: Behrouz Far, PhD
Professor, Department of Electrical and Software Engineering, University of Calgary

To be provided.

Automated Inspection System for Large Mining Vehicles

Speaker: Quamrul Huda, PhD
JR Shaw Applied Research Chair in Industrial Automation, NAIT

Dr. Quamrul Huda is the JR Shaw Applied Research Chair in Industrial Automation and leads applied research at NAIT's Centre for Sensors and System Integration. He has a Ph.D. in Electrical Engineering & Electronics and has 32 years of experience in academic and industrial research. He received the Commonwealth Scholarship award and the Japan Society for the Promotion of Science (JSPS) Fellowship award in the U.K. and Japan, respectively. Quamrul has research accomplishments in electronic materials, nano devices, semiconductor processing, microelectromechanical systems (MEMS), optoelectronics and laser spectroscopy. He worked for eight years in environmental monitoring in the Government of Alberta where he introduced advanced monitoring technologies. He was a recipient of the Government's Innovation Fund Award for leading the development of Internet of Things (IoT)-based low-footprint air monitoring systems. Quamrul led projects on remote sensing technologies, algorithm developments and data analytics for quantification of oil sands facilities' greenhouse gases and tailings pond emissions. He has over 100 publications in peer-reviewed journals and scientific conferences.

Theme 3: Sustainable Communities

Abstract

In the pursuit of smarter, more sustainable, and resilient cities, this session brings together an array of cutting-edge research that spans the intersection of urban development, technological innovation, and environmental stewardship. The talks presented during this session shed light on key challenges and opportunities in modern urbanization, showcasing inventive solutions that leverage technology to address pressing urban and environmental issues. The session encapsulates the multidisciplinary nature of contemporary urban challenges, from harnessing crowdsourced data for informed decision-making to evaluating the utility of drones in emergency scenarios, and from optimizing drone control systems to employing advanced geospatial analytics to mitigate fire hazards. With a keen eye on the evolving relationship between technology, urbanization, and the environment, these talks collectively provide a platform for fostering sustainable and resilient cities in an era of rapid change.

A Changing Climate in an Increasingly Autonomous Society

Keynote Speaker: Stephen Wong, PhD
Assistant Professor, Department of Civil and Environmental Engineering, University of Alberta

Dr. Stephen Wong is an Assistant Professor in the Department of Civil and Environmental Engineering at the University of Alberta and leads the Resilient and Sustainable Mobility and Evacuation (RESUME) Group. Dr. Wong's research focuses on the intersection of disasters/emergencies, decision-making, and transportation and works to create more resilient, environmentally friendly, and equitable transportation systems. He is actively involved in resilience and young professional activities at the Transportation Research Board and evacuation research at the International Association for Fire Safety Science. Dr. Wong received his Ph.D. in Civil and Environmental Engineering from the University of California, Berkeley in 2020.

Integrating GIS & LiDAR Data to Model Fire Hazard - An Urban Empirical Investigation of the City of Edmonton

Session Chair: Karim El-Basyouny, PhD
Professor, Department of Civil and Environmental Engineering, University of Alberta
Theme 3 Lead, ASI

Dr. Karim El-Basyouny *is a Professor of Transportation Engineering, the Associate Dean of Research Infrastructure & Innovation for the Faculty of Engineering, and the inaugural City of Edmonton Research Chair of Urban Traffic Safety. He joined the University of Alberta in July 2011 after completing his MSc and PhD in Transportation Engineering at the University of British Columbia. Dr. El-Basyouny is passionate about all things safety, dedicating his research and professional career to increasing safety and improving mobility for all road users. For the past decade, his research has been supported by all levels of the Canadian industry and government (municipal, regional, provincial, and federal), and has informed public policy and practice in jurisdictions across North America. As a prominent academic, he actively participates as a member of multiple (inter)national safety committees and serves on the editorial boards of key transportation journals. He is a co-founder and steering committee member for the Centre of Smart Transportation.*

Nonlinear Motion Control of a Drone Suspended Payload System

Speaker: Alan Lynch, PhD
Professor, Department of Electrical and Computer Engineering, University of Alberta

Dr. Alan F. Lynch *Alan F. Lynch obtained his B.A.Sc. at the University of Toronto in Engineering Science in 1991, M.A.Sc. in Electrical Engineering from the University of British Columbia in 1994, and Ph.D. in Electrical and Computer Engineering from the University of Toronto in 1999. He was a postdoctoral researcher at the Institut fuer Regelungs und Steuerungstheorie at TU-Dresden. Since 2001 he has been a faculty member at the Department of Electrical & Computer Engineering, University of Alberta and currently holds the rank of Professor. From 2009 to 2010 he was on sabbatical as a Humboldt Research Fellow at the Instituts fuer Systemtheorie und Regelungstechnik (IST), Universitaet Stuttgart. In 2017 he was a visiting professor at the Lehrstuhl fuer Systemtheorie und Regelungstechnik (LSR), Universitaet des Saarlandes. His interests include nonlinear control and its application to electrical and electromechanical and robotic systems. Recent research focus is on developing new capabilities in aerial robotics.*

Integrating drones into emergency fire response: Are drones actually useful?
Speaker: Jeff Boisvert, PhD
Professor, Department of Civil and Environmental Engineering, University of Alberta

Dr. Jeff Boisvert is a professor in Civil and Environmental Engineering at the University of Alberta, co-director of the Centre for Computational Geostatistics (CCG), and an active paid-on-call firefighter for Parkland County. His research interests concentrate on spatial numerical modeling, uncertainty management, decision-making, and artificial intelligence in mining, petroleum, and wildfire contexts.

