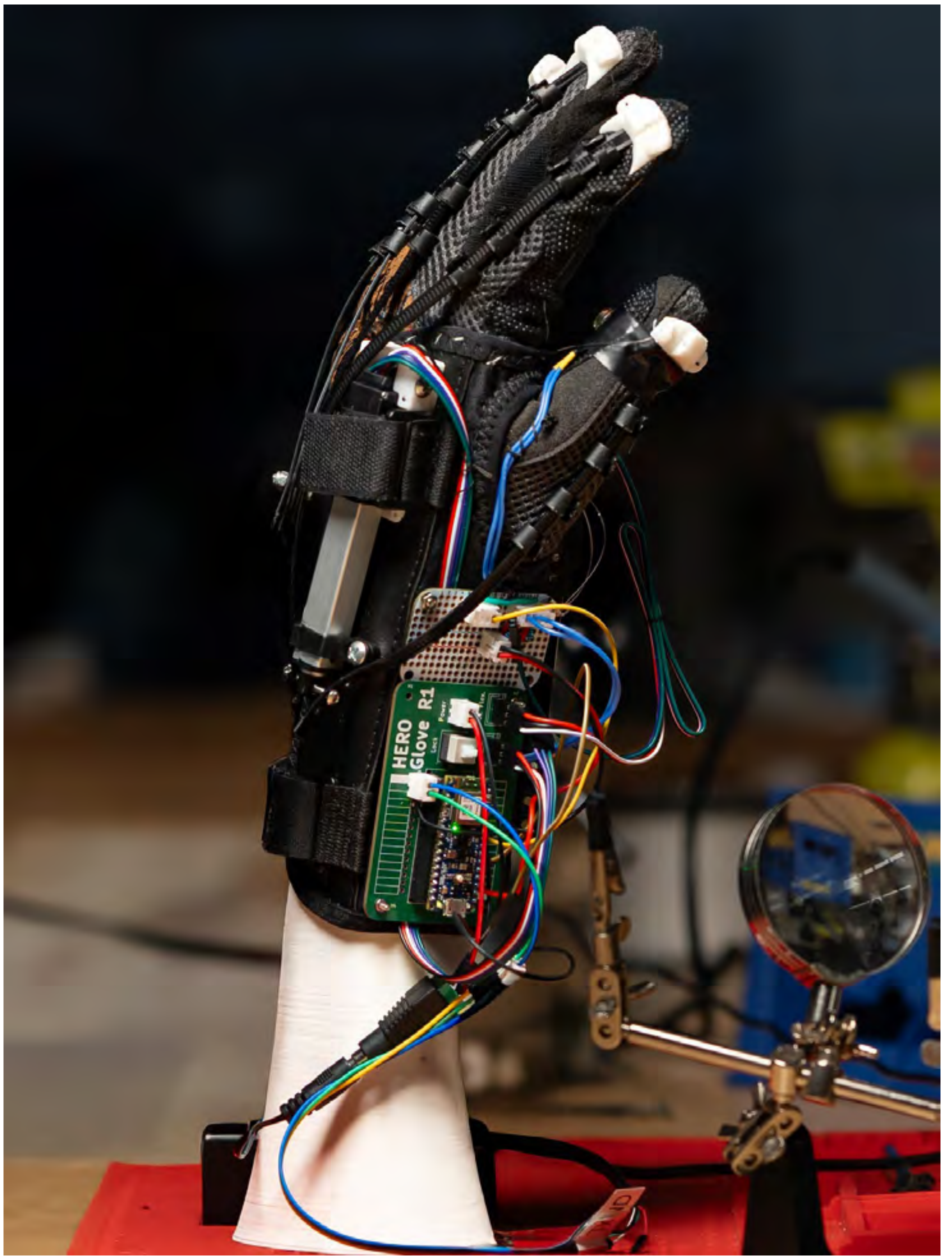
THE CANADIAN SOCIETY FOR MECHANICAL ENGINEERING
LA SOCIÉTÉ CANADIENNE DE GÉNIE MÉCANIQUE
SPRING/PRINTEMPS 2026

BULLETIN



SPECIAL ISSUE ON

How Machines and Robots are Transforming and Shaping the Future World

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COVER PHOTO: ONTARIO TECH UNIVERSITY BIOROBOTICS LAB: THE HERO GLOVE GRIP FORCE CONTROL SYSTEM (PHOTO BY Y KYLE LAVIOLETTE).

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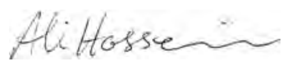

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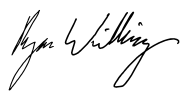

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Chair, CSME Machines and Mechanisms TC
Professor and Associate Dean Academic
Department of Mechanical Engineering
University of New Brunswick

ONCE AGAIN, SPRING IS UPON US, A BEAUTIFUL season where nature awakens from its hibernation. As flowers begin to flourish and trees start to bloom, our surroundings are revitalized with colour, reminding us of the natural beauty that embraces us. In this spirit of renewal, we are pleased to introduce the Spring 2026 issue of the Canadian Society for Mechanical Engineering (CSME) *Bulletin*.

Just as nature evolves, so too does our technological landscape. In this context, the rapid advancement of science and the wide adoption of AI have ensured that intelligent robotics and machinery are no longer futuristic concepts, but the foundational blueprint of our modern era. From autonomous systems to high-precision machines performing life-saving surgeries, these technologies are fundamentally redefining the boundaries of human capability. By automating both repetitive and non-repetitive tasks, machines are shifting the human role toward creative problem-solving and strategic oversight. As we stand on the brink of this paradigm shift, the integration of robotics into our daily lives promises to drive unprecedented efficiency and reshape global economies. To recognize this evolution, this issue highlights the latest contributions made by Canadian researchers and engineers under the theme: 'How Machines and Robots are Transforming and Shaping the Future World?'

This issue is co-edited alongside guest editors Prof. **Yang Shi**, Chair of the Mechatronics, Robotics, and Control Technical Committee (TC), and Prof. **Juan Antonio Carretero**, Chair of the Machines and Mechanisms TC. Our objective is to keep CSME members informed of the most recent technological breakthroughs in robotics and machinery, both within Canada and across the globe. Inside this issue, you will find a wealth of insights across four feature articles and five faculty spotlights. We are proud to highlight research from teams led by Professor **Pan** (Dalhousie University), Professor **Nokleby** (Ontario Tech University), Professor **Lu** (University of New Brunswick), and Professor **Wang** (University of Manitoba).

In their feature article, Professor Pan and the team at the Advanced Control and Mechatronics Laboratory at Dalhousie University explore the critical role of intelligent robotic systems in navigating the complexities of Industry 5.0. Their work spans diverse applications, from healthcare to search and rescue, addressing the significant challenges of autonomous navigation, learning, and adaptive control within unknown and dynamic environments, particularly when diverse robotic platforms must collaborate. By detailing innovative control approaches developed at their Lab, the article demonstrates how integrating learning-based methods and vision-based 'learning-from-demonstration' can achieve safer, more efficient human-robot interaction. Ultimately, the work provides experimental ev-

. . . . *continued page 6*

President's Message

Message du Président

Dear CSME members,

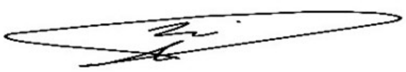
As I write this message, I do so with both pride and gratitude, knowing that this will be my final letter to you as President of the Canadian Society for Mechanical Engineering (CSME). It has been a true privilege to serve this community. I am pleased to share that Dr. Xianguo Li of the University of Waterloo will assume the role of President, and I am confident that the Society will continue to grow and thrive under his leadership.

It is also my great pleasure to recognize and congratulate the recipients of the 2026 CSME Awards, whose achievements reflect the strength of our community. This year's honourees include Dr. Michael Benoit (University of Waterloo), recipient of the G.H. Duggan Medal; Dr. Yu Zou (University of Toronto), recipient of the I.W. Smith Award; and our newly elected CSME Fellows: Dr. Mohsen Akbari (University of Victoria), Dr. Sunny (Ri) Li (University of British Columbia, Kelowna), Dr. Kevin Pope (Memorial University of Newfoundland), Dr. Dan Romanyk (University of Alberta), and Dr. Norman Wereley (University of Maryland). We also congratulate the recipients of the technical medals: Dr. Jerzy Maciej Floryan (Western University), Dr. Patrick Lee (University of Toronto), and Dr. Zengtao Chen (University of Alberta). Going forward, it should be noted that the CSME Board has instituted a new rule whereby the most recent CSME award winners cannot be considered/nominated for awards in the subsequent year.

Looking ahead, preparations for the 2026 CSME Congress in Vancouver are well underway. Hosted by the University of British Columbia under the leadership of Dr. Dana Grecov, the Congress promises to be an excellent gathering of our community. I hope to see many of you there.

As I conclude my term, I would like to sincerely thank all of you, our members, volunteers, and partners, for your continued support and trust. The strength of the CSME truly lies in its people, and it has been an honour to serve this community.

The CSME thrives because of you, serves you, and truly is you.



ALI AHMADI, PhD, P.Eng., MCSME
CSME *President*
Associate Professor, Department of Mechanical Engineering
École de Technologie Supérieure

Chers membres de la SCGM,

Chers membres de la SCGM,

En rédigeant ce message, c'est avec fierté et reconnaissance que je m'adresse à vous une dernière fois à titre de président de la Société canadienne de génie mécanique. Ce fut un véritable privilège de servir cette communauté. J'ai le plaisir d'annoncer que Xianguo Li, Ph.D., de l'Université de Waterloo assumera la présidence, et je suis convaincu que la Société continuera de croître et de prospérer sous sa direction.

J'ai également le grand plaisir de féliciter les lauréats des prix 2026 de la SCGM, dont les réalisations témoignent de la force de notre communauté. Parmi eux figurent Michael Benoit, PhD, (Université de Waterloo), récipiendaire de la médaille G.H. Duggan; Yu Zou, PhD, (Université de Toronto), récipiendaire du prix I.W. Smith; ainsi que les nouveaux Fellows de la SCGM : Mohsen Akbari, PhD, (Université de Victoria), Sunny (Ri) Li, PhD, (Université de la Colombie-Britannique, campus de Kelowna), Kevin Pope, PhD, (Memorial University of Newfoundland), Dan Romanyk, PhD, (Université de l'Alberta) et Norman Wereley, PhD, (University of Maryland). Nous félicitons également les lauréats des médailles techniques : Jerzy Maciej Floryan, PhD, (Western University), Patrick Lee, PhD, (Université de Toronto) et Zengtao Chen, PhD, (Université de l'Alberta). À l'avenir, il convient de noter que le conseil d'administration de la SCGM a instauré une nouvelle règle selon laquelle les lauréats des prix SCGM les plus récents ne pourront pas être pris en considération/nominés pour les prix de l'année suivante.

En regardant vers l'avenir, les préparatifs du Congrès 2026 de la SCGM à Vancouver progressent bien. Accueilli par l'Université de la Colombie-Britannique sous la direction de Dana Grecov, PhD, cet événement s'annonce comme un moment fort pour notre communauté. J'espère avoir le plaisir de vous y retrouver.

Alors que je termine mon mandat, je tiens à vous remercier sincèrement, membres, bénévoles et partenaires, pour votre soutien et votre confiance. La force de la SCGM repose sur ses membres, et ce fut un honneur de servir cette communauté.

La SCGM vit grâce à vous, vous sert et vous représente véritablement.

ALI AHMADI, PhD, P.Eng., MCSME
Président de la SCGM
Professeur agrégé, Département de génie mécanique, École de technologie supérieure

PHOTO: ÉCOLE DE TECHNOLOGIE SUPÉRIEURE

Advancing the Frontiers of Mobility: Ontario Tech's Engineering Legacy

WELCOME TO THE DEPARTMENT OF AUTOMOTIVE and Mechatronics Engineering at Ontario Tech University. As Chair, I am proud of our commitment to preparing students not just for workforce entry, but to lead and drive technological advancement. Since its inception in 2003, our mission is to equip future engineers with the skills to transform the industry.

Excellence Through Multidisciplinary Learning

Our department leads innovation in intelligent machines. We offer CEAB-accredited Bachelor's and Master's degrees in Automotive and Mechatronics Engineering, along with an optional five-year Engineering and Management (Honours) program. The Mechatronics program combines mechanical, electrical, software, and controls engineering, preparing students for careers in robotics, aerospace, and autonomous systems. We also offer Canada's only accredited Automotive Engineering program focused on designing and manufacturing next-generation vehicles.

State-of-the-Art Research and Hands-On Innovation

Advancing robotics relies on practical, hands-on innovation. Our students and faculty design, build, and test advanced mechatronic and automotive systems in facilities including the Robotics and Automation Lab, the Mechatronics and Microprocessor Lab, and the Jeffrey S. Boyce Innovation and Design Studio.

FIG. 1: STUDENTS COLLABORATING ON THE ASSEMBLY AND TUNING OF A FORMULA SAE RACE CAR IN THE UNIVERSITY'S AUTOMOTIVE WORKSHOP.

Our department is home to 14 dedicated faculty members, with 6 focused on Automotive Engineering and 8 specializing in Mechatronics. Our researchers use the ACE Climatic and Aerodynamic Wind Tunnel, a leading testing facility for the Canadian aerospace and automotive industries. Faculty bring extensive industrial R&D experience directly into the lab.

Industry Integration and the Future Workforce

A core pillar of our department is aligning academic learning with the evolving needs of industry. Our Engineering Co-op program partners with over 300 companies, enabling students to complete up to 16 months of work experience in robotics, automotive manufacturing, and industrial automation.

As robots, autonomous vehicles, and intelligent machines reshape our world, the Department of Automotive and Mechatronics Engineering at Ontario Tech University remains committed to advancing technological research and developing the engineers who will shape the future.

FIG. 2: RESEARCHERS IN THE ACE CONTROL ROOM MONITORING REAL-TIME AERODYNAMIC DATA DURING A FULL-SCALE VEHICLE CLIMATIC TEST.

FIG. 3: A STUDENT TECHNICIAN CALIBRATING A FLEET OF MOBILE RESEARCH ROBOTS IN THE MECHATRONICS AND MICROPROCESSOR LAB.

HAOXIANG LANG, PhD, P.Eng.

Dr. Lang is an Associate Professor, currently serving as the Department Chair of Automotive and Mechatronics Engineering. He is also the director of the GRASP (General Robotics and Autonomous Systems and Processes) Laboratory at Ontario Tech University in Oshawa, ON. His research and development areas are mechatronics, robotics, advanced controls, and artificial intelligence. In addition to his research contributions, Dr. Lang is actively involved in academic leadership, curriculum development, and industry collaboration.

idence of robots that can dynamically optimize task sequences and adapt to human partners, offering a visionary outlook on the future of collaborative robotics.

