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University of Windsor
Faculty of Engineering

WE WINDSOR ENGINEERING IS PUBLISHED ANNUALLY BY THE FACULTY OF ENGINEERING AT THE UNIVERSITY OF WINDSOR

Editor
Kristie Pearce
Faculty of Engineering

Editorial
Kristie Pearce

Sarah Sacheli
Office of Public Affairs and Communications

Graphic Design
Angelo Montilla
Office of Public Affairs and Communications

Photography
Kristie Pearce

Tom Zasadzinski
California State Polutechnic University, Pomona
(Page 12)

Submit all editorial inquiries to:
Communications Coordinator
Faculty of Engineering
401 Sunset Ave.
Windsor, Ontario, Canada N9B 3P4
519.253.3000, Ext. 4128
kpearce@uwindsor.ca

Address changes:
Alumni Affairs
alumni@uwindsor.ca
uwindsor.ca/alumni

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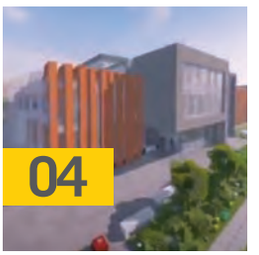

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Student Spotlight

Front Cover: This composite photo includes an image of students, faculty and community members gathered for a research networking event in the Ed Lumley Centre for Engineering Innovation within an image of a researcher examining a test tube. The image implies solutions are within and highlights the critical role engineers have in finding innovative solutions to societal challenges.

A MESSAGE FROM THE DEAN

It has been more than half a year since my last message in the early days of the pandemic. The virus has touched all facets of our daily lives as we adapt to counter the changing circumstances. Pre-pandemic times may never be back and a new normal may be here.

Pandemic or not, life goes on, and the Faculty remains steadfast in its mission to generate knowledge and develop ethical and socially responsible engineers who contribute to the betterment of society. Since March, our students and professors have pivoted to remote education. It takes a Herculean effort to go from the traditional delivery of engineering education to remote teaching. We quickly formed the Engineering Online Teaching Advisory Group (OTAG) to work closely with the university's Centre for Teaching and Learning to address remote teaching pedagogies.

As a community-engaged Faculty, we started on a rapid response to fight against the pandemic. In this issue of Windsor Engineering (WE), you'll learn how our faculty, students and industrial partners came together to provide personal protective equipment (PPE) to health care workers, innovate low-cost ventilator designs, improve COVID-19 testing methods and more. While this issue is mainly devoted to pandemic-related news, the Faculty is making great strides in many other areas such as advancing equity, diversity, and inclusion (EDI); improving students' experience and mental health support and achieving greater prominence in research.

In response to the growing needs of the Faculty amid the COVID-19 crisis, we established the UWindsor Engineering COVID-19 Action Fund. The flexibility of this fund allows us to direct funds where they are needed most to respond to the crisis, including time-critical research; maximizing the curriculum and resources for distance learning; and students who are experiencing hardships.

Our students are and will continue to face enormous COVID-related financial challenges for the foreseeable future. They are now dealing with the uncertainty of employment and internships, a reduction or loss of part-time work, or family related financial hardships. They can use the support of the Faculty's alumni, friends and partners to get through this trying phase in their life and education.

I ask you to open your hearts and consider supporting our students. You can learn more about our Action Fund on the back cover of this magazine. With compassion, resilience and teamwork, we have navigated through the monumental chaos and crisis thus far, and with clouds of the Coronavirus lingering around, I expect that the road ahead will remain bumpy at best. Through empathy and teamwork, we can overcome the hurdles ahead and they too shall pass. I am not sure who exactly coined the quote "success has many parents," but it takes leadership and contributions from everyone — faculty, students, staff, alumni, industrial/government partners, and our friends in the community — to successfully navigate through these times.

The current crisis has taught us how to have more compassion for one another; how to look after the frail and vulnerable amongst us; how to work together towards a common objective; how to be more understanding and selfless; how to care for our planet and environment; and how to love one another.

Now more than ever we need to stay connected even though we are separated by distance. I urge you to remain engaged and connected to the Faculty. And please, keep well and stay safe.

Respectfully yours,

Dr. Mehrdad Saif, FCAE, FIET, P.Eng.
Dean, Faculty of Engineering
Professor, Electrical and Computer Engineering

ENGINEERING BY THE NUMBERS

20+
engineering student clubs

499
Student co-op placements

57
outstanding scholars

14,112
alumni worldwide

86
faculty and support staff

$1.2+ million
Graduate scholarships

1,420
Undergraduate students

24% International
76% Domestic

$1.9+ million
Undergraduate scholarships

1,766
Grad students

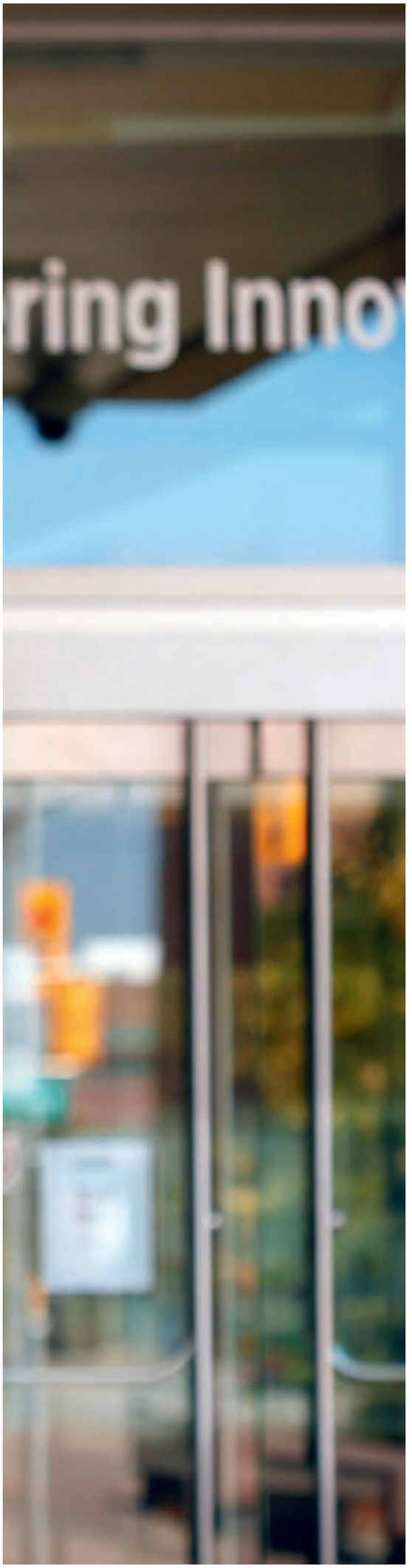
88% International
12% Domestic

52
Number of days it took our students to create a virtual campus

60
Students Involved

Background photo shows a virtual Ed Lumley Centre for Engineering Innovation a team of engineering students created in Minecraft for their peers to visit and connect with each other during remote learning. Learn more about this student-led initiative on page 33.