Towards Smart, Sustainable, and Resilient Cities: Crowdsensing-based Monitoring of Built and Natural Environments (CoMBiNE)
Speaker: Mustafa Gül, PhD
Professor, Department of Civil and Environmental Engineering, University of Alberta

Dr. Mustafa Gül is a Professor in the Department of Civil and Environmental Engineering at the University of Alberta (UofA). Dr. Gül's current research focuses mainly on developing novel technologies for smart, sustainable, and resilient cities and societies by developing technologies for Crowdsensing-based Monitoring of Built and Natural Environments (CoMBiNE). In addition, Dr. Gül investigates various topics, such as efficient integration solar PV Systems into energy-efficient buildings and community-wide and city-wide solar PV applications. Dr. Gül has led more than 25+ large-scale research projects in the infrastructure and energy areas funded by various federal and provincial organizations and industry partners, and he has published 90+ journal papers and 100+ conference papers in the areas of infrastructure and energy. Dr. Mustafa Gül received his BSc and MSc in Civil Engineering from Boğaziçi University in Turkey in 2002 and 2004, respectively. He then pursued doctoral studies at the University of Central Florida (UCF), obtaining his PhD in Civil Engineering in 2009 on monitoring of civil infrastructure systems. While conducting his postdoctoral research, he also obtained an MSc degree in Electrical Engineering at the UCF in 2011 with a focus on image/signal processing and Artificial Intelligence (AI). Dr. Gül has been an Assistant, Associate and Full Professor at the University of Alberta since 2011.*

Theme 1: Methodologies and Tools

Control and Monitoring Tools for Complex and Networked Autonomous Systems

Abstract

Many industrial autonomous/semi-autonomous systems are controlled and monitored by networks and other computing devices, in which resource constraints are present due to various network and computing limitations. The topics addressed include event-triggered control, fault diagnosis, advanced alarm monitoring, cyber-security, multi-agent systems, intelligent sensing and monitoring, and their industrial applications.

Keynote Speaker: Masoud Abbaszadeh, PhD
Principal Research Engineer at GE Research

Dr. Masoud Abbaszadeh received B.Sc., M.Sc. and Ph.D. degrees from Amirkabir University of Technology, Tehran, Iran, Sharif University of Technology, Tehran, Iran, and University of Alberta, Edmonton, Alberta, Canada, in 2000, 2002, and 2008, respectively, all in Electrical and Computer Engineering. From 2001 to 2004, he was working as a Control and Automation Engineer. From 2008 to 2011, he was with Maplesoft, Waterloo, Ontario, Canada, as a Research Engineer. From 2011 to 2013, he was a Senior Research Engineer at United Technologies Research Center, East Hartford, CT, USA, working on advanced control systems, and complex systems modeling and simulation. Since 2013 he has been with GE Research Center, Niskayuna, NY, USA, where he is currently a Principal Research Engineer. His research interests include estimation and detection theory, robust and nonlinear control, and machine learning with applications in cyber-physical security and resilience and autonomous systems. Dr. Abbaszadeh has been the recipient of multiple awards including 2018 GE Dushman Award (highest award at GE R&D), 2020 GE Research Controls & Optimization Innovation Award and 2020 GE Research Technology Award. He has authored over 140 peer-reviewed papers, 9 book chapters, and holds 36 issued US patents with more than 40 additional US patents pending. He has also published two books, an edited volume on cyberphysical systems security and resilience (Springer 2022) and a research monograph on nonlinear optimal control with applications in robotics and energy systems (IET 2022). He is an Associate Editor of IEEE Transactions on Control Systems Technology, and a member of IEEE CSS Conference Editorial Board. He has also held an Adjunct Professor position at the Department of Electrical, Computer and Systems Engineering at Rensselaer Polytechnic Institute, NY, USA.

AUTONOMOUS SYSTEMS INITIATIVE

Automated Futures: Short-term Goals and Long-term Vision
SYMPOSIUM FULL PROGRAM
Thursday September 14th – Friday September 15th 2023

Session Chair: Tongwen Chen, PhD
Professor, Department of Electrical and Computer Engineering, University of Alberta
Theme 1 Lead, ASI

Dr. Tongwen Chen is currently a Professor and Tier 1 Canada Research Chair in Intelligent Monitoring and Control with the Department of Electrical and Computer Engineering at the University of Alberta. He received the BEng degree in Automation and Instrumentation from Tsinghua University, and the MASc and PhD degrees in Electrical Engineering from the University of Toronto. Recently he was the recipient of the 2020 Research Career Award from the Faculty of Engineering at the University of Alberta, and the 2021 Outstanding Engineer Award from IEEE Canada with the citation for outstanding contributions to the theory and applications of computer control systems, networked control, remote state estimation, and advanced alarm management and design. He is a Fellow of IEEE, IFAC (International Federation of Automatic Control), as well as the Canadian Academy of Engineering.