Professor Nokleby highlights their recent work on advanced applications for quadruped robots, focusing on complex tasks such as navigating intricate environments for inspection and performing hazardous duties like firefighting. The article details the collaborative efforts between the Mechatronic and Robotic Systems Laboratory (MARS Lab) at Ontario Tech University and Ontario Power Generation (OPG) to push the operational boundaries of these legged systems, specifically the Boston Dynamics Spot. Moving beyond basic inspection, the authors present sophisticated maneuvers for large-scale industrial settings, including autonomous navigation through multi-story facilities via elevators and proxy-access doors. By integrating custom vision-based algorithms and thermal sensing, the research demonstrates how quadruped robots can autonomously detect, locate, and extinguish fires, effectively serving as rapid first responders for critical infrastructure.

In another interesting contribution, Professor Lu and the team at the Intelligent Mobility and Robotics Lab (IMRL) at the University of New Brunswick examine the transformative potential of intelligent transportation systems in reshaping modern freight logistics and mobility. The author aim to present a practical and scalable solution to the technical and social challenges of fully driverless operations through a human-in-the-loop (HiL) platooning architecture. Developed at IMRL, this framework utilizes a human-driven lead vehicle followed by autonomous trucks that employ advanced sensory systems and intelligent control to maintain safe distances and precise trajectories. By highlighting three core research areas, the article demonstrates how this coordinated approach provides essential layered redundancy and adaptive judgment, offering an evolutionary pathway from assisted platooning to independent autonomous freight deployment on public roads.

Professor Wang of the University of Manitoba highlights research exploring the transition of AI-enhanced robotics from structured industrial environments to complex, human-centered settings, such as agriculture and public roadways. The author present a framework for 'trustworthy autonomy,' emphasizing that the next generation of robots must be defined by their reliability and safety rather than just raw capability. By addressing the challenges of unpredictable terrain, environmental variables, and close-proximity human interaction, the research demonstrates how robotic systems can remain safe and predictable even when confidence is low or models are imperfect. Ultimately, this work underscores the necessity of developing robots that can navigate the inherent uncertainties of the real world while maintaining the high level of trust required for assistive and shared spaces.

In keeping with our tradition of welcoming new faculty to academia, this issue features spotlights on five exceptionally talented early-career researchers working at the forefront of robotics and machinery. This selection includes Dr. **Yurkewich** (Ontario Tech University), who details his development of the Hand Extension Robot Orthosis (HERO) Glove; Dr. **Mu** (University of Prince Edward Island), whose work focuses on foundational algorithms and certifiable control frameworks; and Dr. **Xu** (University of Guelph), who specializes in enhancing the reliability of autonomous systems. We also highlight Dr. **Wong** (Concordia University), whose research centers on achieving both physical and emotional safety in human-robot interaction, and Dr. **Taghavifar** (Concordia University), who shares his vision for cognitive autonomy in robots and intelligent vehicles.

This issue of the CSME *Bulletin* also features a Chair's Corner articles contributed by Professor **Lang** (Ontario Tech University), in which they introduce the Automotive and Mechatronics Engineering programs within their departments.

To keep our members fully informed, this issue also includes updates on the upcoming 2026 CSME Congress, society news, the Student Affairs section, and a list of both recent awardees and new members. Looking ahead, the Fall 2026 issue of the *Bulletin* will focus on 'Designing Sustainable and Resilient Built Environments.' This upcoming edition will be co-edited by Professor **Hamid Akbarzadeh**, Chair of the Engineering Analysis and Design TC, and Professor **Lexuan Zhong**, Chair of the Environmental Engineering TC. As always, we welcome your input; please reach out to the CSME editors if you would like to suggest a theme for a future issue.

We hope you find the insights shared in this issue of the CSME *Bulletin* both informative and inspiring.

Sincerely,
Professors Hosseini, Willing,
Shi, and Carretero

CSME History Committee

The history committee has been continuing with CSME's commitment to the EIC History and Archives Committee oral histories project, in which senior engineers from across Canada are interviewed (from all subdisciplines). The result is a growing collection archived at the Ontario Tech University library.
digitalcollections.library.ontariotechu.ca/engineering-institute-of-canada/engineers-oral-history-interviews/full-interviews

The other activity has been to archive departmental histories, which are posted here for those departments that responded:
www.csme-scgm.ca/content/history-committee

These vary in length and content, but the longer ones include interesting social history content as well, that maps out early developments in our profession at Canada's universities. If your department is not listed, maybe it should be!? Our ever-changing record keeping means that much is lost as our colleagues retire. We have a responsibility to do better and having a history update every 15-20 years is a good way to ensure it happens on a frequency higher than the average professorial career. Ever wondered why your department is there, who started it and how engineering education has evolved from those earlier times? This might be a great service project for a junior faculty member and an opportunity to engage with those of longer memory! Alternatively, professionally researched histories are also feasible and affordable – please contact us if advice is needed. — *Dr. Ian Frigaard, MCSME*

INTELLIGENT ADAPTIVE ROBOTS INTERACTING WITH THEIR ENVIRONMENT AND HUMANS

INTELLIGENT ROBOTIC SYSTEMS ARE WIDELY applied in areas such as inspection, search and rescue, co-manipulation in Industry 5.0, healthcare, agriculture, surveillance, and logistics. Robots with effective intelligent adaptive control are more efficient and have more operational capability in achieving the tasks. In recent years, the planning and control of autonomous systems in unknown environments and effective adaptive interaction in robot-robot and human-robot cooperation have been active areas of research. The use of robotic manipulators for automated manufacturing tasks is well established, with 4.66 million industrial robots operating as of 2024.[1] Industry 5.0 has fueled the development of more flexible multi-purpose robotic solutions that can function in unpredictable environments.

The adaptive cooperation becomes more challenging when the robots vary in hardware, size, and functionality in dynamic environments. Collaborative robots (COBOTs) can efficiently assist humans by interacting with both the user and the environment during complex tasks. They take advantage of the flexibility and cognitive decision-making skills of humans, along with the speed, accuracy, strength, and reliability of robots. Integrating learning-based methods provides more robust, efficient, and generalized operations of these systems. The growing demands of autonomous applications require increased robotic intelligence and adaptability. *Fig. 1* shows the development of human-robot interactions from *(a)* isolated industrial robots to *(d)* active collaboration on shared tasks. As robots increasingly operate within unstructured environments alongside humans, real-time safe and flexible behaviour is critical.

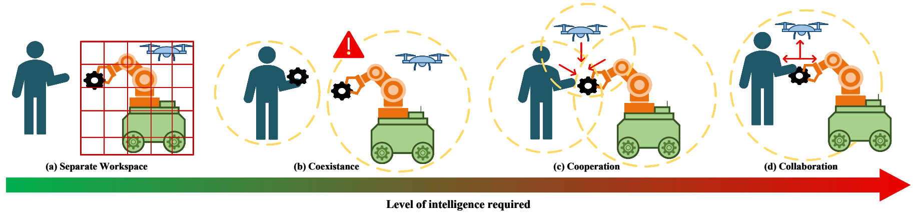


FIG. 1: TYPES OF INTERACTION AND COLLABORATION BETWEEN HUMANS AND INDUSTRIAL ROBOTS.

The main challenge of the navigation, control and learning of intelligent robotics is managing environmental and human uncertainty with limited data. This requires the system to be adaptable through intelligent planning, learning and optimization. Several recent innovative intelligent adaptive control approaches and their experimental demonstrations have been carried out at the Advanced Control and Mechatronics Laboratory (ACM Lab) at Dalhousie University (acm.me.dal.ca). Robots can dynamically adapt to the environment through intelligent planning and adaptive control and optimize their task sequences to minimize energy consumption. Furthermore vision-based learning-from-demonstration and variable impedance control provide the system with human-like skills and compliance for safe human-robot physical interaction.

Robust Adaptive Co-Manipulation

Co-manipulation occurs when two or more agents physically interact to manipulate a common object. This approach is used for large or flexible objects and leverages complementary strengths, such as human dexterity and robot payload capacity. A primary control challenge is guaranteeing safety for both the human and the object while maintaining precise trajectory tracking. When multiple agents grasp an object as in *Fig. 2*, a closed kinematic chain is formed, generating internal forces that stress the object without contributing to its general motion. Regulating these forces is important to prevent damage or to deliberately deform non-rigid objects. Our recent work integrates adaptive sliding-mode control (ASMC) and variable impedance control (VIC) for co-manipulation tasks. This combination ensures stable, robust tracking against unmodeled friction and system uncertainties. Furthermore, it dynamically updates the controller performance trade-off between the position accuracy and the force regulation according to varying task requirements[2] (video: www.youtube.com/watch?v=4hL24kCuOrE).

. . . continued next page

YA-JUN PAN, PhD, P. Eng., FCSME, FCAE, FEIC, FASME

Dr. Pan is a Professor in the Dept. of Mechanical Engineering at Dalhousie University. She received the PhD degree in Electrical and Computer Engineering from the National University of Singapore in 2003. Her research interests are robust nonlinear control, cyber physical systems, intelligent systems, haptics, assistive robotics, and collaborative robots. She is a Fellow of the Canadian Society of Mechanical Engineering (CSME), Canadian Academy of Engineering (CAE), Engineering Institute of Canada (EIC), and the American Society of Mechanical Engineering (ASME). She has has received the CSME Mechatronics Medal Award, Alexander von Humboldt Research Fellowship from Germany, and Research Excellence Award at Dalhousie University.

LUCAS WAN, PhD, MCSME

Wan received the BE, MASc, and PhD degrees in mechanical engineering from Dalhousie University in 2019, 2021, and 2026. His research interests include robust control, multi-agent systems and collaborative robotics. He is currently a researcher in the Advanced Control and Mechatronics Lab at Dalhousie University.

NUO CHEN

Chen received the BE degree in robotics engineering from Southern University of Science and Technology (Shenzhen, China) in 2022 and his MASc degree in mechanical engineering from Dalhousie University in 2024. He is currently working toward his PhD in MechE at Dal. His research interests include human-robot interaction and robotics control. He is a student member of IEEE and IEEE Industrial Electronics Society.

QIGUANG CHEN

Chen received the BE and MASc degrees in mechanical engineering from Dalhousie University in 2021 and 2023, respectively. He is currently working toward his PhD in MechE at Dal. His research interests include multiagent systems, collaborative robotics, and task planning.

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Human-Robot Interaction Through Learning

Human–robot interaction (HRI) remains a challenging problem due to the need for robots to operate safely in uncertain environments while interacting with humans. Enabling robots to learn skills from human demonstrations and maintain robust force interaction with the environment is difficult because of sensor noises and variations in tasks. To address the challenge of skill acquisition, we proposed a vision-based learning-from-demonstration framework that enables a robotic manipulator to learn from multiple human demonstrations.[3] As in *Fig. 3*, human hand motions are captured using a camera and processed through dynamic time warping and Gaussian mixture modeling to generate a representative trajectory. A variance-aware dynamic movement primitives (DMPs) framework is further developed to incorporate the variance from demonstrations, allowing the robot to adapt its motion planning based on the confidence level of human demonstrations. When with unknown payloads, a meta-learning-inspired training framework is proposed to model disturbances using a neural network, while an adaptive controller adjusts task-dependent parameters online[4] (video: www.youtube.com/watch?v=nTPQDUEkxKA).

Intelligent Task Planning for Multiple Robots

Task planning is important when multiple robot manipulators work together and interact with the environment. Multi-manipulator systems are challenging to design because the robots must share the work, avoid collisions, and move together synchronously. Therefore, a high-level intelligent planning method is needed for the system, while a local motion/force controller is applied for a single robot. One common method is planning domain definition language (PDDL), which describes actions, conditions, and goals in a clear symbolic way so that a planner can generate a sequence of actions automatically, as in our work.[5] Another method is hierarchical task network (HTN), which breaks a large task into smaller and easier subtasks. Behaviour trees and finite state machines (FSMs) are also often used because they are straightforward to implement and useful in real-time applications for robot systems. In addition, temporal planning and task allocation methods can help decide when each manipulator should act, and which manipulator should do each part of the task. These methods help connect high-level decision making with low-level robot control command execution.

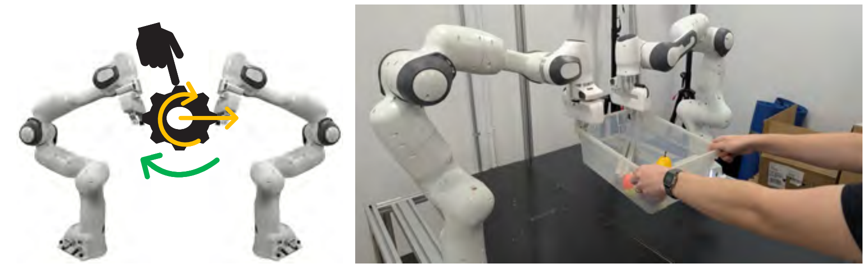

FIG. 2: FRANKA EMIKA ROBOT MANIPULATORS CO-MANIPULATING AN OBJECT WITH HUMAN.

Looking Forward

Intelligence and adaptation are important, especially when robots are deployed in a dynamic and unknown environment with human interaction. In an unstructured working environment such as a human centric collaborative space in Industrial 5.0, pre-planning and hard coding are insufficient to accomplish complex tasks. Integrating task planning with robot control, path planning, and cooperative control can greatly enhance the performance. In imitation learning, one limitation comes from challenges associated with the acquisition of force data during human-robot collaborations and the high cost of high-precision force sensors. Human intention estimation, reliability, robustness to human-caused disturbances, and safety working with robots are not very well addressed in the literature.

AI technologies for robots are very promising for operation in unstructured environments.[6] AI offers an alternative to handle complexity and variability in the real world, while with substantial challenges in real-time implementation, such as continuous and high-dimensional action space limitation in deep learning, low sample efficiency, the challenge of transferring a control policy trained in simulated environments into reality, and difficulty specifying a good reward function. The real-time applications with safe exploration of any advanced methods for robots are the key for success.