Lumley Centre for Engineer



TACKLING A PANDEMIC — TOGETHER

A COMMUNITY RESPONSE TO COVID-19

This past year, the world has been brought to its knees in one collective swoop.

We are facing challenges that transcend geography, culture and social status.

We have been isolated in our homes and forced to communicate with others through the blue glow of our screens.

We didn't get to feel the nervous pit in our stomachs as we walked on campus for our first year of university nor the elation as we proudly strolled across the stage to receive our hard-earned diplomas.

We've missed celebrating milestones and mourning the loss of loved ones. We've lost jobs and businesses and weren't sure how we were going to make ends meet.

Worst of all, we've lost mothers, fathers, daughters and sons — sometimes without being there to hold their hands or kiss them one last time.

We've been told to keep our distance and stay away from one another. But yet, we've come together in unimaginable ways. We asked how we can help ensure our frontline workers are protected and safe, how we can produce enough ventilators to save those in critical care and how communities and businesses can be resilient in the face of a pandemic.

From revolutionizing the COVID-19 testing process to producing face shields for frontline workers, University of Windsor researchers and students, community members and local industry all had the same question — how can we help combat the spread of the virus?

Here's how they responded.

Anna Simone BASc '20 delivered remarks on behalf of the graduating class of 2020 in the university's first-ever virtual convocation.

Parker Drouillard displays the face shield parts he has been producing with 3D printers in the Ed Lumley Centre for Engineering Innovation.

MAKING LIFE-SAVING TECHNOLOGY ACCESSIBLE

Jeff Defoe, a professor of mechanical engineering, is developing a low-cost ventilator that can be assembled from off-the-shelf components and has almost no moving parts.

Dr. Defoe says he expects his model to cost approximately one-tenth the price of most current ventilators.

"The final design will be openly available to enable widespread adoption for manufacturing in case future waves of COVID-19 or other respiratory diseases require high levels of hospitalization in intensive care with ventilators," he says.

Defoe will finalize the design using flow simulation tools that include human lung and chest cavity characteristics.

When the design is proven in a simulated environment, a prototype will be constructed and tested on a medical-grade patient lung simulator device that provides accurate representations of adult pulmonary mechanics and the lung capacity of a typical adult patient. Defoe plans on working with local health centres and medical professionals to conduct in-hospital testing and monitoring with the hopes of clinical trials in the future.

Biafore Associates Inc. and local physician Mason Leschyna have partnered on the $50,000 Natural Sciences and Engineering Research Council of Canada (NSERC) Alliance funded project. Software and user interface design support will be provided by Maya HTT and Grantek Inc.

Dr. Leschyna came up with the concept for the project and is a clinician who will remain actively involved after the project is completed, Defoe says. Experienced with Health Canada processes for approvals of new medical devices, Biafore Associates Inc. will provide management consulting.

Defoe says the design may enable ventilation-supported care in developing nations where traditional ventilator costs are prohibitive.

"The outcome of the overall project will thus be highly significant for health outcomes in Canada and around the world for dealing with the current and future pandemics."

PROTECTING OUR FRONTLINE WORKERS

Valiant TMS is assisting Jill Urbanic's research team with the production of brackets for 3D-printed face shields. The global company headquartered in Windsor has provided material, testing, building and assembly support.

"We are trying to meet requests and there have been several from a wide variety of front-line personnel," Dr. Urbanic says. "This need is what is driving us forward."

Shields have been delivered locally to three nursing departments at Windsor Regional Hospital, two nursing homes and an x-ray clinic and up Highway 401 to the intensive care unit at St. Joseph's Hospital and St. Joseph's Family Medical and Dental Centre in Toronto.

The shields are designed to be lightweight and adjustable in size. Urbanic says the designs have been optimized to leverage the most effective manufacturing processes.

"The top cover and retainer can be laser cut or water jet cut. The materials should allow for reuse. We would like to pursue molding the flexi-band with local mold shops, if they are interested."

Master's student Alireza Pasha and doctoral candidates Hamed Kalami and Morteza Alebooyeh have been brainstorming with engineering professor Urbanic since the pandemic hit.

The team has designed hands-free openers for doors using a J-hook attachment so people can use their forearms to pull a door open. It works on doors with vertical bars for handles, but the team has designed versions for other types of door handles, too. The graduate students are also using the 3D printer to make prototypes of parts for ventilators.

"While there has been no recognized treatment for the virus to the moment, effective prevention with these high-demand supplies and tools is of the most importance," Alebooyeh says.

Urbanic credits her students for putting their expertise and ingenuity to good use.

"All of us have been wanting to help," she says. "This is our duty to society."

Several departments university-wide have joined in on the effort, including UWindsor Print Shop's Jen Almeida, who secured the plastic materials used for the visors. UWindsor EPICentre's Wen Teoh, Amandeep Singh and Paul Brereton are assisting with laser cutting the top cover and retainer and printing the flexi-band part. Rod Strickland and Michael Lucenkiw from the School of Creative Arts have also assisted with printing efforts.

Valiant TMS is assisting Dr. Urbanic's research team with the production of brackets for 3D-printed face shields.

"CAMufacturing Solutions, Inc. has been involved in sourcing hand band straps, face shield materials, logistics, etc. and we also managed to get TheraBands from a local physiotherapist, Praveen Oommen from Sabga Physiotherapy-Huron (The CARE Institute) who provided materials when we didn't receive our order on time."

Not far from Urbanic's lab, tucked away in the Ed Lumley Centre for Engineering Innovation, is a 3D print shop that has been quietly expanding its fleet since the pandemic hit.

In just a week, Parker Drouillard, the owner of Pep Corporation — an incubator member of EPICentre UWindsor's EPIC Industrial Hub — doubled the number of his self-made 3D printers to assist in the global fight against the spread of COVID-19.

"We normally print automotive parts, but our clients, mostly automotive manufacturers, are being asked to retool," Drouillard says from his shop floor filled with the whirring sound of nearly 30 printers hard at work.

"As a result, quite of a few our partners have reached out to us."

Drouillard has been approached by clients and businesses from Windsor to Toronto that need parts to assemble ventilators and face shields, including a Quebec company that is producing sanitization equipment.

He has also joined forces with community partners WEtech-Alliance, EPICentre UWindsor and Windsor-Essex FIRST to donate 500 face shields to essential workers across Windsor-Essex and Chatham-Kent. He is producing the plastic components that hold the face shield in place based on a design created by Kelcom 3D Division.

Unlike most face shields, the Kelcom design — which was created in collaboration with healthcare providers — includes a unique bottom plastic retainer to prevent inhalation of respiratory droplets. It's been dubbed the YQG Shield.

"Patients are typically lying down below the healthcare worker, so this design gives them added protection," Drouillard says.