Speaker: Hari Mohan Rao
Ph.D. Student, Department of Electrical and Computer Engineering, University of Alberta

Harikrishna Rao is a Ph.D. student in Electrical and Computer Engineering at the University of Alberta, Edmonton, Canada. His research focuses on advanced data-driven solutions for the improvement of industrial alarm systems. He aims to develop reliable decision support systems that improve operations and reduce operator workload in the process industries. He received the B.Tech degree in Chemical Engineering from the University of Kerala, India, in 2012, where he was awarded the Proficiency Prize for the Best Outgoing Student. His undergraduate project was completed at the Indian Space Research Organization. Hari joined the graduate program at the University of Alberta with over seven years of industrial experience in process control and automation, alarm management, and fault detection. He holds two patent-approved invention disclosures for his work on the early detection of component failures using process data. His research works have been accepted to prestigious conferences, namely, the American Control Conference and the IFAC World Congress. Hari was recently awarded the IEEE Systems Council James O. Gray Graduate Scholarship. He is actively involved with IEEE and the International Society of Automation.

Speaker: Qing Zhao, PhD
Professor, Department of Electrical and Computer Engineering, University of Alberta

Dr. Qing Zhao received the B.Sc. degree in Control Engineering from Northeastern University (NEU), China, and the Ph.D. degree in Electrical Engineering from the Western University (formerly University of Western Ontario), London, Ontario, Canada. She is currently a Professor in the Department of Electrical and Computer Engineering at the University of Alberta, Edmonton, Alberta, Canada. Dr. Zhao received the A. V. Humboldt Research Fellowship in 2009. During her sabbatical leave from 2008 to 2009, she visited the Control Engineering Department, Université Libre de Bruxelles, Brussels, Belgium, and the University of Duisburg-Essen, Duisburg, Germany. During her sabbatical leave from 2019 to 2020, she visited the Laboratory of Synthetical Automation for Process Industries (SAPI), Northeastern University, China. Her research interests include fault diagnosis, fault-tolerant control, machine condition monitoring, and industrial data analytics

Speaker: Petr Musilek, PhD
Professor, Department of Electrical and Computer Engineering, University of Alberta

Dr. Petr Musilek received the Ing. degree (Hons.) in Electrical Engineering and the Ph.D. degree in Cybernetics from the Military Academy, Brno, Czech Republic, in 1991 and 1995, respectively. In 1995, he was appointed as the Head of the Computer Applications Group, Institute of Informatics, Military Medical Academy, Hradec Králové, Czech Republic. From 1997 to 1999, he was a NATO Science Fellow with the Intelligent Systems Research Laboratory, University of Saskatchewan, Canada. In 1999, he joined the Department of Electrical and Computer Engineering, University of Alberta, Canada, where he is currently a Full Professor. He is also an Associate Dean (Research Operations) with the Faculty of Engineering. His research interests include artificial intelligence and energy systems. He developed a number of innovative solutions in the areas of renewable energy systems, transportation electrification, smart grids, and environmental sensing, monitoring, and modeling.

Speaker: Marek Reformat, PhD
Professor, Department of Electrical and Computer Engineering, University of Alberta

Dr. Marek Reformat received his MSc degree (with honors) from Technical University of Poznan, Poland, and a PhD degree from University of Manitoba, Canada. His initial research projects involved different aspects related to computer networks, especially in the area of management and performance measurement. He co-authored several papers and reports regarding this topic. During his PhD studies, his research interests included distributed computing, with emphasis on fault-tolerant systems in such frameworks as Parallel Virtual Machine (PVM) and Message Passing Interface (MPI); optimization methods; and fuzzy sets and systems. His principle interest was related to evolutionary computing and its application to optimization problems. He proposed a new methodology for design of control systems, which relied on a combination of advanced system simulators and genetic computation. He applied this concept to the control design problem in the area of power systems. In 1997 he joined the Manitoba HVDC Research Centre, where he was a member of a simulation software development team. He was involved in improvement and development of an electromagnetic transients program for time-domain simulation, performed functional and structural testing of the software, and provided expert consulting services in the area of simulation and modeling internationally. Marek has been with the Department of Electrical and Computer Engineering at University of Alberta since July 2000. He is Professor and Associate Chair of Graduate Studies in the Department. In addition, he is an Associate Editor of a number of journals related to computational intelligence and software engineering. He has been a member of program committees of several conferences related to those areas. He is actively involved in North American Fuzzy Information Processing Society (NAFIPS). He is a member of the IEEE and ACM.