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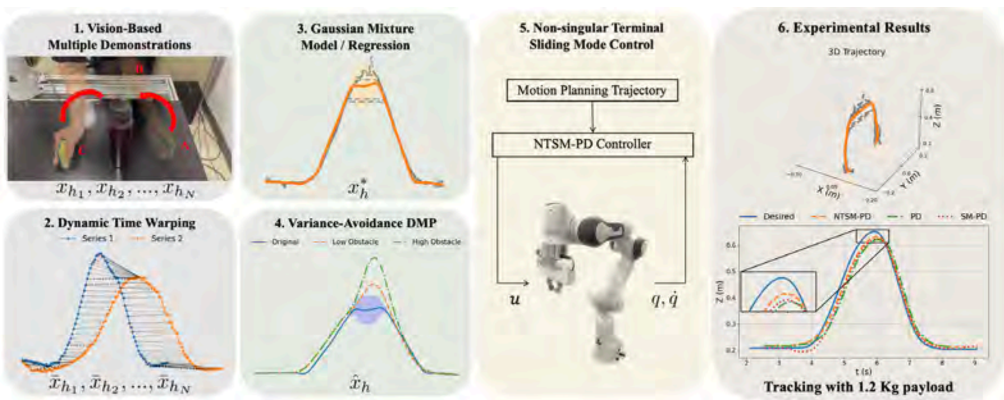
5. Q. Chen and Y.J. Pan, "An Optimal Task Planning and Agent-aware Allocation Algorithm in Collaborative Tasks Combining with PDDL and POPF," arXiv preprint arXiv:2407.08534, 2024.

6. A. Billard, A. Albu-Schaeffer, M. Beetz et al. "A Roadmap for AI in Robotics," *Nature Machine Intelligence*, Vol. 7, 2025, pp. 818–824.

FIG. 3: LEARNING FROM MULTIPLE DEMONSTRATIONS.



Advanced Applications of Quadruped Robots for Inspection Tasks and Firefighting

FIG. 1: SPOT AUTONOMOUSLY EXTINGUISHING A FIRE.

CHRISTOPHER BAIRD, PhD
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IN RECENT YEARS, COMMERCIAL DEPLOYMENT of quadruped robots has become common with the likes of the Boston Dynamics Spot, ANYbotics ANYmal, and the various offerings from Unitree seeing deployment in various industries. The primary use case for these robots has been inspection tasks.

The Mechatronic and Robotic Systems Laboratory (MARS Lab) at Ontario Tech University has been investigating advanced applications of quadruped robots for industrial applications as part of an on-going project with Ontario Power Generation (OPG). OPG is a Crown corporation that is responsible for half of the electricity generation in Ontario. OPG was one of the first adopters of the Boston Dynamics Spot robot when they became commercially available and currently operates one of the largest fleets of Spots in Canada. The MARS Lab was tasked with determining what quadruped robots, like Spot, are capable of doing and push the boundaries of possible applications. What follows is a brief overview of some of the research projects involving Spot undertaken at the MARS Lab.

Autonomous Elevator Use and Proxy Door Access.

The benefit of legged robots is that they are able to traverse terrain that typical wheeled robots cannot, including stairs. However, in large industrial facilities with many floors, traversing numerous staircases can quickly reduce the operating time of a quadruped robot. For such facilities, the ability to use elevators, as well as open proxy-card security doors, is critical to enable deployment of these robotic systems in real-world settings. One of the first projects undertaken with OPG was developing a method for a Spot robot, equipped with an arm, to autonomously traverse one floor to another using elevators.[1] Fiducials were placed outside each elevator bank and inside each elevator. The fiducials were used so Spot would know what floor it was on, which elevator it entered, and where the buttons both inside and outside the elevators were located. A method was developed to use Spot's arm to safely push the elevator buttons. A computer vision algorithm was developed to determine which elevator door was open for cases where there were multiple elevators on a given floor. Testing showed that Spot was able to successfully traverse autonomously from one floor to another, accurately determining which elevator door opened. In addition, Spot was also programmed to use a proxy card to access secure rooms. Spot would tap a proxy card attached to its arm to gain access to a room and then would use the arm to autonomously open the door and enter the room. A video of Spot autonomously using elevators and opening doors with a proxy card can be seen here:
www.youtube.com/watch?v=Ws_V5wNQfts

Autonomous Firefighting

OPG was interested to determine if an autonomous, legged robot could be used as a first responder for fire alarms in a large facility, reaching the possible fire location before firefighting personnel could arrive and, if needed, extinguish a small. The general idea would be to have quadruped robots equipped with fire extinguishers stationed throughout the facility. To determine if such a system was feasible, the MARS Lab undertook a project to develop a robotic system that could explore an unknown environment, locate a fire, and attempt to put it out. This required the development of an algorithm and firefighting payload for Spot to autonomously explore an area, locate a small fire, and extinguish it with a standard 5 lb fire extinguisher.[2]

The proposed use case was in an industrial facility where a fire alarm goes off. Spot, equipped with the firefighting package, would proceed autonomously to the area where the alarm was triggered, determine the location of the fire, and then extinguish it before the fire gets out of hand, responding before firefighters could arrive. This was a complex challenge as Spot's programming does not natively allow it to autonomously explore an area. Normally, Spot needs to be taught by a human operator the path it is traversing using a technique develop by Boston Dynamics called Autowalk. An algorithm was developed by the MARS Lab to allow Spot to autonomously explore a room and detect a fire. The algorithm uses Spot's 360° camera to first identify potential fires using a custom developed vision-based fire segmentation scheme coded in Python. In order to confirm the potential fire detected by the camera is an actual fire, Spot uses its pan/tilt thermal camera to verify that the possible fire is in fact a fire based on its heat signature. If the potential fire is a fire, Spot records the bearing to the fire. Spot then repositions itself and relocates the fire to get a second bearing towards the fire and thus determines the fire's position. With the location of the fire determined, Spot then positions itself at the optimum distance from the fire to deploy the fire extinguisher and then triggers the fire extinguisher, yawing back and forth to put out the fire. The developed system was successfully tested at OPG's Wesleyville Fire & Rescue Academy on live fires. *Figure 1* shows Spot successfully extinguishing a fire in one of the tests. A video of a one of the tests can be seen here:
www.youtube.com/watch?v=2wH8USs-2vo

Long-term Deployment

A major challenge for deploying robots, legged or otherwise, for inspections tasks that are repeated over long durations, e.g., weeks or months, is changes to the environment. The longer the duration, the more likely changes will occur in the environment. If the environment changes too much, for example snow piles develop or vehicles move from a parking spot, the robot could potentially lose localization requiring the task to be reprogrammed by a human operator. In order to address this challenge, research was conducted at the MARS Lab to develop a novel method to effectively merge maps to enable long-term autonomous navigation of robots.[3,4] *Figure 2* shows a comparison of the initially recorded map and a merged map. As can be seen in the figure, many of the dynamic objects that appear in the initial map are not found in the merged map. For example, the truck found at ① and the people that walk around Spot as seen at ② are found in the original map but not in the merged map as they are not in a consistent place between runs. The developed algorithm was tested over 16 months on an 837 meter route around the Ontario Tech campus with Spot travelling a total of 182.5 km through all four seasons without it losing localization. A compilation video of Spot traversing the route over a year can be seen here:
www.youtube.com/watch?v=Nof6R7y4wDE

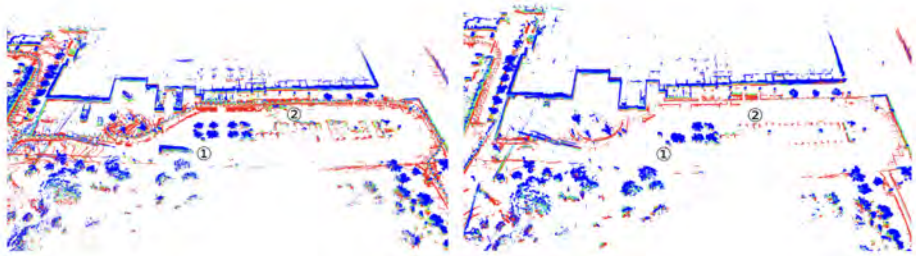

FIG. 2: COMPARISON OF ORIGINAL RECORDED MAP *(LEFT)* AND AN EXAMPLE MERGED MAP *(RIGHT)*.

Future Plans

Robots are typically designed to operate in one medium, e.g., on land or in the air. To date, there are very few multi-modal robots, i.e., robots able to operate in more than one medium. There is a current trend in the robotics sector to develop multi-modal robots that can operate in more than one medium.

The MARS Lab is currently conducting research on enhancing the capabilities of quadruped robots to make them multi-modal, i.e., able to operate on both land and in the air. The idea is to develop a robot that can both walk and fly, not unlike the mythical creature Pegasus. As a first step, a prototype system, dubbed Pugasus, has been developed (see *Figure 3*). Pugasus is comprised of a ROSPug quadruped coupled with a custom-built quad-rotor package. The quad-rotor features a novel design that allows the arms of the quad-rotor section to be stowed and deployed. Preliminary flight testing of Pugasus has been conducted. Future plans are to develop a full-size version of the rotor package that can be equipped on a Spot to enable it to fly. Such a system can walk until in encounters an area it cannot traverse, then take to the air to clear the obstacle, land, and continue walking. The potential applications of such a system are enormous, including Search and Rescue (SAR) missions.

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FIG. 3: PUGASUS PROTOTYPE: ARMS STOWED *(LEFT)* AND ARMS DEPLOYED *(RIGHT)*.

HUMAN-LED COOPERATIVE TRANSPORTATION SYSTEMS

FROM TRUCK PLATOONS TO COASTAL VESSEL FLEETS

FIG. 1: HUMAN-LED AUTONOMOUS TRUCK PLATOONING.

YUKUN LU, PhD

Dr. Yukun Lu joined the Department of Mechanical Engineering at the University of New Brunswick (UNB) as an Assistant Professor in July 2025, where she founded the Intelligent Mobility and Robotics Lab (IMRL). She also holds an appointment as an Adjunct Assistant Professor at the University of Waterloo and serves as the Faculty Advisor for the UNB Formula Racing Team. She earned her PhD in Mechanical and Mechatronics Engineering from the University of Waterloo in 2023, where she continued as a postdoctoral researcher at the Mechatronic Vehicle Systems Lab (MVSL). She holds a BEng in Vehicle Engineering with a minor in Business Administration, completed in 2018. Her background and research interests include ground vehicle corner modules, autonomous mobility, human-machine collaboration, data-driven learning-based control strategies, vehicle dynamics and control, etc.

IMAGES COURTESY OF THE RESEARCHER

INTELLIGENT TRANSPORTATION SYSTEMS have the potential to fundamentally reshape modern freight and mobility by improving safety, reducing operational costs, and increasing system efficiency. In particular, reducing reliance on human drivers can alleviate labor shortages and lower long-term operating expenses, while advanced sensing and control technologies can enhance safety by minimizing human error in complex or hazardous conditions.

Within this framework, autonomous trucking refers to freight transportation systems in which trucks are capable of sensing their environment and performing driving tasks with limited or no human intervention. In recent years, this field has advanced rapidly, transitioning from early demonstrations to Original Equipment Manufacturer (OEM)-integrated commercial deployments. However, fully driverless freight operations across adverse climates, infrastructure conditions, and legal regulations remain both technically and socially challenging. Based on these considerations, the research group at IMRL explores a human-in-the-loop (HiL) platooning architecture, which provides a practical and scalable pathway toward fully autonomous freight. As shown in *Figure 1*, the human driver leads the fleet, while each autonomous follower uses advanced sensory system and intelligent control techniques to stay in line, keep a safe distance, and follow the same path as the human-driven lead vehicle. This architecture enables layered redundancy, adaptive human judgment, and scalable validation for safety-critical deployment on public roads. Furthermore, the dual-use capability of follower vehicles enables an evolutionary transition from coordinated platooning to independent autonomous operation. Within this HiL autonomous trucking framework, the IMRL's research focus on three main areas:

(1) Perception: A multi-vehicle cooperative perception system is being developed at IMRL to provide follower vehicles with real-time situational awareness of their surroundings. In addition, a vision-language model (VLM) trained in-house is used to translate low-level perception outputs into human-readable explanations, so that the system's reasoning can be understood by human operators. This is useful for improving transparency and system validation. It also helps the driver understand what the system sees and why certain decisions are made, which is important for building appropriate trust between human drivers and autonomous systems. The perception system is designed with winter operation in mind, where snow-covered roads, low friction, reduced visibility, and unclear lane boundaries often make perception more difficult and uncertain.

(2) Decision-making considering human-machine interaction: In the HiL platooning framework, the follower vehicles make decisions based not only on perception results, but also on the behavior of the lead vehicle and its human driver. To model this interaction, a game-theory-based decision-making framework is currently being developed that explicitly considers human uncertainty and environmental disturbances. In practice, the autonomous follower continuously evaluates whether the human driver's maneuver is safe and reasonable, and then decides whether to follow, adjust its own trajectory, or behave more conservatively. Over time, the system can also learn the human driver's behavior patterns and adapt accordingly. This creates a two-way adaptation process between the human driver and the autonomous system, which is important for building trust and enabling long-term human-machine collaboration in safety-critical transportation systems.

(3) Data-driven, learning-enabled control strategy: At the control level, a leader-follower cooperative control strategy is developed to treat the fleet as a cohesive system. The goal is to maintain stability and safety while keeping the system scalable to multiple vehicles and different operating conditions. On top of the baseline controller, an additional learning-based layer using reinforcement learning (RL) is added. The baseline controller handles short-term control tasks such as trajectory tracking and spacing control, while the RL layer gradually adjusts control strategies based on human behavior and environmental uncertainty. In this setup, the RL policy works as a supervisory layer that can modify the controller's behavior over time, especially in situations that are difficult to model accurately using traditional rule-based control methods.

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A fully operational scaled 3-vehicle platooning platform has been built and is now available at IMRL, as illustrated in *Figure 2*. The fleet includes a human-operable lead robotic vehicle and two autonomous follower vehicles. This setup is based on ROS 2 Humble and the Autoware Universe architecture, equipping LiDAR, stereo camera, 6-axis IMU, and wheel encoders, and powered by the Nvidia Jetson Orin NX for autonomous mobility research.

While intelligent vehicle technologies are rapidly transforming the trucking industry, similar ideas can also be applied to near-shore maritime transportation. Coastal shipping routes share several operational characteristics with highway transportation networks. One key reason is that near-shore environments are relatively structured compared to the open ocean. Coastal shipping routes often follow defined navigation channels, harbor approach corridors, and traffic separation schemes. These structured pathways function similarly to highway lanes in road transportation, making it feasible to adapt trajectory planning, cooperative navigation, and leader-follower coordination strategies. Another practical advantage is the shorter operating range. Near-shore vessels usually travel between nearby ports or coastal facilities, often within a few tens of kilometers from shore. This makes monitoring, coordination, and system supervision much easier compared to open-ocean operations. For these reasons, near-shore maritime transportation provides a realistic starting point for cooperative and human-supervised autonomy, as illustrated in *Figure 3*. It also offers a practical pathway toward higher levels of autonomy, while still keeping human oversight and operational safety in the loop.