Pep Corporation's 3D printers are made in-house with 136 parts printed on the company's existing machines and water-jet cut materials produced by UWindsor Engineering technologists.

"We're quite fortunate to be in the position we are in; being able to help out and being busier than ever, rather than the sad reality many businesses today are facing," says Drouillard.

FASTER AND MORE RELIABLE TESTING

A multidisciplinary UWindsor team is trying to revolutionize the testing process for COVID-19 by developing a portable device that is quicker, cheaper and more accurate than current laboratory tests.

Dr. Jill Urbanic's team has designed hands-free door openers using a J-hook attachment.

Parker Drouillard holds 3D-printed parts that can be used for ventilators.

Dubbed Lab-on-a-Chip, the device would allow healthcare workers to test and diagnose patients on the spot, says Jalal Ahamed, one of four UWindsor professors behind the research.

"Accurate, rapid, on-site and point-of-care detection has paramount importance not only in Canada but also worldwide for early intervention and infection control," he says.

"Development of such a device will be highly impactful in our fight against COVID-19."

Currently, testing is performed in sophisticated laboratory settings. Patients are swabbed and the samples are sent away to labs, with the turnaround time for results usually measured in days. Lab-on-a-Chip devices could give results in minutes.

Dr. Ahamed, who is working on the project with fellow engineering professor Mitra Mirhassani and chemistry professors Yufeng Tong and Simon Rondeau-Gagné, has been awarded a $50,000 NSERC grant.

It is one of many COVID-related projects at UWindsor that NSERC has funded at the maximum amount available under a special $15 million fund established to address the pandemic.

The research team has partnered with APAG Elektronik Corp., a Swiss firm with a Windsor production site that manufactures electronics and lighting components.

"Our device is based on detecting the electrical signal produced when a viral protein binds with the virus receptor of human cells called ACE2, short for human angiotensin converting enzyme-2 protein," Dr. Tong explains.

The company will lend its electronic manufacturing and distribution know-how to the project, building on the UWindsor researchers' expertise in developing sensors.

"Until a vaccine is developed, our ability to reduce the transmission of COVID-19 is directly dependent on the capacity to rapidly test, diagnose the virus and place those infected in isolation," Dr. Mirhassani says.

"With this new device in our hands, our response to this crisis will be significantly improved, helping healthcare providers fight the virus and reduce its spread."

KEEPING US PROTECTED

The rise of the COVID-19 pandemic has exposed a worldwide need for readily accessible, high-grade face masks.

"The limited supply of essential protective equipment such as N95 face masks, which have been determined to aid in minimizing the spread of this disease, has proven detrimental to both health professionals and the public," says Reza Riahi, a professor of materials engineering.

Dr. Riahi is working with local manufacturers to develop activated nano-fibre layers produced by an electrospinning method, where a high voltage is applied to a polymer solution to produce nano-fibres with a high surface area and surface charges. These layers can be used to fabricate filters that are more effective than N95 masks, he says.

"By using porous functional nano-fibre layers, we can produce high-efficiency mask filters to block fine particles, including bio-airborne, while minimizing breathing effort," he says of the material, which can also be used as a filter in home-made masks or as a standalone fabric to make masks.

Riahi has partnered with NanoPhyll Inc. and River Drive Manufacturing on the $50,000 NSERC funded project. The companies are providing $29,000 of in-kind support.

While many civilians have turned to homemade masks, Riahi says they provide only limited protection for those around and little for the user. Surgical masks, he adds, offer limited protection due to the high particle size penetration provided by its mechanical filters as opposed to the low penetration size offered by N95 masks.

"However, the majority of N95 masks are manufactured outside of Canada," Riahi says.

"The results from this project will be readily transferable to Canadian industries to produce high-efficiency mask filters for protection against COVID-19 for both the users and those around."

SHIELDING ESSENTIAL WORKERS

Civil engineering professors Rajeev Ruparathna and Niel Van Engelen are using computer modeling to help construction workers operate safely and efficiently during pandemics.

The two are developing an implementation strategy for maintaining physical distance using a Building Information Modeling (BIM)-based optimized work schedule.

The 4D modeling feature of BIM will allow the duo to predict construction worker movements and make alterations to project schedules to mitigate health risks.

"Site managers will be able to leverage the proposed scheduling technique and training material to enhance site productivity and safety and avoid costly shutdowns during pandemics," says Dr. Ruparathna.

BIM and dynamic modeling will help the researchers identify high-risk zones in construction projects and develop safer work schedules that help maintain physical distancing.

The proposed schedules will be further evaluated to understand the impact on the total project cost, schedule and quality. Investigators aim to use this project to promote and develop training material for BIM-based safety planning in the construction industry.

The project is funded through a $49,500 NSERC Alliance Grant and will be completed in collaboration with the Infrastructure Health and Safety Association, which is providing $15K of in-kind support.

IMPROVING LIFE IN ISOLATION

Eunsik Kim, an engineering professor who specializes in gamification, is looking into ways of offering virtual rewards for things like social distancing, self-isolation, fitness, or even handwashing during the pandemic.

"We will use game elements in a non-game context to encourage people to maintain healthy practices, not just for entertainment, but to educate people," Dr. Kim says.

"In addition, by connecting with others through gamification the loneliness epidemic associated with social distancing, quarantine and isolation can be allayed."

Gamification is the application of typical elements of game-playing — competition, scoring and rules of play — to encourage participation.

Gamification encourages participants to engage in desired behaviours by capitalizing on the human psychological predisposition to engage in gaming.

Dr. Reza Riahi is working with local manufacturers to develop activated nano-fibre layers produced nano-fibres with a high surface area and surface charges. These layers can be used to fabricate filters

Kim's project, which will be developed in collaboration with master's student Gorav Nayak, will involve designing a website available to Apple and Android operating systems that users can share through social media.

Participants will be able to create activities and share tips while competing for virtual prizes, scoring points, earning badges, or climbing leaderboards.

The project's goal is to slow the spread of COVID-19 by encouraging people to engage in prudent behaviours to combat the pandemic.

Kim has received funding through the University of Windsor and the WE-Spark Health Institute, a research partnership involving the University of Windsor, Windsor Regional Hospital, Hotel-Dieu Grace Healthcare and St. Clair College. It is one of more than 20 local COVID-related research projects receiving support from WE-Spark through its COVID-19 Rapid Response grant program.

by an electrospinning method, where a high voltage is applied to a polymer solution to produce that are more effective than N95 masks.

HOW TO BE RESILIENT TO FUTURE PANDEMICS

What is it about some communities that allows them to manage a pandemic and return to normalcy faster than others?

A UWindsor team led by engineering professor Edwin Tam will delve into that question with sweeping research into municipalities' experiences under COVID-19. The research team will examine demographics, governance, infrastructure and services to create a template to help Windsor and Essex County and other cities prepare for future pandemics.