Autonomous Systems Initiative

Automated Futures: Short-term Goals and Long-term Vision
SYMPOSIUM FULL PROGRAM
Thursday September 14th – Friday September 15th 2023

Theme 5: Industrial Communities

Robotization of Industrial Repair and Manufacturing for Alberta: Promises and Pitfalls

Abstract

The theme supports industrial efforts to reduce the environmental impact of disaster events. It also utilizes event-triggered control tools for Autonomous Systems in an on-site industry setting. In order to accomplish these goals, we develop hybrid intelligent additive manufacturing of advanced, next-generation materials enabled by semi-autonomous vision-guided robot navigation and manipulation. These solutions are used for in situ in-field assessment and repair without on-site human intervention. By targeting extreme environments that are in corrosive, low and high temperatures, underground, mining, or remote locations, we enable immediate robotic response and leaks/disaster mitigation/avoidance at remote unmanned infrastructures. These infrastructures may include well-heads, pumping stations, pipelines, electric sub-stations, and lines.

Session Chair: André McDonald, PhD
Professor, Department of Mechanical Engineering at the University of Alberta
Theme 5 Lead, ASI

Dr. André McDonald is currently the Associate Vice-President (Strategic Research Initiatives and Performance) and a Professor in the Department of Mechanical Engineering at the University of Alberta. Dr. McDonald has nearly twenty years of experience in the fabrication, development, and performance assessment of thermal- and cold-sprayed coatings. His current research involves the development of multi-functional coatings that provide wear and erosion resistance, heating, and structural health monitoring to a variety of structures. Modelling work to predict and analyze the performance of coatings is a focal feature of his research program. He has received several awards including the Jules Stachiewicz Medal from the Canadian Society for Mechanical Engineering for Heat Transfer, Fellow of The Institute of Materials, Minerals and Mining, Fellow of ASM, Fellow of The Institution of Mechanical Engineers, the Mentorship Award from the Faculty of Engineering (University of Alberta), and the Association of Professional Engineers and Geoscientists of Alberta's Early Accomplishment Award. Dr. McDonald has trained nearly 100 students, fellows, and research associates in the areas of thermal spraying and heat transfer. Among many other leadership contributions, he was chair of the Natural Science and Engineering Research Council (NSERC) Scholarships and Fellowships Selection Committee – Civil and Mechanical Engineering and is currently the Editor-in-Chief of the Journal of Thermal Spray Technology, Chairman of the Canadian Cold Spray Alliance, and Past President of the ASM Thermal Spray Society Board. He currently leads the Experiential Learning in Innovation, Technology, and Entrepreneurship (ELITE) Program for Black Youth – an externally funded university-

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government-industry-community collaboration to support hands-on learning and work-integrated training of Black Youth in science, technology, engineering, and mathematics fields and in entrepreneurship.

Speaker: Ehsan Hashemi, PhD
Assistant Professor, Department of Mechanical Engineering, University of Alberta

Dr. Ehsan Hashemi is an Assistant Professor in the Department of Mechanical Engineering at the University of Alberta (since 2021) with an adjunct appointment in the Department of Mechanical and Mechatronics Engineering at the University of Waterloo. He earned his PhD in Mechanical and Mechatronics Engineering from the University of Waterloo, followed by a postdoctoral fellowship at the University of Waterloo and a research fellowship at Karlsruhe Institute of Technology (Germany). Dr. Hashemi was a Research Assistant Professor at the University of Waterloo and a Visiting Professor at the school of Electrical Engineering and Computer Science, KTH Royal Institute of Technology (Sweden). He has large- and small-scale projects with Canadian and International industry partners on autonomous navigation and connected robots with several technology transfers and patents. Dr. Hashemi is an IEEE senior member, and his expertise is in control theory, distributed estimation for manufacturing systems, cyber-physical systems, and human-robot physical interaction.

Speaker: James Hogan, PhD
Associate Professor, Department of Mechanical Engineering, University of Alberta

Dr. James Hogan is an Associate Professor in the Department of Mechanical Engineering at the University of Alberta. He is the Faculty of Engineering George Ford Chair in Materials Engineering and the Engineering Research Chair in Development and Advanced Manufacturing of Next-Generation Materials. Dr. Hogan's research program (website: https://sites.ualberta.ca/~jdhogan/) focuses on developing next-generation materials and structures that are resistant to impact and blast for defence and energy applications.

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Speaker: Wylie Stroberg, PhD
Assistant Professor, Department of Mechanical Engineering, University of Alberta

Dr. Wylie Stroberg is an Assistant Professor of Mechanical Engineering at the University of Alberta. He holds a B.S. in Mechanical Engineering from the University of California, Berkeley and a Ph.D. in Theoretical and Applied Mechanics from Northwestern University. Before joining the University of Alberta, he held a postdoctoral fellowship at the University of Michigan. Wylie's research interests lie in theoretical and computational modeling of materials at the nanoscale, and the development of methods for bridging atomic scale material structure with macroscopic properties. His research group uses atomic simulations combined with state-of-the-art machine learning methods to design novel application-specific materials.