At IMRL, a group of students is investigating key components of modern maritime transportation and exploring how the previously introduced vehicle-based perception, decision-making, and cooperative control framework can be adapted for maritime applications. The work involves understanding and modeling key maritime systems, including the Automatic Identification System (AIS), the International Regulations for Preventing Collisions at Sea (COLREG), maritime traffic lanes, and coastal navigation systems. These elements are being incorporated into the development of perception, decision-making, and collision avoidance algorithms for near-shore operations. To support trajectory planning and cooperative control, a six-degree-of-freedom vessel dynamics model is developed for coastal operations. Compared with ground vehicles, marine vessels respond more slowly and are strongly affected by hydrodynamic forces, wind, and ocean currents. Meanwhile, collision avoidance is implemented based on COLREG rules, which specify right-of-way and maneuvering responsibilities for different encounter situations. A rule-based collision avoidance module is integrated with the trajectory planner and cooperative decision-making layer. The algorithm first identifies the encounter scenario, then assigns give-way or stand-on roles, and finally generates course or speed adjustments that are feasible under vessel dynamics and environmental disturbances. This rule-based module forms the basis for higher-level cooperative autonomy and human-supervised fleet operations in near-shore environments.

FIG. 2: THE FULLY OPERATIONAL SCALED-DOWN FLEET PLATFORM AT IMRL.

Building on the current work in human-led truck platooning and near-shore cooperative vessel operations, the next step is to develop a unified leader-follower cooperative framework applicable across diverse mobility platforms and operating environments. In this framework, perception uncertainty will be explicitly incorporated into decision-making, and game-theoretic models will capture interactions between human operators and autonomous agents in mixed fleets. Advancing toward full autonomy is critical not only for improving operational efficiency and reducing reliance on human labor, but also for enhancing safety, consistency, and scalability in complex and high-risk environments. By enabling a gradual and human-centered transition, this research aims to bridge current technological limitations and unlock the broader societal and industrial benefits of autonomous transportation systems.

FIG. 3: HUMAN-LED AUTONOMOUS NEAR-SHORE VESSEL FLEETS. *NOTE THAT THIS FIGURE WAS GENERATED USING AI-BASED TOOLS AND IS INTENDED FOR ILLUSTRATIVE PURPOSES ONLY.*

Declaration of AI-Assisted Technologies

This manuscript was proofread using ChatGPT-5 developed by OpenAI. The tool was used to refine grammar, enhance clarity, and improve the readability of the text. All technical contents were independently reviewed and verified by the author to ensure accuracy and integrity. The use of AI tools was solely for linguistic and stylistic improvements, with no influence on the scientific or analytical aspects of the manuscript.

TRUSTWORTHY AI-ENHANCED ROBOTS IN UNCERTAIN, HUMAN-CENTERED ENVIRONMENTS

Recent advances in robotics and artificial intelligence (AI) are enabling robots to move beyond structured factories and into roadways, agricultural fields, and assistive settings shared with people. Although farming and assistive robotics may seem far apart, both involve uncertain conditions, many difficult-to-model variables, and a need for safe, predictable robot behavior in close proximity to humans.

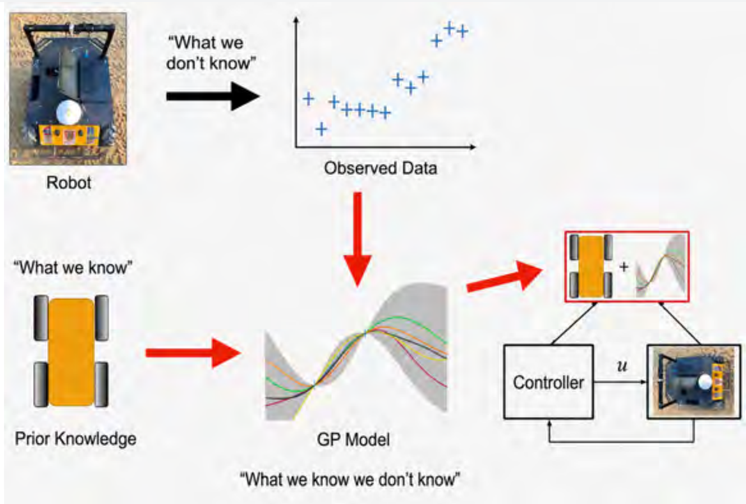

FIG. 1: A HYBRID LEARNING-BASED CONTROL FRAMEWORK IN WHICH PRIOR MODEL KNOWLEDGE IS COMBINED WITH OBSERVED DATA THROUGH A GP MODEL, ALLOWING THE CONTROLLER TO ACCOUNT FOR BOTH KNOWN DYNAMICS AND LEARNED MODEL MISMATCH.

JIE (JAY) WANG, PhD, P.Eng.,

Dr. Wang is an Assistant Professor in the Department of Mechanical Engineering at the University of Manitoba and Director of the Robot Autonomy Lab. His research focuses on trustworthy AI-enhanced autonomy for mobile robots and autonomous vehicles operating in uncertain, unstructured, and dynamic environments. He develops learning-based control and modeling methods that combine machine learning with physics-based robotics to improve safety, robustness, and real-world deployment. His current work spans agricultural robotics, field robotics in harsh environments, assistive robotics, and safe autonomous systems. His work has appeared in journals including Journal of Field Robotics and IEEE Transactions on Intelligent Transportation Systems.

ROBOTS ARE NO LONGER CONFINED TO FENCED industrial cells performing repetitive tasks in controlled settings. Advances in mechatronics, sensing, embedded computing, AI, and control are pushing robotics into environments where uncertainty is the norm. These settings bring uneven terrain, changing weather, imperfect sensing, and frequent interaction with people. For that reason, the next generation of robots must be judged by more than raw capability. A system that performs well only in ideal, highly structured settings is not enough. Robots must react safely when confidence drops, remain reliable under disturbances, and continue operating when models are imperfect. The future of robotics will be shaped not only by autonomy, but by trustworthy autonomy.

From automation to uncertainty-aware autonomy

AI has expanded what robots can do by improving perception, prediction, and adaptation. Learning-based methods can capture dynamics that are difficult to model analytically, especially in systems that interact with uncertain terrain or unpredictable human behavior such as sudden braking, unexpected lane changes, or irregular walking motions. Yet real-world deployment also reveals a limitation: more learning does not automatically mean more trustworthiness.[1]

A practical path forward is to combine machine learning with physics-based modeling and control rather than replacing classical engineering with purely black-box models. In this view, data-driven models compensate for what nominal models miss, while control systems provide structure and mechanisms for enforcing safety constraints. This hybrid philosophy is essential in robotics, where failures are physical and can damage equipment, disturb crops, or create hazards near operators.

Approaches such as uncertainty-aware learning, robust model predictive control (MPC), and barrier-function-based safety filters can improve adaptability while preserving operational guarantees.[1,2] *Figure 1* illustrates this idea. Rather than replacing the entire control stack, the framework begins with nominal kinematic and dynamic models and uses observed data to learn what remains unknown. A Gaussian process (GP) model provides both a correction to the nominal model and an estimate of uncertainty, allowing the controller to respond more cautiously when confidence drops.

Learning-based control in the field

This hybrid approach, combining GP learning, feedback linearization, and MPC, has shown strong promise in outdoor mobile robotics for applications such as agricultural scouting, environmental monitoring, and search-and-rescue in rough terrain. Off-road field robots operate on sand, soil, grass, gravel, and other uneven terrains where nominal models are often insufficient.

In our recent work on mobile robot path following, we developed a learning-based MPC framework that combines GP learning, feedback linearization, and MPC to improve path-following accuracy across straight, curved, and more complex off-road trajectories while retaining computational efficiency.[5] Field experiments with a Clearpath Husky A200 platform showed that the learned controller could follow challenging off-road paths more accurately than a nominal model-based baseline.

This direction is especially relevant to agricultural robotics. Agriculture faces labour shortages, productivity pressures, and growing demands for precision and sustainability.[3,4] Yet farms are not structured factories. Terrain changes from row to row, sensing varies with dust and lighting, and the interaction between robot, tool, crop, and soil during scouting, soil probing, targeted sensing, and crop monitoring is difficult to model fully. Trustworthy agricultural autonomy therefore requires robots that can adapt online, quantify uncertainty, and degrade gracefully when weather, lighting, localization, or terrain conditions change unexpectedly.

That need is shaping our research at the Robot Autonomy Lab. In the context of Prairie farming, this means building field robots that can maintain reliable navigation when the robot's position estimate becomes uncertain, operate safely near crops and workers, and coordinate mobility, sensing, and manipulation under changing conditions. *Figure 2* shows one example of the testing context that motivates this work.

FIG. 2: AN AGILEX SCOUT MINI PLATFORM DURING OUTDOOR TESTING IN A PRAIRIE FIELD NEAR A SURVEY-GRADE RTK-GNSS BASE STATION. THIS SETUP IS USED TO EVALUATE NAVIGATION AND CONTROL PERFORMANCE UNDER UNEVEN TERRAIN AND REALISTIC LOCALIZATION CONDITIONS RELEVANT TO AGRICULTURAL FIELD ROBOTICS.

Safe autonomy around people and other agents

Although agricultural and assistive robotics may seem quite different, both require robots to operate safely under uncertainty, adapt to changing conditions, and behave predictably when working near people.

Roads provide a clear example of this broader challenge. Autonomous vehicles must interact with human-driven vehicles whose behavior is variable and only partly predictable. Traditional control models struggle to capture this variability because they rely on nominal assumptions about how human drivers respond. Learning-based models can help, but only if uncertainty is represented explicitly and incorporated into decision-making.

In our recent work on mixed traffic, we used GP-enhanced modeling to capture uncertainty in human-driven vehicle behavior and incorporated that information into predictive control for interactions between autonomous and human-driven vehicles.[6] The resulting chance-constrained MPC improved safety by adjusting following distance according to estimated uncertainty while avoiding unnecessary conservatism. The broader principle is that robots operating near people should not rely on best-case assumptions; they must reason about uncertainty, maintain safety margins, and respond conservatively when another agent behaves unexpectedly.

This same challenge is becoming increasingly important in assistive robotics. At the Robot Autonomy Lab, we are exploring quadrupedal robot systems as assistive companions for wheelchair users, using a Unitree A2-W platform with a mounted robotic arm to support co-navigation, door opening, item retrieval, and safe handover. In this setting, trustworthy autonomy cannot be judged by task success alone. The robot must operate safely, smoothly, and predictably in close proximity to people during shared navigation and physical assistance tasks. Trustworthy autonomy is therefore not only a control problem, but also a human-centered engineering requirement.

Why mechanical engineers are central to this future

Robotics is often discussed primarily through the lens of software and AI, but its future will depend just as much on embodiment, sensing, actuation, energy, and control. Mechanical engineers are central to this transformation because trustworthy autonomy is ultimately a systems problem. It requires the integration of learning algorithms with physical design, state estimation, motion control, safety constraints, and task-specific hardware.

The most important robotic systems of the next decade will not be the ones that deliver the most spectacular demonstrations under ideal conditions. They will be the ones that work reliably across changing terrain, uncertain inputs, imperfect localization, and human-centered environments. They will combine learning capability with sound mechanics, control, and system-level engineering.

That is why the next stage of robotics should be viewed not simply as a race toward smarter machines, but as a shift toward machines that can be trusted in uncertain, human-centered environments. Solving that challenge will define the next era of mechatronics, robotics, and control.

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ME NEWS & RESEARCH

HIGHLIGHTS

Fault-Tolerant and Adaptive Control for Autonomous Vehicles (AVs)

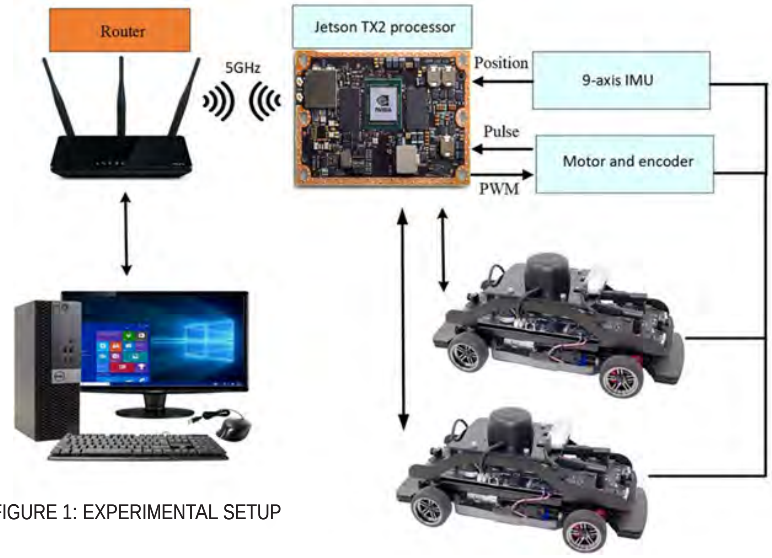

FIG. 1: FIGURE 1: EXPERIMENTAL SETUP

AUTONOMOUS VEHICLES (AVS), SUCH AS self-driving cars and drones, are widely used in transportation, delivery, mapping, environmental monitoring, mapping, and inspection. However, they can operate in uncertain and degraded conditions, where sensor faults, actuator failures, and external disturbances can compromise stability and mission performance. Conventional control systems are designed for nominal conditions, with limited ability to detect, isolate, and compensate for faults in real time, which can lead to trajectory deviation, mission failure, and safety issues. In safety-critical applications such as coordinated multi-drone missions, automated infrastructure inspection, and networked self-driving cars, there is a growing need for robust fault-tolerant and adaptive control strategies that ensure continued operation under faults and disturbances. Sensor faults and/or actuator failures can occur due to many reasons, including but not limited to physical damages and cyberattacks.

A group from Concordia University and École de technologie supérieure developed a unified framework to improve the safety of autonomous vehicles, specifically self-driving cars, not only by addressing physical actuator faults, but also by considering cyberattacks simultaneously.[1] The developed framework integrates an adaptive fault-tolerant control (AFTC) system combined with an intrusion detection and protection system (IDPS).

The core method is a hierarchical backstepping controller that uses adaptive laws to estimate and compensate for unknown faults and disturbances in real time, without requiring prior knowledge of attack types. The IDPS continuously monitors system behavior and classifies attacks using a lightweight rule-based approach. Once a threat is detected, it dynamically adjusts controller gains and parameters to maintain stability and tracking performance. The controller relies on measurable residual errors rather than exact system states, which allows the system to function even with corrupted or delayed data.

The developed framework guarantees stability through Lyapunov-based analysis while remaining practical for applications. This framework was validated experimentally on autonomous self-driving cars (Quanser QCar as seen in *Fig. 1*). The experimental results showed that the proposed framework maintains stable trajectory tracking even under simultaneous actuator faults and cyberattacks, with only temporary performance degradation.