"We hypothesize that specific municipal characteristics enhance a community's resiliency," says Dr. Tam. "Our overall goal is to assess if there are physical characteristics, demographic profiles, infrastructure, policies and practices specific to a community that enhance its ability to withstand and overcome a pandemic."

Put simply, he says "they want to know what it is about a city that helps it combat the spread."

Tam, who specializes in research in environmental engineering, has partnered with fellow engineering professor Tirupati Bolisetti and math and statistics professors Mohamed Belalia and Myron Hlynka on the one-year project. Law professor Anneke Smit, founding director of the Windsor Law Centre for Cities, will bring her expertise about governance issues as another partner on the research.

The team will be looking at all manner of municipal services and policies. It will examine the overlap of pandemic response and other emergency or public health planning, Tam says. In heat emergencies, for example, people would normally be directed to shopping malls, community centres, or municipal pools. With facilities closed during the pandemic, how are communities responding?

Using flooding as another example, Tam asked, "How do you deal with climate change during a pandemic?"

The team will use data on municipalities collected by the Canadian Urban Institute, a national platform for people interested in building better cities. Tam says his team also hopes to compare Windsor to Detroit.

The severity of the impacts varies by country and by city, with city characteristics such as size, population and density playing a role, Tam says.

"However, these alone cannot explain all differences and similar regions or cities have not experienced the impacts equally."

He says the project will be an opportunity for students to do research. He intends to have the team's analysis completed in early 2021.

Tam has been awarded a $5,000 grant to begin collecting data and doing interviews. The money comes from UWindsor's Office of the Vice-President of Research and Innovation and the WE-Spark Health Institute.

Read a column on this topic written by Dr. Edwin Tam on page 24.

A UWindsor team is collecting samples from the Lou Romano Water Reclamation Plant in Windsor, Ont., pictured above, to track COVID-19 levels in the community.

TRACKING COVID-19 IN WINDSOR-ESSEX THROUGH WASTEWATER

A team of UWindsor researchers is using sewage to track and create an early warning system for the community spread of COVID-19.

Mike McKay, executive director of UWindsor's Great Lakes Institute for Environmental Research, is leading the project in conjunction with civil and environmental engineering professors, Nihar Biswas and Rajesh Seth and researchers from UWindsor's Faculty of Science and the University of Tennessee.

Early into the pandemic, Dr. McKay recognized you can determine trends in the infection rates in a given community by detecting the presence of the virus's genetic signature in the sewage entering wastewater treatment plants.

"An alternative to testing individuals lies literally beneath our feet in our municipal sewer systems," McKay says.

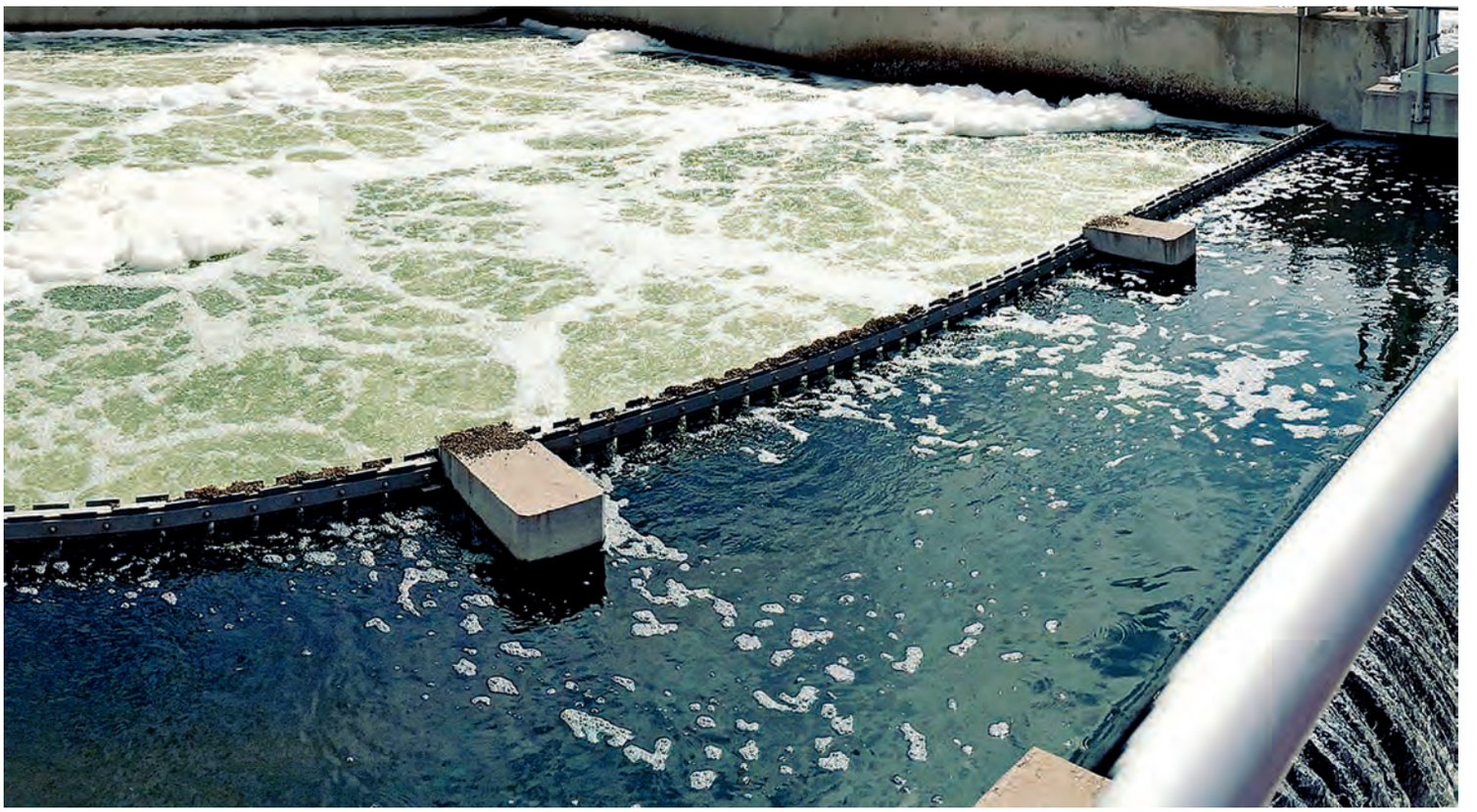
"A 24-hour composite sample of raw sewage represents the fecal discharge of the entire community served by the plant, effectively providing a community-wide swab."

Staff at sewage treatment plants regularly collect samples of wastewater entering and leaving their facilities as part of regulatory compliance and process testing.

The UWindsor team is gathering those samples from plants in Windsor, Lakeshore, Amherstburg and London and analyzing them for the presence of the virus's RNA.

"It appears many people infected with the virus are asymptomatic or experience less severe symptoms and do not seek medical care or are otherwise not tested," McKay says.

Dr. Seth and Dr. Biswas are providing data analysis and investigating the potential of concentrating sampling at targeted locations.