Speaker: Rafiq Ahmad, PhD
Associate Professor, Department of Mechanical Engineering, University of Alberta

Dr. Rafiq Ahmad is an Associate Professor in the Department of Mechanical Engineering, University of Alberta, is a prominent figure in the field of smart engineering systems design and sustainable manufacturing. As the founder and director of the renowned "Smart & Sustainable Manufacturing Systems Laboratory (SMART Lab)," he spearheads cutting-edge research in systems design and engineering. With a wide-ranging interest in technology development, Dr. Ahmad's research encompasses various innovative areas such as digitization, smart manufacturing systems, hybrid manufacturing, additive manufacturing, robotics, and green technologies. His commitment to sustainability is evident through his focus on the three pillars of recycling, remanufacturing, and repair (3Rs) to promote eco-friendly practices in engineering and manufacturing.

Speaker: Martin Jagersand, PhD
Professor, Department of Computing Science, University of Alberta

Dr. Martin Jagersand's research interests are in Robotics, Computer Vision, and Graphics, especially vision guided motion control, vision-based human-robot interfaces, and learning robot object manipulation from visual and haptic demonstrations. He studied Engineering Physics at Chalmers Sweden (MSc 1991). He was awarded a Fulbright fellowship for graduate studies in the USA. He studied Computer Science at the Univ. of Rochester, NY (MSc 1994, PhD 1997). He held an NSF CISE postdoc fellowship at Yale University, and then was a research faculty in the Engineering Research Center for Surgical Systems and Technology at Johns Hopkins University. He is now a professor at the University of Alberta, Canada.

Speaker: Tonya Wolfe, PhD
Associate Vice President Applied Research, Red Deer Polytechnic
Adjunct Professor, Department of Chemical and Materials Engineering, University of Alberta

Dr. Tonya Wolfe is Red Deer Polytechnic's Associate Vice President, Applied Research, as well as an adjunct professor in the Department of Chemical and Materials Engineering at the University of Alberta. Tonya is responsible for providing strategic direction to the Centre for Innovation in Manufacturing - Technology Access Centre (CIM-TAC), Energy Innovation Centre and clusters of research in health, environment and child welfare at Red Deer Polytechnic. Tonya has a Professional Engineering designation (P.Eng), a Bachelor of Applied Science from Queen's University, and graduate degrees from the University of Alberta. Her MSc investigated the use of biomaterials for prosthetic applications and her PhD studied composite overlays deposited by plasma-transferred arc welding. She is a member of the Association of Professional Engineers and Geoscientists of Alberta (www.apega.ca), the Minerals, Metals & Materials Society (www.tms.org), and a founding member of the Alberta Additive Manufacturing Network (www.albertaamn.com).

Lab Demonstrations - Theme 1

ELITE Grid Laboratory, Faculty of Engineering

Presented by Petr Musilek, PhD

Location: Electrical & Computer Engineering Research Facility (ECERF) W7-020

Abstract

Power electronic technology plays a vital role in today's energy systems in terms of efficient energy conversion, integration of dispersed energy resources, and electric vehicles — among others. The ELITE Grid Research Lab aims at developing key technologies for Canada's next-generation electric grids with a high percentage of renewable energy generation, highly-efficient transmission and distribution grid structure, reliable and efficient power electronic interfaces to integrate renewable energy and high efficiency loads, and the highest cyber security and system reliability. The tour will concentrate on technology stack for a number of application areas, including integration of renewable energy systems and storage systems into existing grid infrastructure; modeling, control, and energy management of microgrids and other smart distribution systems; and smart grid-interfacing power converters.

Lab Demonstrations - Theme 2

ACTIVE Connected Vehicle Laboratory, Faculty of Engineering

Presented by Siqi Yan, PhD Student & Kaizhe Hou, PhD Student

Location: Natural Resources Engineering Facility (NREF) 5-043

Abstract

The lab demonstration at the ACTIVE Connected Vehicle Laboratory housed in the University of Alberta promises to be an enlightening experience for all attendees. It will showcase the outcomes of recent field data collection, present cutting-edge research tools, and highlight the South Campus testbed's impressive capabilities. The lab underscores the university's commitment to shaping the future of transportation and inspiring the minds that will drive innovation in this field. This demonstration not only celebrates past achievements but also sets the stage for future breakthroughs in the pursuit of safer, more efficient, and sustainable transportation systems.

Lab Demonstrations - Theme 4

Telerobotic and Biorobotic Systems Lab, Faculty of Engineering

Presented by *Mahdi Tavakoli, PhD*

Location: *Electrical & Computer Engineering Research Facility (ECERF) W7-070/079/081*

Abstract

The Telerobotic and Biorobotic Systems Group is directed by Prof. Mahdi Tavakoli in the Electrical and Computer Engineering Department of the University of Alberta. This group specializes in developing robots and robotic systems for various medical/biomedical applications including surgery, therapy, rehabilitation, telehealth, and telemedicine. Visitors will see lab demos in the following three laboratories: CREATE Lab focusing on Collaborative, REhabilitation, and AssisTivE Robotics research, HANDS Lab focusing on Haptics AND Surgery research, SIMULAT-OR Lab as a SIMULATed Operating Room featuring a da Vinci Surgical System. The presented robotic, augmented reality and artificial intelligence technologies will make medical interventions more efficient and less traumatic and will also reduce the burden on the healthcare system in Alberta, Canada, and the world.