The main importance of this work is the integration of cybersecurity and control into a single continuous adaptive framework, rather than treating them separately or switching between controllers. This has been done in a practical way to ensure seamless integration to self-driving cars.

—Technical Editor, Dr. Hassan Alkomy, MCSME

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Adaptive Event-Triggered Robust Control for Networked Robotic Systems

ROBOTIC SYSTEMS, INCLUDING ROBOTIC manipulators, drones, self-driving cars, and mobile robots, are now deeply integrated into modern life and industry. They are used in manufacturing automation, warehouse logistics, infrastructure inspection, precision agriculture, healthcare assistance, and disaster response. Many of these applications rely on multiple robots working together as coordinated teams, often connected through communication networks, i.e., networked robotic systems. However, real-world environments are unpredictable, and robots must operate under uncertainties such as external disturbances, model inaccuracies, sensor noise, and limited communication bandwidth. In ideal conditions, controllers are typically designed with continuous communication and accurate models, which limits their effectiveness in some practical scenarios. These limitations can lead to inefficient operation, increased energy consumption, reduced scalability, and even safety risks in critical applications. Therefore, robust and resource-efficient control strategies that allow networked robotic systems to operate reliably in dynamic, real-world conditions are vital.

A research group from the Spacecraft Dynamics Control and Navigation Laboratory (SDCNLab) at York University led by Prof. Jinjun Shan focuses on addressing some of these practical challenges, such as limited onboard computation, restricted communication, and the need for reliable coordination among multiple autonomous systems. The team developed an advanced adaptive dynamic event-based control framework specifically aimed at improving the performance and efficiency of networked autonomous systems modeled as Euler–Lagrange systems.[1] The framework is designed to reduce unnecessary communication between autonomous systems while maintaining high control accuracy, making it particularly suitable for large-scale robotic networks used in industry.

The framework integrates a fully distributed adaptive sliding mode controller with a nested adaptive sliding mode estimator. The estimator allows each robot to reconstruct important system information, such as the motion of the leader robot, even when measurements are noisy or incomplete. At the same time, the controller uses a time-varying sliding mode design to handle uncertainties and disturbances without requiring prior knowledge of their limits. The adaptive event-triggering mechanism enables robots to communicate and update their control actions only when needed, rather than continuously. This significantly reduces network

IMAGES COURTESY OF THE RESEARCHERS

congestion and energy consumption, which are critical factors in real-world networked robotic systems, such as drone swarms and mobile robot teams. The framework operates in a fully distributed manner, which means that each robot relies only on local information. This enhances scalability and robustness.

The team verified and validated their framework mathematically, using Lyapunov-based analysis, and experimentally, using drones performing coordinated formation tasks under disturbances. Despite the reduced communication and computational effort, this framework achieved acceptable performance in terms of task completion.

The significance of this work lies in its direct impact on real-world networked autonomous systems applications. By reducing communication requirements and improving robustness, it enables more efficient and reliable operation of multi-robot systems in industries such as automated manufacturing, logistics, and aerial inspection.

— Technical Editor, Dr. Hassan Alkomy, MCSME

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High-Fidelity Simulation and Development of Networked Maritime Autonomous Systems for Underwater Surveillance of Critical Infrastructure

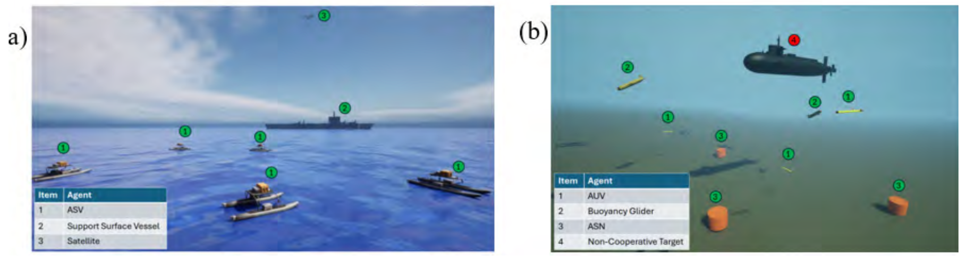

FIG. 1: THE INTEGRATED UNDERWATER SURVEILLANCE NETWORK CONSISTING OF (A) ABOVE-WATER (ASV, A SUPPORT VESSEL, AND SATELLITE), AND (B) UNDERWATER (AUV, BUOYANCY GLIDER, AND ASN) MAS.[1]

Underwater surveillance is essential to detect, localize, and classify activities that threaten critical undersea infrastructure (CUI) such as communication cables, offshore wind farms, and oil and gas pipelines. CUI are fundamental to energy supply, digital connectivity, and economic stability, making their protection a priority. However, they face increasing risks from both human activities and environmental forcing. Anchoring vessels, bottom trawling, unauthorized seabed operations, and malicious underwater vehicles can cause direct damage, while severe storms, strong currents, seabed mobility, and ice interactions can accelerate structural degradation and increase failure risk. Effective protection of these assets requires situational awareness over large and often remote marine regions. Conventional inspection and monitoring approaches, typically based on divers and remotely operated vehicles supported by crewed surface vessels, are expensive, time-limited, and spatially limited in their coverage. As a result, they are usually deployed only after suspected incidents or at scheduled intervals rather than enabling continuous surveillance. This creates significant gaps during which damage or interference may go undetected. Current monitoring systems rely primarily on acoustic sensing, particularly sonar, due to the rapid attenuation of electromagnetic waves underwater. Optical and electromagnetic methods are therefore limited to short-range applications. While these techniques are well established, their effectiveness rely heavily on platform availability and operational endurance. With the rapid expansion of offshore infrastructure and marine defence systems, there is a growing need for persistent, wide-area, and cost-effective surveillance solutions. This has driven increase interest in autonomous and networked monitoring systems capable of continuous coverage and improved detection through distributed sensing.

Based on the highlighted requirements, the Intelligent Systems Laboratory at Dalhousie University, led by Dr. Mae Seto, and supported by graduate research students, N. Cain, J. Flaherty, A. de la Cruz, and post-doctoral fellow, Dr. Jay Patel, is conducting studies to study this problem.[1] Their approach addresses these limitations by advancing the concept of networked maritime autonomous systems (MAS), comprising autonomous underwater vehicles (AUVs), autonomous surface vehicles (ASVs), and seabed nodes. Such systems offer a scalable, cost-effective solution for persistent monitoring, enabling broader optimized spatial coverage and enhanced sensing diversity, particularly for passive acoustic detection. By reducing dependence on crewed vessels and enabling long-duration deployment with periodic main-

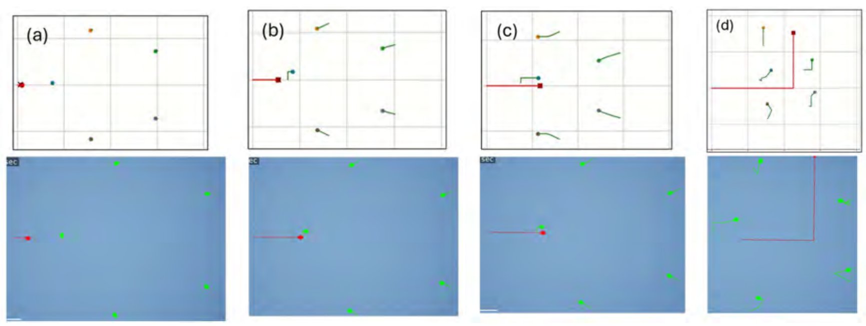

FIG. 2: COLLABORATIVE BROADSIDE-SEEKING BEHAVIOUR FOR A TARGET MISSION THAT STARTS AT A 90° HEADING FROM THE LEFT, TRAVELS 4.5 KM THEN CHANGES TO A 0° HEADING.[1]

tenance, MAS networks represent a shift toward continuous undersea situational awareness. To achieve these objectives, HoloOcean was selected as the simulation platform due to its capability to model underwater acoustic propagation and support multiple types of MAS as dynamic agents. These agents represent marine robotic platforms equipped with sensors such as sonar, Doppler velocity logs, and inertial measurement units, and can execute autonomous or collaborative missions through configurable control strategies and actuator commands as indicated in *Fig. 1*. The platform's compatibility with the underwater MAS further enhances its utility by enabling seamless transfer of developed control and autonomy algorithms from simulation to real-world AUV, ASV, and seabed node systems. The developed surveillance network integrates both surface and underwater MAS, designed to detect and monitor non-cooperative targets such as submarines or marine mammals, with flexibility to include surface or above-water targets (*Fig. 1*). The primary sensing modality is passive acoustic monitoring with hydrophone arrays. Upon detection of a target, the MAS network employs a self-organizing broadside-seeking strategy to collaboratively optimize spatial positioning for the best target localization and tracking.

The implementation leverages the HoloOcean simulation framework, enhanced with a site-specific environment based on Bedford Basin, Nova Scotia, integrating its bathymetry and sound velocity profiles. Acoustic propagation is modelled using ray-tracing as the MAS are in the far-field from the target. Their work also focuses on developing and refining of MAS agents, such as improved AUV and ASV dynamics, and the introduction of new platforms including seabed nodes and buoyancy gliders. A central contribution of this study is the development of a high-fidelity simulation testbed to design and validate collaborative detection, localization, and tracking strategies for mobile underwater acoustic targets. This virtual environment mitigates the risks and reduces the amount of in-water testing while enabling rigorous evaluation of multi-agent coordination, sensing, and autonomy. The primary novelty of their work is the development and validation of a self-organizing broadside-seeking localization strategy within a high-fidelity underwater surveillance testbed. As an intermediate step toward full three-dimensional deployment with AUVs, a two-dimensional configuration using five ASVs was implemented and successfully verified, demonstrating feasibility under realistic operational constraints. Despite these added complexities, the agents preserved the intended collaborative behavior, confirming the robustness of the approach. *Fig. 2* show the agents can autonomously and dynamically reconfigure their spatial positions in response to a moving, non-cooperative target. Starting from a pentagonal formation, the ASVs adapt to maintain optimal broadside configurations, balance range reduction, and avoid co-linearity, which degrades localization accuracy. The system exhibits collaborative behavior, with agents collaboratively prioritizing different behaviours depending on their collective relative positions to the target.

– Technical Editor, Dr. Baafour Nyantekyi-Kwakye, MCSME

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Toward Advanced Human-Robot Interaction: The Role of Mechanical Engineering in System Design and Physical Intelligence

Human-Robot Interaction (HRI) is undergoing a structural shift from controlled laboratory environments to real-world deployment in healthcare, manufacturing, defense, and field operations. As a core domain, HRI examines how humans and robots collaborate physically and cognitively in shared environments. While advances in artificial intelligence have accelerated perception and decision-making, the realization of effective interaction remains fundamentally dependent on the Mechanical engineering discipline. It is mechanical design that governs embodiment, compliance, actuation, and safety, enabling robots to operate in close proximity to humans. Contemporary robotic systems such as Atlas (Boston Dynamics) illustrate how physical intelligence emerges from the integration of mechanical systems with sensing and control, enabling robots to execute complex, contact-rich tasks in dynamic environments.[1]

Mechanical engineering enables physical intelligence through three tightly coupled pillars: embodied design, dynamic control, and sensor integration. Embodied design focuses on compliant structures and materials that enable safe and adaptive interaction, particularly in uncertain or unstructured settings.[2] Advances in soft robotics and variable stiffness actuation are allowing robots to modulate force and absorb disturbances during human contact.[3] From a control standpoint, interaction requires sophisticated regulation of forces and motion, typically implemented through impedance and admittance control frameworks that allow robots to respond intuitively to human input.[4] Equally important is the co-design of sensing and mechanics, where tactile, visual, and proprioceptive sensing systems are embedded within the robot's physical architecture. This integration enables real-time feedback and adaptive behavior, which are essential for collaborative manipulation, assistive robotics, and human-centered automation.

Canada has emerged as a globally competitive hub for HRI research, with strong contributions from leading universities that integrate Mechanical engineering, artificial intelligence, and human-centered design. HRI research and development are supported by a robust ecosystem of academic institutions, research laboratories, and industrial partnerships. Institutions such as the University of Toronto Robotics Institute (led by Prof. Timothy Barfoot) and University of Waterloo's Active and Interactive Robotics Lab (led by Dr. Yue Hu) are advancing research in human-centered robotics, with emphasis on ergonomics, safety, and collaborative autonomy. The former institute integrates expertise across engineering, computer science, and biomedical domains to develop robots capable of operating in complex environments, from surgical microrobots to autonomous field systems. Similarly, research in robotics and HRI is advancing through interdisciplinary efforts in cognitive robotics, assistive systems, and human feedback-driven learning at Dalhousie University. For instance, Dr. Nils Wilde's research focuses on human-robot interaction, preference learning, and multi-robot coordination, emphasizing systems that adapt to human users in real-world environments. Complementary efforts in biomedical and rehabilitation robotics explore assistive manipulation and mobility systems, integrating robotic arms and mobile platforms for healthcare applications.[5] These activities are further supported by research in motor control and neuroscience, which investigates the neural basis of human movement, providing critical insight for designing intuitive and responsive robotic systems. Both Université Laval and McGill University contribute significantly to the mechanical and control foundations of HRI. Laval's Robotics Laboratory, established within the mechanical engineering department and led by Professor Clément Gosselin, has a long-standing tradition in robotics and mechatronics. The lab's work in robotic mechanisms, kinematics, and system design directly informs the development of physically capable and reliable robotic platforms including mechanically backdrivable robots for intuitive sensorless pHRI using the concept of proprioceptive actuation.[6] At McGill, the Centre for Intelligent Machines currently led by Professor Derek Nowrouzezahrai, advances interdisciplinary research across robotics, con-

. . . . *continued page 28*

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Re-imagining Independence through User-Inclusive Design, AI & Robotics

Older adults and people with disabilities should have equal opportunity to access services and live independently. However, these individuals have challenges with basic needs like preparing and eating home-cooked meals, getting in and out of their building and accessing public transportation. The Ontario Tech University BioRobotics Lab develops assistive and rehabilitation robots that enable people to complete activities of daily living independently whether it be through the use of an assistive device or the restoration of their mobility. With this added independence, users can live more active and fulfilling lives, achieve their occupational goals and ease the roles of caregivers and support workers.