"We are investigating the possibility of using sewersheds to track and mitigate outbreaks at targeted, high-risk locations, such as long-term care facilities or student dorms," Seth says. "In addition to providing a broader scan of people who have not been tested, it's cost effective."

Seth says just a few wastewater samples collected from sewers at targeted locations or the sewage treatment plants are able to capture results from the entire contributing population. Developing wastewater-based epidemiology expertise and related infrastructure can help the community prepare for future pandemics or return waves of the current one, he adds. The project has to date received $300,000 for equipment from the Canada Foundation for Innovation and $50,000 from NSERC under special funds established in response to COVID-19.

The team is also collaborating with scientists conducting similar research across Ontario coordinated through the Canadian Water Network's COVID-19 Wastewater Coalition.

INVEST IN TIME-CRITICAL RESEARCH

In response to the growing needs of the Faculty of Engineering amid this uncertain time, we have established the UWindsor Engineering COVID-19 Action Fund.

Engineers are essential to finding innovative solutions to problems that are critical to society.

As you've read in this issue of WE, our researchers, students and community partners have come together to tackle the global pandemic.

You can join us by supporting their innovative solutions to challenges sweeping the globe by making a donation to this Action Fund at www.uwindsor.ca/donate - designate to "Engineering COVID-19 Action Fund."

For more information, please contact Katie Mazzuca, major gift officer, at katie.mazzuca@uwindsor.ca or 519-253-3000, Ext. 5959.

ALUMNI PROFILE

AN ALUM'S RISE IN ENGINEERING AND POLITICS

"WHERE I AM NOW IS BECAUSE OF WINDSOR — AND THAT'S THE TRUTH."

DR. MOHAMED RAFIQUZZAMAN
MASc '72, PhD '74

Mohamed Rafiquzzaman is pictured in his lab at the California State Polytechnic University, Pomona.

Mohamed Rafiquzzaman has managed Olympic events, advised the White House on technology policies and worked on Governor Arnold Schwarzenegger's economic recovery team.

He's launched a global company that manufactures lenses for cataract patients and published 18 books that have been translated into Russian, Spanish and Chinese languages.

But he's never forgot where it all started.

Dr. Rafi MASc '72, PhD '74, remembers working diligently to prove himself to professors who challenged him to be his best. He also remembers those same professors welcoming him to jovial holiday gatherings in the staff room and joining him for a burger break at the Harvey's on campus.

"When you worked, you worked very hard, but I learned how to enjoy life there too," Rafi says about a belief he's carried throughout his life. "Where I am now is because of Windsor — and that's the truth."

Rafi was born in Bangladesh and moved to Canada in 1970 with his family to pursue a master's in electrical engineering at the university that presented him the most competitive offer on both sides of the border — the University of Windsor.

His thesis advisor, Dr. William Miller, helped him and his wife and son settle in a new country they now called home and introduced Rafi to computers, which he had never seen before in his life.

To this day, the two still talk and visit each other when they can.

Miller had a significant influence on his career; from the months of collaboration in the lab, to the meticulous hours the professor spent helping him prepare an industry-ready resume.

"And now I do the same thing with my students," says Rafi, who followed in Miller's footsteps and became an electrical engineering professor.

Rafi's career started in Toronto at Bell Northern Research and then Imperial Oil in Sarnia. He now resides in Los Angeles where his business is headquartered and the university he teaches at, California State Polytechnic University, Pomona, is located.

Rafi has rubbed shoulders with Schwarzenegger and eventually landed a spot on the former governor's economic advisory team to help determine which areas of the economy should be mended first. He now calls him a friend.

A quip he made to a stranger in a bathroom led him to the Olympics as a manager of the Olympic swimming and diving events. It turns out the man he made laugh was the CEO of one of the biggest sponsors of the '84 Olympics.

"It's so important to be focused and positive. I try to beat any negativity," Rafi says. "Start your day with laughter. Work hard along with a positive attitude and you'll never lose."

Rafi says the valuable lessons he learned and practiced in life are crucial to his success. He tries to instill the same principles in the hundreds of students he's taught in his 42-year career.

"I tell them to always try to improve yourself and you can do anything in this world," he says. "Don't blame someone else when something doesn't work out. You improve it. If you have that attitude, no one is going to stop you."

Engineers especially have an opportunity to make an impact in the world, he adds. During a three-year stint as an advisor to the White House's Technology Policy Committee in 2003, he helped bolster breakthrough bio-medical research.

Dr. Rafi also helped introduce computer technology in Bangladesh in 1990 as an advisor to the country's president.

FACULTY INNOVATION

A PARADIGM SHIFT IN EV DESIGN

The results of a collaboration between industry and researchers in UWindsor's Centre for Hybrid Automotive Research and Green Energy will be integrated into next generation electric vehicles.

POWERING NEXT-GEN ELECTRIC VEHICLES

With a powerhouse team of multi-disciplinary researchers, a UWindsor Engineering prof is paving the way for an electric future.

Narayan Kar has received nearly $4.6 million in federal and industrial funding to develop the next generation of motors for electric vehicles in collaboration with the Canadian auto industry.

They are required to be lightweight, compact, low-cost, efficient and above all, reliable.

These high–performance motors, in addition to new motor testing technologies, have the potential to significantly reduce costs and extend the driving range of electric vehicles to meet aggressive 2025 traction motor targets set by the U.S. government, automakers and energy companies.

Recent trends show electric vehicle manufacturers adopting multi–motor, all–wheel drive systems to increase the driving range and performance.

However, to support mass market adoption of these technologies, Dr. Kar says there is a critical need to develop motors that are high-performing, compact, lighter, cost–effective and easily manufacturable.

"Our industrial collaborations aim to directly address these needs by developing lightweight, multi–material and high–efficiency traction motors with improved thermal and structural integrity, as well as fast and comprehensive evaluation methods for motors," adds Kar, who is the founder and leader of UWindsor's Centre for Hybrid Automotive Research and Green Energy (CHARGE) Lab.

Kar is leading several projects with multidisciplinary teams of University of Windsor experts in materials, electrical, mechanical, thermal and software engineering in collaboration with leaders in the automotive sector, including Ford Motor Company of Canada, Nemak and D&V Electronics.

The final results of the projects are expected to be integrated into next generation electric vehicles. Through the CHARGE Lab's long-standing partnerships with Ford and D&V Electronics, Kar and his multi-disciplinary team of researchers have successfully developed new, compact, efficient and reliable electric motors.

More than 40 researchers from undergraduate and graduate students to post–doctoral fellows will contribute to the projects.

"Our students will acquire research expertise and capabilities by interacting with supporting organizations to advance traction motor and automated motor testing technologies and to help propel a paradigm shift in overall electric vehicle design," Kar says.

Kar's multiple projects have secured more than $2.1 million from the Natural Sciences and Engineering Research Council of Canada (NSERC) with additional industry cash and in-kind investment of more than $2.4 million.