Surgical Simulations Lab, Faculty of Medicine & Dentistry

Presented by *Bin Zheng, PhD*

Location: *Heritage Medical Research Center (HMRC) 162*

Abstract

The Surgical Simulation Research Lab (SSRL) stands as a pioneering research hub within the Department of Surgery at the University of Alberta, dedicated to elevating the clinical confidence of surgeons through cutting-edge simulations. Our facility boasts an array of simulation models, ranging from complete simulated operating rooms to task-specific training models. Here at SSRL, our team of scientists and surgeons collaboratively deliver comprehensive training courses tailored to surgeons-in training. In close partnership with the Department of Surgery's program directors, we commit to cultivate an environment wherein surgical trainees of varying proficiency levels can progressively enhance their surgical competencies. Leveraging advanced technologies such as motion tracking, eye-tracking systems, and immersive virtual and augmented reality tools, both graduate students and surgical residents are empowered to explore groundbreaking research in surgical education and simulation advancement. Acknowledging that simulation-based education is an exciting new frontier in the field of surgery, we warmly invite young scientists and aspiring surgeons from all over the world to join us in pushing the boundaries of this field together.

Ultrasound and IoT Lab, Faculty of Engineering

Presented by Edmond Lou, PhD

Location: Electrical & Computer Engineering Research Facility (ECERF) W5-050

Abstract

The Ultrasound and IoT Group is directed by Prof. Edmond Lou in the Electrical and Computer Engineering Department of the University of Alberta. This group specializes in developing 3D ultrasound with applying artificial intelligence (AI) for various medical applications such as imaging children with scoliosis and hip dislocation. The IoT systems are being used in therapy and rehabilitation. Visitors will see the live demos in the laboratory. The presented ultrasound system will make screening and monitoring for scoliosis and hip dislocation more efficient and safer because ultrasound has no ionizing radiation. It will significantly reduce the overall cost on the healthcare system in Alberta, Canada, and the world.

Lab Demonstrations - Theme 3

Applied Nonlinear Control Laboratory, Faculty of Engineering

Presented by Alan Lynch, PhD

Location: Electrical & Computer Engineering Research Facility (ECERF) Room 4-50

Abstract

The lab tour will demonstrate an indoor flying arena for multirotor drones. The performance of custom developed motion control will be shown. The largely open-source development environment will be described.

Lab Demonstrations - Theme 5

Advanced Heat Transfer and Surface Technologies (AHTST) Laboratory, Faculty of Engineering

Presented by André McDonald, PhD

Location: Mechanical Engineering (MEC) Room 1-27A

Abstract

André McDonald on Thermal Spray Manufacturing. Discover the science behind surface enhancement in our laboratory demo on thermal spray, featuring cold spray and flame spray. Learn how these techniques harness kinetic energy and employ intense heat to propel powdered materials onto surfaces, yielding durable coatings for various applications.

Centre for Design of Advanced Materials (CDAM), Faculty of Engineering

Presented by James Hogan, PhD

Location: Mechanical Engineering (MEC) Room 6-27

Abstract

James Hogan on High Rate Mechanical Testing and Modelling of Materials and Structures. This tour will showcase advanced high rate and impact testing facilities, and ultra-speed cameras and interferometers used in development of materials for defence and energy applications. Website here: https://sites.ualberta.ca/~jdhogan/

Workshop - Theme 1

Control and Monitoring Tools for Complex and Networked Autonomous Systems: Student Presentations

An Overview of the Alarm Management Toolbox Developed at the University of Alberta
Presenter: Harikrishna Monhan Rao, PhD Student

Data Analytics for System Monitoring and Anomaly Diagnosis
Presenter: Muhammad Haseeb Arshad, PhD Student

Resilient Strategies for Cybersecurity in Network Control Systems
Presenter: Amin Nazarzadeh, PhD Student

Predictive Situation Awareness and Anomaly Forecasting in Cyber-Physical Systems
Presenter: Masoud Abbaszadeh, Principal Research Engineer, GE Global Research

Event-Triggered Consensus Control of Multi-Agent Systems with Time-Varying Communication Delays
Presenter: Milad Abbasi, PhD Student

Domain Transfer and Adaptation Using Machine Learning Techniques
Presenter: Jiaobao Yao, MSc Student

Stealthy Attacks and Robust Detectors for Cyber-Physical Systems with Bounded Uncertainty
Presenter: Ziyi Guo, PhD Student

Digital Transformation in the Energy Sector
Presenter: Zahra Nazari, Postdoctoral Fellow

Vulnerability analysis of Energy Smart Contracts
Presenter: Bahareh Lashkari, PhD Student