Dr. Yurkewich's research team utilizes an iterative user-inclusive design process in which older adults, people with disabilities, therapists, caregivers and researchers work together to establish occupational goals and co-design technologies that support goal attainment. Driven by the need to enable people with severe hand impairment after stroke to perform functional tasks and hand opening exercises, the Hand Extension Robot Orthosis (HERO) Glove soft hand exoskeleton was collaboratively developed.[1] This device provides strong extension forces to open clenched hands and provides strong grip force to hold objects for long periods without fatigue. The HERO Glove utilizes biomimetic flexible tendons to conform to a range of object geometries and is portable and affordable to enhance independence and access to rehabilitation in clinic and home settings.[2] The HERO Glove's hardware and software are open-source, which allows our team and researchers worldwide to collaborate in customizing the design and control, such as by integrating electrical stimulation, muscle activity and force controllers, modifying the device size and transmission system for cerebral palsy or spinal cord injury populations, and developing rehabilitation games to enhance motivation.[3,4]

FIG. 1: DR. YURKEWICH DEMONSTRATING THE HERO GLOVE SOFT HAND EXOSKELETON AT THE ONTARIO TECH UNIVERSITY BIOROBOTICS LAB.

FIG. 2: DAIMEN LANDORI-HOFFMANN, MASc DEMONSTRATING THE HERO GLOVE GRIP FORCE AND COMPUTER VISION CONTROL SYSTEM FOR EVERYDAY TASK ASSISTANCE AND REHABILITATION.

When assistive and rehabilitation research technologies are deployed in real-world contexts there is heterogeneity in the patients' recovery profiles and their use of the technology, motivating the investigation of more engaging and personalized therapy techniques and the underlying mechanisms of human-robot interaction on neuromotor recovery. A neurofeedback rehabilitation game was designed in collaboration with Evelina Children's Hospital, UK, where the user plays a video game by controlling their brain activity while performing hand movements. The main aim of this game is to keep children with cerebral palsy engaged in their exercises while strengthening the neural pathways important for sensorimotor tasks.[5] A portable robotic system, HRX-1, was designed with low inertia, high backdrivability and modular attachments for the wrist, elbow and ankle joints, in collaboration with Imperial College London and King's College London.[6,7] This system is being utilized to sense the subtle motions of people with impaired motor function and apply precise forces and motions that enable researchers and clinicians to experiment with new human-robot interaction control theories and assess their patients' changes in neuromechanics throughout therapy.[8]

Technology translation is essential to convey the significance of research to the community, accelerate the development of mechatronics control theories and enhance peoples' independence and motor recovery. Two start-up companies were founded (WearAbility and HumanRobotiX) to develop manufacturing processes to make the HERO Glove and HRX-1 accessible to researchers internationally so they can use these systems across human motor control and rehabilitation paradigms.

AARON YURKEWICH, PhD, P.Eng., MCSME

Dr. Yurkewich is an early career researcher and tenure-track Assistant Professor in Mechatronics Engineering at Ontario Tech University, where he leads Ontario Tech's biomedical robotics research, applying technical, clinical, and neuromechanics analysis expertise. He received his PhD in Biomedical Engineering from the University of Toronto, completed his postdoctoral fellowship at Imperial College London and is an Affiliate Scientist at KITE-Toronto Rehabilitation Institute. He has made significant contributions to the development of the HERO Glove soft hand exoskeleton and its integration into clinic and home rehabilitation settings. His work is supported by funding from AGE-WELL, CIHR and NSERC.

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University of Prince Edward Island
Dr. Bingxian Mu

From Algorithms to Autonomy: Building Robots That Think, Act, and Stay Safe

Dr. Bingxian Mu is the principal investigator of the Robotics and Autonomous Systems Laboratory (RASL) in the Faculty of Sustainable Design Engineering at the University of Prince Edward Island. RASL is dedicated to advancing the science and engineering of intelligent autonomous systems, with capabilities spanning motion planning, real-time control, and full-system integration from research prototype to commercial deployment. The laboratory's long-term goal is to develop certifiably safe and computationally efficient autonomy frameworks that enable robots to operate reliably alongside humans in complex, real-world environments. Toward this vision, Dr. Mu's work bridges foundational algorithm design and applied systems engineering, spanning agile aerial vehicles, intelligent manufacturing, and consumer robotics.

A central thrust of Dr. Mu's research is making robotic motion planning fast enough for real-world deployment. As robots increasingly leave laboratories and enter everyday life, they must think and adapt in real time. His algorithm BLIT*[1] enables robots to find high-quality, collision-free paths through complex environments with unprecedented efficiency. Its inclusion in the Open Motion Planning Library (OMPL) marks only the eighth university contribution to this globally used platform since the library's inception in 2011, accelerating development of robotics applications worldwide. Building on this foundation, his follow-up algorithm MEET[2] achieves runtimes more than 100 times faster than conventional methods—a critical capability for robots operating alongside humans in dynamic settings.

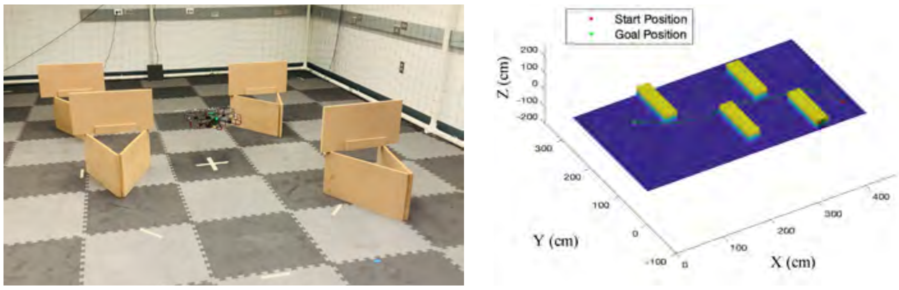

FIG. 1: EXPERIMENTAL TEST SPACE. LABORATORY 3-D FLIGHT TEST SPACE AND COLLISION-FREE WAYPOINTS.[3]

Intelligence alone is not enough; robots must also operate safely under real-world conditions. Dr. Mu's dual-layer Explicit MPC–Integral Sliding Mode Control architecture for quadrotors[3] achieves 1000 Hz control updates while robustly mitigating disturbances, enabling drones to maintain stable flight with mathematical certainty. Demonstrated in the laboratory's 3-D flight test space (*Fig. 1*), this framework shows how advanced control theory can be implemented on resource-constrained hardware without sacrificing performance or safety guarantees.

Dr. Mu's vision extends beyond the laboratory to tangible systems people use every day. As Lead Technical Specialist at Zhejiang Yat Electric Co. Ltd., he led a team of more than 20 engineers developing an intelligent boundary-free lawn mower, advancing the project from concept to pre-launch prototype in just 18 months. Concurrently, his laboratory pioneered an autonomous welding robot by co-designing deep learning-based seam detection with advanced motion planning, demonstrating how foundational robotics research can address labor shortages and improve precision in manufacturing.

The transformation of our world by machines and robots is unfolding now at UPEI. Through foundational algorithms that make robots smarter, certifiable control frameworks that make them safer, and integrated systems that bring autonomy from laboratory to life, Dr. Mu's research is advancing RASL's mission: to create a future where humans and intelligent machines work together safely and effectively to solve society's greatest challenges.

BINGXIAN MU, PhD, MCSME

Dr. Mu received his BEng from Northwestern Polytechnical University, and his MASc (2013) and PhD (2017) from the University of Victoria. He was a Control Engineer at General Motors Canada (2018–2019), developing fault diagnosis and optimization algorithms. From 2020 to 2023, he was an Assistant Professor at the University of New Hampshire. He then served as Lead Technical Specialist at Zhejiang Yat Electric Co. (2023–2025), leading a team of 20+ engineers to develop an intelligent boundary-free lawn mower. He is now an Assistant Professor at the University of Prince Edward Island, researching motion planning, control, robotics, AI, and autonomous welding. He is a member of CSME.

Related links:
BLIT in OMPL*
github.com/ompl/ompl/blob/main/src/ompl/geometric/planners/lazyinformedtrees/src/BLITstar.cpp

Quadrotor experiment video
youtu.be/VFPGz-rjjQM

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University of Guelph
Dr. Binyan Xu

Making Autonomous Systems Reliable: MPC-Enabled Fault-Tolerant Control

Modern engineering systems are becoming more interconnected and complex, often incorporating a large collection of actuators, sensors, and communication components. Although this integration brings enhanced functionality, it also introduces new vulnerabilities. For example, actuator degradation, sensor malfunctions, and unexpected operating conditions can substantially compromise system performance and safety. These issues are particularly important in safety-critical applications, such as autonomous vehicles, robotic systems, and high-precision platforms. Consequently, ensuring reliable operations under these circumstances becomes a key challenge within modern control engineering.

Traditional fault-tolerant control strategies usually separate fault detection and estimation from control design. This means faults tend to be handled only after they occur, which may lead to slower responses and noticeable performance degradation. Hence, model predictive control (MPC), with its predictive nature, ability to handle constraints, flexibility in control allocation, and inherent robustness against uncertainties, provides a promising framework for fault-tolerant control.[1] However, standard MPC formulations do not consider faults explicitly in the decision-making process, which limits their effectiveness in safety-critical applications.

Dr. Binyan Xu's research seeks to bridge this gap via an MPC-based fault-tolerant control framework. As shown in *Fig. 1*, this framework systematically integrates fault detection, estimation, and control reconfiguration together within an optimization-driven structure. In this framework, MPC serves as the central decision-making tool with fault-related information incorporated into the control process.

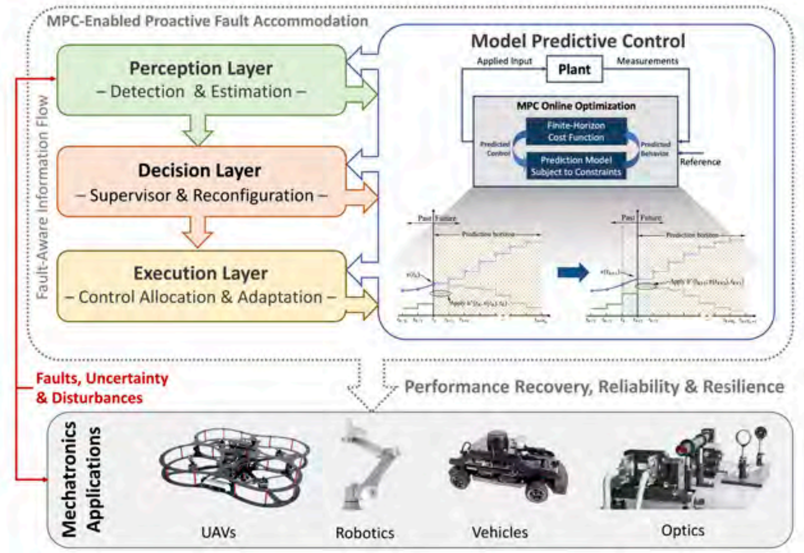

FIG. 1:MPC-ENABLED FAULT-TOLERANT CONTROL ARCHITECTURE WITH REPRESENTATIVE APPLICATIONS.

By utilizing the predictive and constraint-handling features inherent in MPC, the proposed framework enables a shift from reactive fault handling to proactive, performance-aware control across diverse engineering systems.

To facilitate practical application within rapid and safety-sensitive systems like unmanned aerial vehicle (UAV) flight control, her research introduces hierarchical and multi-rate control architectures that balance computational efficiency and control performance.[2] In the developed control system, fault-aware MPC operates at a higher level, using real-time fault information to manage constraints and optimize system behavior, while lower-level controllers ensure fast and reliable execution. This idea is further extended to distributed settings, enabling coordinated control of multi-agent systems under both individual faults[3] and communication failures.[4] In addition, in collaboration with researchers at the University of Guelph, fault-tolerant control for high-precision optical systems with hundreds of actuators is investigated, addressing control reallocation with actuator redundancy under faults.[5]

Looking ahead, Dr. Xu aims to further advance a unified framework that seamlessly integrates optimization, estimation, learning, and control. At the University of Guelph, she is establishing a research group exploring new ways to improve the reliability of complex engineering systems. Its current and developing experimental platforms, reflected in *Fig. 1*, include ground and aerial vehicle systems for autonomous mobility research, temperature control systems for process and sampled-data control, and high-precision adaptive optics systems for precision mechatronics control applications. Through this, the group seeks to support collaborations in autonomous systems, robotics, smart manufacturing, and safety-critical control applications, with the ultimate goal of enabling the dependable deployment of autonomous systems in increasingly complex and uncertain environments.

BINYAN XU, PhD, P.Eng., MCSME

Dr. Xu is an Assistant Professor in the School of Engineering at the University of Guelph. She received her BEng and MASc degrees in control engineering from Nanjing University of Aeronautics and Astronautics in 2016 and 2019, respectively, and her PhD in Mechanical Engineering from the University of Victoria in 2024, where she was awarded the CSME Gold Medal for Outstanding Academic Achievement at the PhD level. Her research focuses on developing advanced control methods for reliable autonomous systems, with applications in robotics, unmanned aerial vehicles, and high-precision engineering systems. She is currently establishing a research lab at the University of Guelph, with capabilities in reliable control, optimization-based autonomy, robotic systems, UAV control, and real-time experimental validation.

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Concordia University
Dr. Christopher Yee Wong

Achieving physical and emotional safety in human-robot interaction

Autonomous robotic assistants can help people with disabilities and support elderly independence through direct physical assistance, e.g., helping users move around or provide rehabilitation. These interactions must be physically and emotionally safe, intuitive, and comfortable for users. At the Living with Assistive and Interactive Robots (LAIR) Lab at Concordia University in Montreal, we use a variety of robots (Kinova Gen3 robot arm and Hello Robot Stretch 3 mobile manipulator), sensors (cameras, tactile sensors, and physiological sensors), and virtual reality with haptic controllers to research physical-social human-robot interaction (psHRI). Our core goal is to advance robot cognition in human-robot interactions with a focus on touch.

Our approach begins with the analysis of bidirectional physical interactions (both human-to-robot and robot-to-human). We combine machine learning with computer vision and robotic skin to interpret human-initiated touch and predict user intent, enabling more intuitive interactions. For example, physically manipulating a hyper-redundant humanoid robot purely by touch[1] or analyzing the user to prevent tool collision during a collaborative manufacturing scenario.[2] In the other direction, we use multimodal sensing and robot-initiated touch to estimate and influence the human physical and emotional state. For example, there are many ways a robot can grasp a person's hand, each with vastly different emotional effects: a soft underhand grip may be appropriate during a supportive motion, while a firm overhand grip would be more effective to stop a child from touching a hot stove. We analyze interaction forces, facial expressions, gaze, body motions, and physiological signals to assess the user's emotional state, allowing the robot to then choose the interaction type accordingly.

FIG. 1: USING VIRTUAL REALITY TO STUDY PHYSICAL-SOCIAL HUMAN-ROBOT INTERACTION.