The grants are funded through NSERC's Discovery Grant and Alliance Grant programs,

Narayan Kar has received nearly $4.6 million in federal and industrial funding to develop the next generation of motors and drives for electric vehicles.

which support research with long-term goals and encourage university researchers to collaborate with private, public or not–for–profit sector organizations to generate new knowledge and accelerate the application of research results.

Six UWindsor researchers are contributing to the projects, including Xueyuan Nie, Henry Hu and Ofelia Jianu from the Mechanical, Automotive and Materials Engineering Department; Engineering Dean Mehrdad Saif from the Electrical and Computer Engineering Department; Nick Vukotic from the Chemistry and Biochemistry Department; and Ziad Kobti, director of the School of Computer Science.

STUDENT SPOTLIGHT

WINDSOR STARTUP SHINES ON INTERNATIONAL STAGE

CUTTING-EDGE CREATION

It's a hot summer day and your grass needs a trim. Sweat drips down your face as you lug your lawnmower out of the shed and yank on the starter rope until the sharp blades roar to life.

There's got to be a better way, you think, as exhaust fumes fills the air and the motor drowns out the chirping birds and children playing in their yards.

Nigel Christian and Zain Shaikh found one.

Inspired by their humid, childhood summers in Southern Ontario, the two, now studying engineering at the University of Windsor, have created a lawnmower that is virtually silent, lightweight, emissions-free and safer than any product on the market. They call it Secara — derived from a Latin word for cut.

"Lawnmower accidents are the leading cause of major amputations for children under 10," Christian says.

"Traditionally, lawnmowers use a heavy rotating blade, which can also cause debris such as rocks and sticks to become a dangerous flying projectile. Our patent-pending, reciprocating blade technology can prevent this from happening."

Secara is made with 75 per cent less components than other mowers and its cutting technology is maintenance free — this means no sharpening. Shaikh says the high-grade stainless steel used contains specific properties for low friction and granular wear, ensuring a sharp edge throughout the lifetime of the blade. The battery-powered, cordless mower is also 80 per cent quieter than conventional mowers.

(L-R) Nigel Christian and Zain Shaikh receive a special recognition award at the Jacobs Startup Competition in Bremen, Germany.

"Weight-saving materials like high-grade aluminum and stainless steel in addition to sustainable manufacturing methods allow us to produce durable, lightweight and cost-effective components," Shaikh says.

"As a result, Secara's light weight makes lawnmowing accessible to everyone regardless of physical ability."

The 2020 engineering graduates were selected out of thousands to represent Canada in the Jacobs Startup Competition, a global competition held in Bremen, Germany in late March.

Secara is made with 75 per cent less components than other mowers and its cutting technology is maintenance free — this means no sharpening.

There, they joined 10 teams from around the world to present a sales pitch to established accelerators and investors.

The two landed a free partnership with a marketing firm located in London, England and met with industry leaders from top European companies, who provided resources to further expand their start-up business, Aviot Industries.

Robin Wolters, the organizer of the Jacobs Startup Competition, said the competition provides a platform for "the best entrepreneurs from all around the world to stand out with their business idea."

"Secara inspired the audience with its innovative idea of a virtually silent and lightweight lawnmower. Secara stood out among other startups by introducing a physical product that every house owner needs. I can see this startup idea turning into a success story very fast, very soon."

The next step for Aviot Industries is to launch Secara on its upcoming crowdfunding campaign and export the product from Canada to customers worldwide. The lawnmower will soon be available for pre-order online and ultimately, in big box stores in the near future.

"Our market research discovered that in addition to safety concerns, noise and emissions, one of the major obstacles current lawnmower users face is mowing hard-to-reach places such as underneath trees, lawn furniture and decks," says Christian.

"WEIGHT-SAVING MATERIALS LIKE HIGH-GRADE ALUMINUM AND STAINLESS STEEL IN ADDITION TO SUSTAINABLE MANUFACTURING METHODS ALLOW US TO PRODUCE DURABLE, LIGHTWEIGHT AND COST-EFFECTIVE COMPONENTS."

ZAIN SHAIKH, CO-CREATOR OF SECERA

To solve this, the duo designed a handlebar that can be adjusted by 90 degrees, allowing users to easily maneuver and cut grass under tight spots.

The duo says the support of the WindsorEssex Small Business Centre and University of Windsor has been critical to their success.

Learn more about Secara and its launch at https://mailchi.mp/bdc20a218ce4/secara.

INVESTING IN OUR FUTURE ENGINEERS

The Dr. Voiko Loukanov Engineering Scholarship will be given to an engineering student who is contributing to electric vehicle research at UWindsor's CHARGE lab, pictured above.

DR. VOIKO LOUKANOV ENGINEERING SCHOLARSHIP ESTABLISHED AT UNIVERSITY OF WINDSOR BY D&V ELECTRONICS IN HONOUR OF ITS FOUNDER

In celebration of an entrepreneur who had a passion for mentoring students and an appetite for innovation, a memorial scholarship will support students at the forefront of electric vehicle research.

The Dr. Voiko Loukanov Engineering Scholarship has been established at the University of Windsor by D&V Electronics in honour of its founder, who has guided many engineering students in research projects to develop advanced technologies.

Dr. Loukanov was an entrepreneur who led D&V Electronics in pioneering and developing scientific testing technologies and expanded the test equipment company's reach to thousands of customers in more than 90 countries.

In addition to taking co-op students under his wing, Loukanov spent more than a decade advancing electric vehicle research with Dr. Narayan Kar, a UWindsor prof who leads the Centre for Hybrid Automotive Research and Green Energy (CHARGE) Lab.

D&V continues to work closely with Kar and is developing cutting-edge testing methods for electric motors in collaboration with UWindsor and Ford Motor Company on a $4.3 million project.

"Voiko was a firm believer in the importance of investing in education and research. He truly believed that engineers would change the world. He loved to mentor students," says his wife Kalina Loukanov, executive vice president of D&V Electronics.

"Forward thinking industries require a steady stream of talented innovators and engineers. That's why he always believed in the young generation; in mentoring them and inspiring them — the next generation of engineers."

Loukanov started his career as an engineering professor in Bulgaria. He was a beloved professor and researcher.

Teaching was his passion, Kalina says. He and his family moved to Canada in 1994 and less than three years later, he was running his own business.

When he passed away suddenly in 2016, Kalina says there was an outpouring from D&V employees, including one colleague who told her they had "lost their father."

D&V's team of approximately 150 employees is a tight-knit group that designs and manufactures performance, endurance and production systems for the advanced testing of electric and hybrid vehicle motors, inverters, batteries and E-axles.

The company has automotive clients across the globe.

"My husband deeply cared for and respected all D&V employees."

When D&V opened a new facility in 2003 on the outskirts of Woodbridge that wasn't easily accessible by public transit, Loukanov arranged for employee transportation.