CommonSense Knowledge Graphs
Presenter: Navid Rezaei, PhD Student

Streaming Clustering
Presenter: Omar Ibrahim, Postdoctoral Fellow

RGBD SLAM for Autonomous Driving
Presenter: Gayan Brahmanage, PhD Student

LoRaWAN Acoustic Sensing for Urban Noise Monitoring
Presenter: Emre Erdem, PhD Student

Workshop - Theme 2

Connected and Automated Vehicles: Student Presentations

Continuous Mapping of Winter Road Surface Conditions using AI-
Driven Data Analytics
Presenter: Mingjian Wu, PhD Student

Developing a Robust Road Surface Classifier with Transfer Learning for
Urban Winter Roads in the City of Edmonton
Presenter: Qian Xie, MSc Student

Real-time Data Acquisition from On-Board Sensors of Autonomous
Mining Vehicles for Remote Monitoring of Operational Readiness
Presenter: Lei Yang, PhD, Electronic Systems Specialist

Autonomous Docking of a Robot for Self-Charging Towards Sustainable
Operations
Presenter: Jonas Quilala, Student Research Assistant

A Morphology-Based Computer Vision Method for Hydraulic Oil Detection of Mining Truck
Presenter: Amin Moradkhani, PhD, Visiting Researcher

Weakly Supervised Semantic Segmentation for Road Construction Zones based on Segment Anything Model
Presenter: Siqi Yan, PhD Student

Vehicle as Sensor
Presenter: Gary Zhang, MSc Student

Traffic State Estimation from Connected Vehicle Trajectories with Anisotropic Gaussian Processes
Presenter: Fan Wu, PhD Student

Measure the Latency in Connected Vehicle Side-Link Communication
Presenter: Kaizhe Hou, PhD Student

Achieving Energy-Efficient and Travel Time-Optimized Trajectory and Signal Control for Future CAEVs
Presenter: Huiyu Chen, PhD Student

Stability and Spacing Analysis of Vehicular Platoons under Bidirectional Communication Topologies
Presenter: Amir Zakerimanesh, PhD Student

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Automated Futures: Short-term Goals and Long-term Vision
SYMPOSIUM FULL PROGRAM
Thursday September 14th – Friday September 15th 2023

Workshop - Theme 3
Keynote Speech & Theme 3 Expert Panel Discussion

Advance Robotic Systems for Urban Search and Rescue Operations Inside Highly Confined Spaces

Keynote Speaker: Alex Ramirez-Serrano, PhD
Professor, Director of the Robotarium Robotics Research Lab, University of Calgary.

Dr. A. Ramirez-Serrano is a full-time professor at the University of Calgary, where he has served on diverse roles including director of the Manufacturing program and director of the graduate program within the Department of Mechanical and Manufacturing Engineering. He is the founder and director of the Robotarium research laboratory where he performs R&D activities in aerial and multi-legged robotic systems. Specifically, Dr. Ramirez-Serrano performs developmental work in highly maneuverable drones and multi-legged systems for deployment in highly confined GPS-denied spaces such as those encountered inside collapsed buildings, beneath tree cover, mines, and inside hazardous industrial environments. This work includes swarm robotics of highly maneuverable aerial systems capable to perform maneuvers that no aerial (manned or unmanned) can execute such as pitch hover maneuvers (at any desired angle including inverted flight) enabling the aircraft to land and take off from sloped surfaces (e.g., mountainous terrains), vessels moving of rough waters, and position its sensors systems strategically at any position and orientation using a myriad of tools including mathematical formulations and artificial intelligence techniques.

Summary

As the world grapples with the increasing frequency and severity of natural disasters, there is a growing need to develop autonomous systems to bolster infrastructure resilience and improve disaster response strategies. This expert panel discussion delves into the critical role of new technologies in mitigating the impact of disasters and advancing our capabilities in disaster management. Focusing on Canada's experience with climate-induced disasters, the panel will explore the necessity for more robust avenues to enhance disaster preparedness, response, and recovery endeavors.

Moderator: Karim El-Basyouny, PhD

Panel members: Stephen Wong, PhD; Alan Lynch, PhD; Jeff Boisvert, PhD; and Mustafa Gül, PhD

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Workshop - Theme 4

Advancing Healthcare through Autonomous Systems: Student Presentations

Summary

Autonomous systems integrated with healthcare can enhance surgical, therapeutic, diagnostic, and rehabilitative procedures. This integration increases the reliability, accuracy, and safety of patient treatments. ASI-funded students have investigated various applications of biomedical autonomous systems like robotics and wearables, addressing challenges and proposing solutions that combine human skills with machine decision-making capabilities. This workshop will showcase their work.