Robotics researchers are often limited by what robots are available to them, which inhibits psHRI research. We address this by combining virtual reality (VR) with physical robots to enable low-cost but contextually rich research environments. For example, a participant using VR may see an expensive full-sized humanoid robot while a low-cost manipulator arm is physically interacting with them. While embodied VR can lower the cost of psHRI research, we must validate the VR-dependent results by determining which factors, and to what degree, influence the validity of the results. For example, do mismatched robot sound signatures disrupt immersion, or what positional and velocity thresholds cause participants to notice discrepancies between virtual and physical interactions.

Finally, we are developing a novel theoretical framework called Sensor Observability Analysis (SOA).[3] SOA analytically determines the cumulative sensing quality of directional sensors (e.g., joint torque sensors, load cells, and cameras) distributed on articulated robots. It transforms sensor axes from joint space to task space, analogous to forward kinematics but for sensors. SOA can identify and optimize robot trajectories to avoid sensor blind spots. For example, it can determine whether a particular joint configuration prevents joint torque sensors from detecting forces in certain axes, which is a critical concern for safety in psHRI. We are currently extending SOA to optimize sensor placement on robots during the design phase and to accommodate unidirectional sensors with limited field of views (e.g., cameras).

Overall, the LAIR Lab takes a multidisciplinary and holistic approach to physical-social human-robot interaction research to prepare for an increasingly roboticized future. More information on our work can be found on the LAIR Lab website: lair-lab.github.io.

PHOTO BY DR. CHRISTOPHER YEE WONG

CHRISTOPHER YEE WONG, PhD, P.Eng., MCSME

Dr. Wong is an Assistant Professor at Concordia University in the Department of Mechanical, Industrial and Aerospace Engineering where he leads the Living with Assistive and Interactive Robots (LAIR) Lab. He received his PhD in mechanical engineering from the University of Toronto in 2017. He currently serves on the Canadian Robotics Council Research and Training Committee and is the co-founder and vice chair of the Québec Chapter of U.S.-Canada JSPS Alumni Association. His current research interests include the fields of physical-social human-robot interaction and the scholarship of teaching and learning within engineering education.

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Concordia University
Dr. Hamid Taghavifar

Learning with Control: Cognitive Autonomy for Robots and Intelligent Vehicles

The Laboratory for Autonomy, Control and Intelligent Transportation Systems (LACITS) as a part of the Department of Mechanical, Industrial and Aerospace Engineering (MIAE) of Concordia University focuses on addressing the key critical question in robotics and autonomous systems: How can intelligent autonomous systems be designed to coexist with humans in complex shared environments safely and reliably?

A major focus has been on learning-enabled control, where hybrid physics-data models are built by exploiting both existing domain knowledge and data-driven AI methods. In fields such as intelligent transportation systems, where safety is critical, navigation and control policies that are predicated on data exclusively can lead to unpredictable and uninterpretable behaviors. These outcomes can be due to distribution shifts, sensor faults, occasional edge cases, etc. Thus, Taghavifar's lab develops data-driven state/uncertainty estimation algorithms to obtain important motion states of the robot if sensors are faulty or only provide partial information. Then, recovered information is used to design control algorithms using reinforcement learning, adaptive robust control, and vision-language-action models.[1,2,3] In addition, runtime safety layers are subsequently added to the framework to monitor risk and enforce safe behavior through a feedback loop.

Another ongoing thrust within LACITS is human-centric autonomy in intelligent transportation systems. The goal here is to produce human-aware decisions that are safe and interpretable in mixed traffic scenarios because human-aware decisions consider nearby human behavior, other autonomous vehicles and road users. In recent works,[4,5] Taghavifar's group has designed a new navigation framework for behaviorally-aware multi-agent systems through deep reinforcement learning by integrating social value orientation to balance the individual agents' social preferences with safety and performance objectives. The lab develops unified and cohesive systems that mix decision-making, local planning, and control. The systems are validated in high-fidelity simulation environments and human-/hardware-in-the-loop experimental setups with the goal of realizing designed algorithms that are aware of real-time hardware constraints.

HAMID TAGHAVIFAR PhD, FHEA, SMIEEE, P.Eng.

Dr. Taghavifar received his PhD in Mechanical Engineering from Urmia University in 2016. From 2017 until 2019 he was a Horizon postdoctoral fellow at Concordia University. In 2019 he joined the School of Mechanical, Aerospace and Automotive Engineering of Coventry University as an Assistant Professor until he joined Concordia University in August 2022 where he is currently an Assistant Professor and Director of the LACITS Lab. His research develops safe and trustworthy autonomy for intelligent transportation and robotics by coupling learning with control: adaptive robust control and state estimation combined with deep reinforcement learning, vision-language models, and risk-aware planning under real-time constraints.

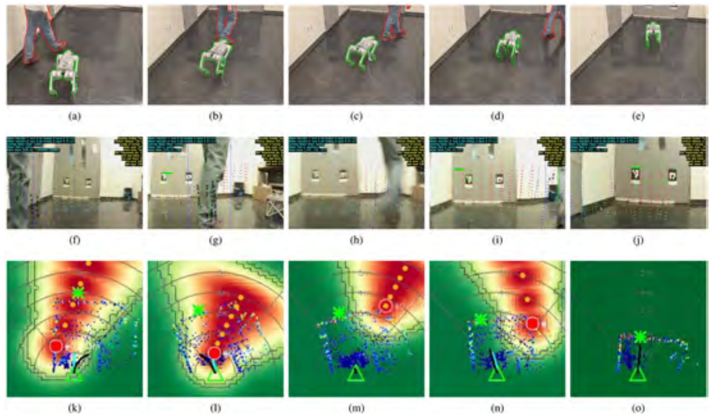

FIG. 1: DEPLOYMENT OF SOCIAL-LOVON ON UNITREE GO2 FOR NAVIGATING AROUND A MOVING HUMAN OBSTACLE. IMAGES A) TO C) ARE A THIRD-PERSON POINT OF VIEW RECORDING OF THE EPISODE. IMAGES D) TO F) ARE SCREENSHOTS OF THE ROBOT'S POINT OF VIEW. IMAGES G) TO I) ARE A VISUALIZATION OF THE APF, PREDICTED HUMAN TRAJECTORY, AND ROBOT TRAJECTORIES. THE ROBOT'S NOMINAL TRAJECTORY IS COLORED IN BLUE AND THE CORRECTED TRAJECTORY IS IN BLACK.

A second thrust is safety-critical embodied autonomy on quadruped robots, using a physical robot as a repeatable platform for sim-to-real iteration and for studying failures that matter in terms of latency, sensing limits, and unpredictable human motion. In recent work, the lab introduced a lightweight, training-free social action shield that extends a vision-language-action navigation system (LOVON) to improve social compliance around people. First, a safety potential field is constructed from estimation of human pose and short-horizon trajectory prediction. Then a hysteresis trigger is activated to avoid chattering which replaces the nominal command when a considerable risk level is detected. In comparative validations, the proposed approach showed improved success and reduced collisions relative to other existing methods. *Figure 1* illustrates the framework that was deployed on a physical quadruped robot to assess the latency and sensing constraints in the physical world. Looking ahead, LACITS considers development of trustworthy autonomy as a major objective by building safety-filtered learning methods, interpretable shared autonomy, and AI-enabled perception and estimation schemes that can be robust and resilient to failure or malfunction. This will help to build robots and autonomous vehicles that operate reliably alongside humans in everyday complex environments.

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The Canadian Society for Mechanical Engineering
A constituent society of the Engineering Institute of Canada

La Société Canadienne de génie mécanique
Une société constituante de l'Institut canadien des ingénieurs

NEWS COMMUNIQUÉ

The Canadian Society for Mechanical Engineering (CSME), founded in 1970, is pleased to announce the winning recipients of its 2026 regular awards. These awards may be bestowed annually to members of the society for their outstanding contributions to specific areas of mechanical engineering in Canada.

The following exceptional professionals, along with previously announced winners of CSME's technical medals, will be presented with their awards on 26 May at the 2026 CSME International Congress to be hosted on 24-27 May by UBC in Vancouver.

Please consider attending the 2026 CSME International Congress to congratulate these exceptional winners: www.csmecongress.org.

CSME G.H. Duggan Medal

For "the best paper in the Transactions of the Canadian Society for Mechanical Engineering *dealing with the use of advanced materials for structural or mechanical purposes"*

Michael Benoit, PhD, MCSME
University of Waterloo, Waterloo, ON

Dr. Michael Benoit is an Assistant Professor in Mechanical Engineering at the University of Waterloo. He is being awarded the CSME G.H. Duggan medal for his recent co-authored publication, entitled "Characterization of a manual gas tungsten arc weld overlay using Inconel 686". This study has advanced our understanding of the relationships between welding process conditions, microstructure, and properties of nickel superalloy Inconel 686 in weld overlay applications for extreme service conditions. Beyond his research contributions, he is also an active member in the manufacturing and materials communities nationally and internationally, undertaking significant service roles such as Chair of the 2025 Canadian Materials Science Conference and Assistant Editor of the *Journal of Materials Processing Technology*.

I.W. Smith Award

For "outstanding achievement in creative mechanical engineering within 10 years of PhD degree"

Yu Zou, PhD, MCSME
University of Toronto, Toronto, ON

Dr. Yu Zou, Associate Professor and Canada Research Chair (CRC) in Materials and Manufacturing for Extreme Environments at the University of Toronto, is recognized in the subdiscipline of Materials and Manufacturing Engineering. He is an international leader in designing advanced structural alloys and additive manufacturing. By linking composition, processing, and mechanical response, his work has accelerated the development of materials tailored for additive manufacturing and demanding service conditions. These advances enable stronger, more reliable components and faster translation from lab concepts to manufacturing solutions. The resulting impacts span aerospace and automotive lightweighting, improved durability for nuclear energy systems, and new options for biomedical materials—benefiting Canadian innovation while strengthening international competitiveness.

Fellow

Mohsen Akbari, PhD, FCSME (2026)

University of Victoria, Victoria, BC

Dr. Mohsen Akbari is an Associate Professor of Mechanical Engineering at the University of Victoria and his exceptional contributions to advanced materials, particularly the development of bioactive fibers for tissue printing and organ weaving, have led to numerous groundbreaking technologies with significant implications for tissue engineering and regenerative medicine. Dr. Akbari's commitment to knowledge translation is evident through his establishment of three companies, organization of events and symposiums, service on the boards of directors of CSME and other Canadian societies, numerous awards and recognitions, and publication of research findings in high-impact journals.

Fellow

Sunny (Ri) Li, PhD, FCSME (2026)

University of British Columbia, Kelowna Campus, BC

Dr. Sunny Li is a professor of mechanical engineering in the School of Engineering at The University of British Columbia. He received his MASc and PhD degrees from The University of Toronto in 2004 and 2008, respectively. Before joining UBC in 2011, he was a research scientist at GE Global Research, NY. At UBC, his Thermal Management & Multiphase Flows Lab advances the knowledge of heat transfer and multiphase flows and develops new methods of enhancing thermal management and predicting heat transfer performance for varied engineering applications. His research contributions are related to effective and energy-saving cooling for microchips and datacenters, heat and moisture transfer through textiles for human thermal comfort, thermal management for gas fuels, and waste heat recovery

Fellow

Kevin Pope, PhD, FCSME (2026)

Memorial University of Newfoundland, St John's, NL

Dr. Kevin Pope at Memorial University of Newfoundland has made significant contributions to more resilient and sustainable energy systems. His contributions to sustainable energy systems, clean hydrogen production, and ocean energy have been published in over 140 journal and conference papers and 4 book chapters. Dr. Pope has developed new predictive models and operating strategies that have improved system performance and reliability, particularly for wind energy and hydrogen production. These research outcomes will significantly contribute to increasing the installed capacity of wind turbines, especially in Canada's remote and northern regions, as well as provide important advances in clean fuel development and decarbonizing energy intensive industries. Dr. Pope received the CSME I.W. Smith award for outstanding achievement in creative mechanical engineering and led the creation of the university's Master of Applied Science in Energy Systems Engineering program. Dr. Pope's impactful contributions to mechanical engineering make him a worthy Fellow of the CSME.

Fellow

Dan Romanyk, PhD, FCSME (2026)

University of Alberta, Edmonton, AB

Dr. Dan Romanyk is an Associate Professor in the Department of Mechanical Engineering, with additional appointments in Biomedical Engineering and the School of Dentistry, at the University of Alberta. He also completed his BSc, PhD, and Postdoctoral Fellowship at the University of Alberta. Dr. Romanyk's primary areas of research surround the characterization of natural and synthetic biomaterials in the craniofacial environment and studying the biomechanics of orthodontic treatment, publishing over 65 journal articles to date. In 2022, Dr. Romanyk served as the Planning and Events Chair for the CSME International Congress, where he was also named as the Chair of the Student Affairs Committee. He also received the CSME IW Smith Award in 2024 for early career achievements. Through both impactful research and service activities, Dr. Romanyk has made a tremendous contribution to CSME and the field of mechanical engineering.

Fellow

Dr. Norman Wereley, PhD, FCSME (2026)

University of Maryland, Maryland, MD

Dr. Wereley, the Minta Martin Professor of Aerospace Engineering at the University of Maryland College Park, is an internationally recognized scholar in (1) smart, composite and cellular materials for occupant protection systems, (2) magnetorheological fluids and devices, and (3) pneumatic artificial muscles for morphing aircraft and robotic applications. He has been recognized as a key architect behind the first-ever organ transplant delivery flight via VTOL drone. He has co-authored over 600 articles, 8 edited books, 19 book chapters, and is the co-inventor of over 20 patents. He is the recipient of the ASME Adaptive Structure and Material Systems Award and SPIE Lifetime Achievement Award in Smart Structures and Materials. Dr. Wereley earned his B.Eng.'82 in Mechanical Engineering from McGill University, and his M.S.'87 and Ph.D.'90 in Aeronautics and Astronautics from the Massachusetts Institute of Technology. He is a Fellow of AIAA, ASME, IOP, RAeS, SPIE, and VFS, acknowledging his extensive technical and service contributions.

Welcome to the Q&A section of the Spring 2026 CSME Bulletin*. In this issue, we have the distinct privilege of sitting down with our outgoing CSME President, Dr. Ali Ahmadi. A distinguished researcher and faculty member at ÉTS Montréal, Dr. Ahmadi has expertly navigated the demands of leading a national engineering society alongside a rigorous academic research program in biofabrication, bioprinting, microfabrication, microfluidics, drug delivery systems, and tissue engineering. As his term draws to a close, he shares his reflections on the evolving landscape of mechanical engineering in Canada. He also offers practical insights into balancing academic responsibilities with professional service and discusses the vital importance of fostering active engagement among our students and colleagues. We hope his experiences and advice inspire your own journey within our professional community.*

Q: As your term as CSME President comes to a close, what initiative or accomplishment during your tenure are you most proud of?