"Even though D&V has moved ownership, we try to preserve the same culture of innovation that Voiko established when he was here," says Bill Hardy, D&V's CEO. "A culture with the highest degree of engineering standards and a caring, customer-focused workplace."

Hardy says the company is known for giving engineering grads a high degree of responsibility and accountability in the company.

Brad Sato BASc '19, the first recipient of the scholarship, is a research intern in the CHARGE Lab who completed a co-op placement at D&V, which he says was a highlight of his undergrad experience.

"The one thing that stood out to me the most was the quality of people employed there, not just in terms of intellect but also in character," Sato says.

"Through my time there I was able to work with state-of-the-art technologies and witness first-hand the applications of the many things I learned in my classes. Collaborating with the brilliant minds and working with the advanced technologies at D&V were some of the driving forces that inspired me to pursue a post-graduate degree working with electric machines."

Loukanov took the company in new directions when he ventured into electric vehicle and powertrain test systems for R&D and production, including the aftermarket, Hardy says. "It's a nice space to be in. Serving the cleanliness of our air and environment."

The company has extended its innovative designs into an alternator and starter system tester used in auto parts stores. Most test companies mainly work with researchers and engineers, but "very few cover the full life cycle like we are now — R&D, production and aftermarket."

Dr. Loukanov with CHARGE Lab researchers.

In honor of Loukanov's longstanding commitment to research collaborations and student mentorship with the University of Windsor, D&V Electronics has gifted $125,000 to establish the Dr. Voiko Loukanov Engineering Scholarship endowment. An annual award of $5,000 will be given to an engineering graduate student or exceptional undergraduate student in excellent academic standing who is contributing to electric vehicle research at UWindsor's CHARGE lab.

Kalina says the scholarship will celebrate her husband's legacy of innovation and generosity.

"Voiko left a lasting impact on those who were fortunate to cross his path," she says. "His love, kindness, generosity and gratitude truly reflected his inspiring soul."

PANDEMIC AND THE CITY

DR. EDWIN TAM

Dr. Edwin Tam, PhD, PEng
Associate Professor, Civil and Environmental Engineering
Cross appointed, Mechanical Engineering

The current, global COVID-19 pandemic of 2020 is poised to create a humanitarian crisis in terms of the loss of human life, long term health impacts, and socio-economic upheaval. However, the severity of such impacts varies widely by country, by region, and even city and by city. It would seem as if population size and density would account for the differences experienced by different communities, but these alone cannot explain all inconsistencies: early on, similarly sized regions or cities did not experience the impacts equally, and now months later, there are still widely varying incidents of COVID-19 within the same region as the world faces ongoing waves of the pandemic.

What are the physical characteristics, demographic profiles, infrastructure, policies, and practices of a community that enhance its resiliency to withstand and overcome a pandemic based on the experiences with the outbreak of COVID-19? Our team – which includes Anneke Smit from Law, Tirupati Bolisetti from Civil Engineering, and Myron Hlynka and Mohamed Belalia from Mathematics and Statistics – is researching what are preferred characteristics and actions for municipalities to improve their resiliency to respond and just as importantly, recover from pandemic scenarios. The initial research is funded by WE-Spark and the VP of Research here at the University of Windsor.

The COVID-19 crisis has highlighted how critical the medical services, transportation of goods and services, information technologies, and municipal utilities are to maintaining a functioning community. What differs by location is the resiliency to sustainably deliver goods and services, and the disruption to work, education, and social activities. There are also controversies – does the infrastructure and systems, such as transit, contribute to the pandemic? How they can be managed?

Large, dense urban centres face greater challenges because of the need to coordinate large scale responses, containment, public communication, and much more. At the same time, their size, systems, and institutions may afford them the greatest medical, supply, and resources to respond. In contrast, remote, rural regions have fewer infections, but are concerned they may be overwhelmed should infections surge. Mid-sized municipalities that possess sufficient infrastructure but do not have significant high densities could potentially represent an optimal size to withstand a pandemic.

But unlike in other disaster scenarios such as flooding, where infrastructure such as roads might be unusable due to physical destruction, most infrastructure systems remain intact in a pandemic crisis. The response measures to a pandemic therefore permit the selective curtailing of targeted municipal systems to reduce transmission. However, reducing services can have unexpected, unintended consequences - including health and related socio-economic impacts, which disproportionately affect vulnerable groups, and may have long-term sustainability impacts. Public transit is a primary example.

Finally, there is the added dynamic that many cities are already in crisis: many are wrestling with the impacts from climate change. Cities must now contend with these ongoing threats while also dealing with the pandemic: how can one handle a flooding or heat emergency but still contend with COVID-19 restrictions? Our communities face calls to “be bold” and to emerge with a better, more sustainable, more resilient and fairer society out of the recovery from the COVID-19 crisis. This ongoing research will help us to rethink our urban settlements to ensure they are equitable and resilient as we confront the challenges facing us in an uncertain 21st century.

The research proposed will consist of two primary approaches:

Creating a model that reflects the rates of disease progression and outcomes based on city population size, population density, and other demographic or geographic parameters. In particular, the model will focus on neighbouring cities that share cross border issues, such as Windsor/Detroit. Data will be drawn from local sources and authorities in Windsor and Detroit to assist with developing the model.

Assessing the infrastructure similarities and differences between neighbouring cities in terms of engineered capacity and capability, as well as governance policies on managing infrastructure, to determine if there are relationships between such factors and the disease development and its containment. Neighbouring cities will be compared (Windsor/Detroit), but also other Canadian and global cities for additional information.

UWindsor President and Vice-Chancellor Robert Gordon speaks at a memorial service held on campus.

PLANE CRASH VICTIMS REM TALENTED SCHOLARS, LOVI

They were dedicated researchers who were bolstering bridge safety with artificial intelligence, improving the accuracy of critical medical procedures and using solar energy to increase greenhouse efficiency.

They were friends who never forgot a birthday, supported each other like family and reminded others of the importance of living in the moment.

On Jan. 8, 2020, the University of Windsor lost five cherished members of its community, who were returning to campus, when Ukrainian International Airlines' Flight PS752 crashed in Iran and claimed the lives of all 176 on board.

"We all feel the tremendous depth of human suffering caused by this tragedy," says Dr. Robert Gordon, UWindsor president and vice-chancellor. "Our own students were standing on the very doorstep of discovery in their research careers and their potential was limitless. We will never know what life-changing contributions they may have made in their areas of study and academic pursuits — and that loss is unfathomable."

Engineering doctoral candidates Hamidreza Setareh Kokab, Pedram Jadidi, Zahra Naghibi and her spouse Mohammad Abbaspour Ghadi and biology research assistant Samira Bashiri will be remembered by friends, faculty and staff as vital contributors and caring companions.

"I can tell you that Zahra's innovative work in bringing solar energy into food production was unrivaled," says Dr. Rupp Carriveau, Naghibi's faculty advisor.