Between-person Haptic Feedback on Learning of Different Types of Movement
Presenter: *Yao Zhang, PhD Student*

Precise Human Movement Control in the Moving Platform
Presenter: *Yuzhang Li, PhD Student*

Instrumented Surgical Skill Assessment toward Surgical Training
Presenter: *Farzad Aghazadeh, PhD Student*

Training Surgeons by Regulating their Cognitive Loads
Presenter: *Yun Wu, PhD Student*

Model Agnostic Personalization of Attention-based Intention Prediction Model for Myoelectric Control of an Upper-Limb Exoskeleton
Presenter: *Paniz Sedighi, MSc Student*

Surgical Robot Autonomy using Reinforcement Learning and Learning from Demonstrations
Presenter: *Yafei Ou, PhD Student*

Point-Based 3D Virtual Fixture Generating Method for Image-Guided and Robot-Assisted Surgery in Orthopedics
Presenter: *Teng Li, PhD Student*

Robotic Surgeon-Support System for Ultrasound Image Scanning, Guidance and Visualization to Enhance Situational Awareness in Percutaneous Breast Therapies
*Presenter: **Kirill Makhachev, MSc Student***

Applying Machine Learning to Automatically Extract Parameters from Images of Children with Scoliosis
*Presenter: **Jason Wong, PhD Candidate***

Applying Machine Learning to Fast Reconstruct 3D Spinal Images using Biplanar Radiographs
*Presenter: **Weiying Chen, PhD Student***

An Ultrasound Imaging Approach to Assess Hip Displacement in Children with Cerebral Palsy
*Presenter: **Thanh-Tu Pham, PhD Student***

Automated Cognitive Testing for Seniors Using an End-to-End Speech Interface
*Presenter: **Lukas Grasse, PhD Student***

Resistive Bend Sensor Characterization for Finger Motion: Precursor to Instrumented Gloves
*Presenter: **Zeinab Estaji, MSc Student***

Face-Touching Detection Leveraging Wrist-Mounted Inertial Measurement Unit Utilizing Dynamic Time Warping and K-Nearest Neighbours: Controlled and Natural Environment Validation
*Presenter: **Ramin Fathian, PhD Student***

Workshop - Theme 5

Autonomous Systems for Industrial Communities: Robotization of Industrial Repair and Manufacturing for Alberta

Industry 4.0: Smart Robust Scheduling in Manufacturing Using AI

Keynote Speaker: Soumya Ranjan Sahoo, PhD
Machine Learning Researcher, NTWIST

Dr. Soumya Ranjan Sahoo is presently serving as a machine learning researcher at NTWIST. He earned his doctorate in process control from the University of Alberta's Department of Chemical Engineering. With a seven-year background in machine learning and process control, his present research focus lies in dynamic optimization, reinforcement learning, image processing, and model predictive control. His academic excellence has been recognized with the esteemed Alberta Innovates Graduate Student Scholarship award.

Summary

The theme supports industrial efforts to reduce the environmental impact of disaster events. It also utilizes event-triggered control tools for Autonomous Systems in an on-site industry setting. In order to accomplish these goals, we develop hybrid intelligent additive manufacturing of advanced, next-generation materials enabled by semi-autonomous vision-guided robot navigation and manipulation. These solutions are used for in situ in-field assessment and repair without on-site human intervention. By targeting extreme environments that are in corrosive, low and high temperatures, underground, mining, or remote locations, we enable immediate robotic response and leaks/disaster mitigation/avoidance at remote unmanned infrastructures. These infrastructures may include well-heads, pumping stations, pipelines, electric sub-stations, and lines.

Transfer to Electrical and Computer Engineering Research Facility (ECERF) Room 4-40

Field Robotic Arm and Hand Manipulation for Emergency Response and Repair
Presenter: **Martin Jagersand, PhD**

Abstract

Emergency response to remote infrastructure such as wellheads, pumping stations, electric transmission infrastructure such as substations is a challenge. Bringing crews by helicopter takes time. Leaks of gas or fluids can be dangerous. We present a compact and capable mobile manipulator that can assess damage, shut down units by closing valves and switches designed for humans, and perform basic repair tasks like changing modules and replacing pipes. Our solution is completely unmanned. Robot cameras provide inspection and situational awareness thousands of kilometers away. Through a remote interface and full force/haptic control remote operators can probe the scene and perform remote repair from a safe operating room.

Transfer to SMART Lab, Mechanical Engineering (MEC) Room 1-38

Autonomous Robot-Assisted Repair Platform Demo
Presenter: **Rafiq Ahmad, PhD**

Abstract

Given finite natural resources and rising demand, there's an urgent need for systems enhancing product reusability and lifespan, particularly high-demand items. Current manual repair of cylindrical mechanical components is labor-intensive and time-consuming. This demo showcases a semi-autonomous, robot-assisted approach for repairing and restoring metal components, aided by intelligent software.

Transfer to NODE Lab, National Institute for Nanotechnology (NINT) Room 5-002

AI-enabled Manufacturing/Fabrication
Presenter: **Ehsan Hashemi, PhD**

Abstract

The Networked Optimization, Diagnosis, and Estimation (NODE) Lab at the University of Alberta is developing the algorithms and technologies for augmented perception and remote sensing for autonomous navigation, and autonomous mobile manufacturing systems in remote and GPS-denied areas. The demonstration at the NODE lab will focus on on-board perception and visual state estimation for mobile robots used as the platform for material deposition (e.g., thermal spray).