Honestly, no single accomplishment belongs to the President. It is really the result of many people contributing their time and effort to the Society.

That said, we have worked to make CSME more transparent, inclusive, and engaging. We have also strengthened our connection with industry, including creating a new industrial award, increasing industry presence at the Congress, and offering industrial workshops to our members.

We have built strong and productive relationships with other Societies, and made progress on improving our membership system, with an updated CSME website coming soon.

Overall, it has been a collective effort, and that is what I am most proud of.

Q: Leading a national society provides a unique vantage point. How has your perspective on the mechanical engineering landscape in Canada evolved over the course of your presidency?

Over the past few years, things have been changing very quickly, especially with the evolving geopolitical context. There is now a stronger emphasis on supporting Canadian industries and building more resilient and self-reliant systems.

At the same time, AI is rapidly transforming many sectors. It is reshaping how we design, manufacture, and operate systems.

Overall, it has highlighted the need for engineers to stay adaptable and to understand the broader context in which we innovate.

Q: Can you share a specific moment or interaction from your time as President that reinforced the value of volunteer leadership in our professional community?

At the Congress, what stayed with me most was seeing students actively participating as volunteers or participants. Their energy and enthusiasm were present everywhere, from presentations to informal conversations. For me, it was really meaningful to see how much it mattered to them to be part of this community.

Q: Operating a rigorous research program at ÉTS Montréal, particularly one focused on demanding fields like biofabrication, microfluidics, and tissue engineering, while leading a national society is a massive undertaking. What practical strategies have you used to balance your lab's demands with your service commitments, and have your leadership roles within CSME unexpectedly informed or benefited your research directions?

Serving CSME is something I genuinely enjoy, so it never felt like a burden. That said, balance still requires making choices. At times, I had to reduce my service commitments within the department at ÉTS to make room for this role.

While my role at CSME did not directly shape my research directions, I learned a lot from the experienced colleagues on the Board and those who have organized Congresses. I have also been inspired by the accomplishments of CSME award winners.What advice do you have for early-career faculty members who are trying to establish their own research groups but are hesitant to take on service roles? Why should they prioritize getting involved with CSME?

Getting involved helps you build your network, develop leadership skills, and expand your social and professional connections. Opportunities like the Congress, technical committees, student activities, and workshops are great ways to start.

CSME may not always be a highly specialized technical community, but it is our home Society. It is where you see familiar faces, reconnect with colleagues, and meet your role models.

It is also one of those things where everyone contributes a little to create something meaningful that everyone benefits from. I have personally found my involvement with CSME very rewarding.

Q: Engaging the next generation of engineers is crucial for the society's vitality. What approaches have you found most effective for bringing undergraduate and graduate students into the CSME fold?

We worked to activate more local student chapters and create concrete opportunities for students to get involved. At the Congress, we consistently facilitated student presentations and tried to keep registration fees as low as possible to make participation accessible. We also supported free membership for students to lower the barrier to entry.

We encouraged continued engagement beyond graduation by involving former students, now professionals, in different activities. For example, Dr. Lucas Hof at ÉTS, who chaired the 2025 Congress, first attended as a student in 2016 and even won a student award.

Q: Looking ahead, what do you see as the most pressing challenge, or the greatest opportunity, for mechanical engineers in Canada over the next decade?

One of the key challenges and opportunities is ensuring that technological development is ethical and responsible. This may sound obvious, but in today's context, it is more important than ever. As new technologies continue to emerge, engineers need to think beyond performance and efficiency.

Our profession sometimes needs to pause and reflect, and perhaps redefine its relationship with economic drivers, political context, and society. This means considering not only how technologies are developed, but why, and for whom. Maintaining this perspective will be essential to ensure that innovation remains thoughtful, responsible, and aligned with real needs.

Q: As you prepare to pass the baton, what is next for you, both within your research group and in the broader engineering community?

I have recently started working with a European cluster on a large collaborative project, which will require a significant amount of my time and energy. On the service side, I would like to focus a bit more on contributing within my department at ÉTS, especially since they have been very supportive in allowing me to serve CSME over the past few years.

The Engineering Institute of Canada honours two CSME members

A target of 20 members of EIC constituent societies are awarded the title of EIC Fellow by the Council of the Institute in recognition of their excellence in engineering and their services to the profession and to society. (The number of new fellows each year may vary owing to ties for the 20th spot.)

CSME extends congratulations to Professor and Department Chair **Markus Bussmann** (University of Toronto) and Professor **André McDonald** (University of Alberta) who were inducted as 2026 EIC Fellows at a Gala ceremony in Ottawa on April 25 *(pictured below with President of the EIC, Dr. Marius Paraschivoiu).*

Professor Bussmann was named Fellow "*for his leadership and exceptional contributions to mechanical engineering education and administration.*"

Professor McDonald was named Fellow *"for his leadership and outstanding contributions to heat transfer, thermal-sprayed coatings and technology ecosystems."*

ME NEWS *continued . . .*

Toward Advanced Human-Robot Interaction (p. 17)

trol systems, computer vision, and human-computer interaction, emphasizing adaptive and intelligent systems capable of interacting with complex environments. On the west coast, University of British Columbia (UBC) has established itself as a leader in physical human-robot interaction, particularly through research in collaborative robotics and multimodal interfaces. Work within UBC's Mechanical engineering programs focuses on natural and intuitive interaction, integrating gesture recognition, force sensing, and augmented reality to enable seamless human-robot collaboration in manufacturing and service applications. Research also addresses socially aware navigation and intent communication, ensuring that robots can operate safely and predictably in pedestrian-rich environments. These contributions highlight the importance of combining mechanical design with human factors to achieve socially acceptable and functionally robust robotic systems.

Despite this progress, several engineering challenges remain central to advancing HRI. Ensuring safety in unstructured environments requires rigorous validation of mechanical systems and adherence to evolving standards for human-robot collaboration. Achieving high levels of dexterity remains a critical bottleneck, particularly for manipulation tasks involving deformable or fragile objects. Additionally, the development of energy-efficient actuation systems that balance power, weight, and compliance continues to be an active area of research. Human-centric design considerations also play a crucial role, as successful HRI systems must align with human perception, comfort, and trust. Addressing these challenges requires an integrated approach that combines mechanical design, control theory, materials engineering, and human factors. Looking forward, the transition toward Industry 5.0 underscores the importance of human-centric automation, where robots act as collaborators rather than replacements. Mechanical engineering will play a decisive role in enabling this paradigm through the development of safe, adaptive, and efficient physical systems. Emerging applications include assistive robotics for aging populations, collaborative manufacturing systems, and autonomous platforms for remote and extreme environments, including Canada's offshore and Arctic regions. The integration of machine learning with mechanical embodiment, often referred to as physical AI, will further enhance the adaptability of robotic systems, enabling real-time learning and interaction. – *Technical Editor, Dr. Baafour Nyantekyi-Kwakye, MCSME*

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CALL FOR SUBMISSIONS

DESIGNING SUSTAINABLE AND RESILIENT BUILT ENVIRONMENTS

As the Editor of the Canadian Society for Mechanical Engineering (CSME) *Bulletin*, I would like to invite you to submit any of the following items for consideration for publication in the next CSME *Bulletin* issue.

The next issue focuses on **Designing Sustainable and Resilient Built Environments** and will be published in **November 2026**. The guest editors of the issue will be Professor **Hamid Akbarzadeh**, Chair of the Engineering Analysis and Design Technical Committee (TC), and Professor **Lexuan Zhong**, Chair of the Environmental Engineering TC.

FEATURED ARTICLES

The aim of the featured articles is to give our readers an overview of a given sub-topic of the theme (**Designing Sustainable and Resilient Built Environments**), the most recent advancements in the area, and finally, the most critical aspects for future research. The article should be 1,200 words (9,000 characters including spaces) long. If you are interested in submitting a featured article, please submit an Expression of Interest (EoI) by sending a 300-word abstract of the article and a 50-word biography to either **Ali Hosseini** (SayyedAli.Hosseini@ontariotechu.ca) or **Ryan Willing** (rwilling@uwo.ca) by **July 1, 2026**. The most significant contributions will be invited to submit a full featured article that will be due on **Oct. 1, 2026**.

FACULTY SPOTLIGHT

This section highlights new faculty in the Mechanical Engineering Departments across Canada within 4-5 years of their appointment, ideally working on the topic of the issue (though not essential). The aim of this section is to introduce new faculty members to the CSME community; therefore, the article should provide a short biography, an introduction to your research (what is the topic of your research? why is the research topic important?), and a description of your laboratory including past and future work. If you are eligible and interested in submitting an article, please submit an Expression of Interest (EoI) by sending a 100-word abstract and a 50-word biography to either Ali Hosseini (SayyedAli.Hosseini@ontariotechu.ca) or Ryan Willing (rwilling@uwo.ca) by **July 1, 2026**. The most significant contributions will be invited to submit a full article (500 words or 4,000 characters) that will be due on **Oct. 1, 2026**.

SHORT NEWS ITEMS

News of interest to the ME community prior to **Oct. 1, 2026**.

RECOGNITIONS

Highlighting the achievements of ME peers *(not self)* prior to **Oct. 1, 2026**.

IN MEMORIALS

Recognizing the passing of ME members prior to **Oct. 1, 2026**.

For examples of the above contributions, please see previous issues at www.csme-scgm.ca/bulletin.

Thank you for your consideration. I look forward to hearing from you soon.

Sincerely,

Ali Hosseini, PhD, PEng
Associate Professor, Department of Mechanical and Manufacturing Engineering, Ontario Tech University
Editor, Canadian Society for Mechanical Engineering (CSME) *Bulletin*
SayyedAli.Hosseini@ontariotechu.ca

and

Ryan Willing, PhD, PEng
Associate Professor, Department of Mechanical & Materials Engineering, Western University
Associate Editor, Canadian Society for Mechanical Engineering (CSME) *Bulletin*
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TECHNICAL COMMITTEE REPORTS

Advanced Energy Systems

- Our technical committee promoted the Symposium on Advanced Energy Systems in the CSME International Congress 2026 and supported the submission review process. And we will continue to work with the organization committee and support the Symposium in the Congress.
- We organized the Advanced Energy Systems and Thermal Science and Engineering Online Workshop on January 15, 2026, collaborating with the Thermal Science and Engineering TC. Six invited speakers from Canada and Spain shared their perspectives on decarbonizing energy and transportation in municipalities.

— *Dr. XiaoYu Wu*, MCSME

Computational Mechanics

- The interests of this Committee include the development of new algorithms and non-standard applications of existing algorithms. Routine use of software packages for various simulations falls outside its interests.
- The Committee has completed its website.
- The Committee participates in the activities of the International Association for Computational Mechanics. The distribution of individual memberships among its members is being completed.
- The Committee organized a Symposium on Computational Mechanics as a part of the 2025 CSME Congress. This Symposium is sponsored by the Canadian National Committee for Mechanics (IUTAM). A similar symposium is being organized for the 2026 CSME Congress.
- The Committee participates in the activities of the Canadian National Committee for Mechanics.

—*Dr. J.M. Floryan*, FCSME

Environmental Engineering

- Welcomed two new TC members, Prof. Qian Zhang (Queen's University) and Prof. Vahid Hosseini (Simon Fraser University).
- Supporting the Environmental Engineering Symposium as part of the 2026 CSME International Congress at the University of British Columbia (UBC), May 24-27, 2026
- Nominating Prof. Gregory Kopp as a keynote speaker for the Environmental Engineering Symposium at CSME 2026.

— *Dr. Lexuan Zhong*, MCSME

Fluid Mechanics

1. Prof. Fabian Denner, Co-Chair of the Fluid Mechanics Engineering TC, serves as the Fluid Mechanics Chair for the CSME–CFDSC–CSR 2026 International Congress. The symposium has received approximately 40 submissions, and a keynote speaker has been confirmed. Prof. Denner, together with the co-chairs, has reviewed the submissions for the Fluid Mechanics Symposium.
2. Prof. Dana Grecov, Chair of the Fluid Mechanics Engineering TC, continues to serve as an Associate Editor for the *Transactions of the Canadian Society for Mechanical Engineering*.

—*Dr. Dana Grecov, FCSME*

Manufacturing

Current activities:

1. Serving as an associate editor for the *Transactions of the Canadian Society for Mechanical Engineering* (TCSME).
2. Organizing the Advanced Manufacturing symposium at the 2026 CSME Congress at UBC.

Future activities:

3. Continuing to serve as an associate editor for *TCSME*.
4. Continuing the CSME webinar series on Manufacturing, featuring both international and national invited speakers

— *Dr. Farbod Khameneifar*, MCSME

Transportation Systems

CSME 2026 Congress

- Dr. Yuping He (TC chair) and Dr. Bruce Minaker (TC vice chair) will co-chair the Symposium of Transportation Systems at 2026 CSME Congress, May 24-27, 2026, Vancouver, BC.
- Dr. Yuping He reviewed four submissions to the Symposium of Transportation Systems at 2026 CSME Congress, May 24-27, 2026, Vancouver, BC.

TCSME

- Dr. Yuping He (TC chair) serves as an associate editor of TCSME.

— *Dr. Yuping He*, FCSME

CSME STUDENT AFFAIRS REPORT

The 2025/2026 year has continued to be a busy one for student activities and we are very much looking forward to the upcoming Annual Congress at the University of British Columbia. We now have over 10 active CSME Local Student Chapters, with more institutions showing interest all the time as activity grows. The University of Alberta Local Chapter held an Industry Mixer on February 9, where 17 industry representatives from companies including WSP, Aurora Hydrogen, and Baker Hughes met with approximately 50 students to discuss their career paths and experiences *(photos below)*. A number of other insitutions have expressed interest for upcoming planned events engaging their local industry, such as Concordia, and we are excited to see what other Local Chapters have planned!

We are saddened to report that the previous National Design Competition (NDC) Chair, Dr. Grant McSorley, stepped down due to other commitments. Dr. McSorley did an incredible job leading the NDC over the past three years and played an instrumental role in significantly increasing the number of NDC entries to 42 in last year's competition. While we will miss Dr. McSorley, we are excited to welcome Dr. Alison Olechowski from the University of Toronto as the incoming NDC Chair. Submissions will follow last year's competition in an "open format" style allowing teams to submit their report in almost any format to help reduce workload on students and increase interest. For any questions regarding the NDC, please do not hesitate to contact Dr. Olechowski (a.olechowski@utoronto.ca).

— *Dr. Dan Romanyk, MCSME*

INDUSTRY MIXER: UNIVERSITY OF ALBERTA CHAPTER

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