"She really expanded our portfolio in terms of research in agriculture and renewable energy. If anyone here ever met Zahra, I'm sure you would realize how remarkably affable and sweet she was."

Friends say Naghibi was the type of person who always remembered birthdays and enjoyed giving

EMBERED AS NG FRIENDS

Engineering Dean Mehrdad Saif says faculty, staff and students were heartbroken by the news

hand-picked presents. Her husband Ghadi was remembered for his warm welcomes and gathering friends for get-togethers that always had them in stitches.

Jadidi was returning from mourning the one-year anniversary of his father's death with family and friends in Iran.

Despite losing his father weeks before he started his PhD research, Jadidi's "enthusiasm and tactfulness" helped him garner a reputation as an exceptional researcher.

Dr. Shaohong Cheng, Jadidi's faculty advisor, says he was at the forefront of his field.

"If his work is completed successfully, it's expected to have a huge impact on the bridge industry and engineering community," she says. "I never doubted that someday he would become an excellent researcher. He was such a polite and generous young man, who was very reliable and responsible."

Cheng says she could count on him for almost anything.

"If I ever needed his help, his response would always be, 'Dr. Cheng, consider it done.'"

Bashiri and Kokab were known as the glue that held fellow Iranian students together.

Friends say the couple provided endless support, motivation and joy that helped form a home away from home.

Dr. Jill Urbanic says barely a year into his PhD research, Kokab received a young research award for his machine learning and CAD design for modeling organs and skeletal elements. His research focused on improving biomechanical mannequins used to train medical students on lumbar punctures and thoracentesis — an invasive procedure that involves inserting a needle into the chest to remove fluid or air.

"Rarely, has anyone made such a contribution in such a short period of time," Urbanic says.

Bashiri was a veterinarian who started as a volunteer in Dr. Lisa Porter's cancer cell research lab. Bashiri worked tirelessly day and night proving to everyone in the lab how intelligent, talented and motivated she was, Porter says.

"She was so capable, so we turned her position into a paid research assistant," Porter adds.

Bashiri used Instagram to share what she was learning about Canadian values in addition to sharing what she treasured about her own culture and life in Iran.

Following the news of their deaths, the university received an immediate outpouring of support from the UWindsor community and general public to establish the Iranian Students Memorial Scholarship - Remembering Flight PS752.

"We need people like Samira who embrace different cultures and use creativity and happiness to show us that peace, freedom, equality and education are the way forward," Porter says. "We need people like Samira to truly make the world a better place."

Engineering Dean Mehrdad Saif says faculty, staff and students were heartbroken by the news. The university held a campus memorial, which was attended by thousands of community members and live-streamed for family and friends who live outside of Windsor. It is still available on YouTube under the name UWindsor Memorial Service live at 1 p.m. Friday Jan 10.

HONOURING THEIR LEGACY

The university has partnered with the Iranian community in Windsor and the City of Windsor to honour the victims by creating a memorial site on the west end of the city's riverfront not far from campus.

The commemorative site will include a plaque, benches and a tree.

Following the news of their deaths, the university received an immediate outpouring of support from the UWindsor community and general public to establish the Iranian Students Memorial Scholarship - Remembering Flight PS752, a graduate scholarship endowment that will support international students conducting vital research in the Faculties of Engineering and Science.

Dr. Shervin Erfani, a UWindsor Engineering professor, has committed to matching up to $10K in donations to help the university reach its goal in permanently endowing the scholarship. Dr. Erfani, an Iranian-Canadian, has been a long-time supporter of engineering students at UWindsor and was deeply touched by this tragedy.

He hopes to encourage others to give to uphold the legacy of the exceptional students honoured by this memorial fund.

Donations to the memorial fund will be matched 1:1 and can be made by credit card online at www.uwindsor.ca/supportuwindsor/remembering-flight-ps752 or by contacting Katie Mazzuca, the Faculty of Engineering's major gift officer, at 519-253-3000, ext. 5959 or katie.mazzuca@uwindsor.ca.

NEWS

Dr. Mitra Mirhassani has received the inaugural APMA Institute of Automotive Cybersecurity Outstanding Individual Cyber Achievement Award and was named one of Canada's Top 20 Women in Cyber Security by IT World Canada.

PROFESSOR RECEIVES SECOND NATIONAL CYBERSECURITY AWARD

Dr. Mitra Mirhassani's research in autonomous vehicles and cybersecurity has put her on the national stage for the second time this year.

The associate professor in the Faculty of Engineering received the inaugural APMA Institute of Automotive Cybersecurity (apmaIAC) Outstanding Individual Cyber Achievement Award during a virtual awards ceremony on Oct. 29 for showing exemplar cyber security achievements in both education and research.

Mirhassani was recently recognized as one of Canada's Top 20 Women in Cyber Security (2020) by IT World Canada for her innovative cyber security research and dedication to helping others better understand the function and connectivity of our devices.

She was chosen out of more than 170 nominations for women working in cyber security across a wide variety of organizations and roles, including CISOs, company founders, professors, directors and women holding numerous specialty positions in both the public and private sectors.

"What worries me most is the health and security of the devices that we build and buy," says Mirhassani, who leads UWindsor's Analog and Mixed Signal Research Lab."

There are many challenges in our way to understand the complexity of the process."

Mirhassani's latest research includes the investigation of cybersecurity issues that arise when using electric vehicle fleets with battery charging infrastructure and improving the security of autonomous and connected vehicles.

"We are thinking about mobility and autonomous cars more and that's where I see these innocent electronic devices and think 'we don't know who made you and what information you're keeping and how you are storing our data,'" she says.

"So, the health of manufacturing is something that I'm deeply concerned with these days."

Mirhassani is also a faculty advisor to the first Canadian Student Chapter of Women in Cybersecurity and a senior member of the Institute of Electrical and Electronics Engineers.

"Dr. Mirhassani is an outstanding mentor to a wide variety of students and an outstanding leader in her field of cybersecurity research," says Heather Pratt, UWindsor's Executive Director of Research and Innovation.

Taku Chitekeshe is the first student specializing in aerospace engineering who has completed his Private Pilot's License (PPL) through UWindsor.

PILOT'S COURSE HELPS FUTURE STUDENTS TAKE WING

Taku Chitekeshe is the first student specializing in aerospace engineering who has completed his Private Pilot's License (PPL) through UWindsor.

It's always been Taku Chitekeshe's dream to design aircrafts.

The mechanical engineering student never thought one day he'd be flying them.

Thanks to a partnership between UWindsor's Faculty of Engineering and the Aeronautics Leadership Program housed in the university's Faculty of Arts, Humanities and Social Sciences, Chitekeshe is the first student specializing in aerospace engineering who has completed his Private Pilot's License (PPL).

"The first time I flew alone, I felt accomplished," Chitekeshe says. "It has been intriguing to learn how aircrafts are designed, but after getting the experience to fly an airplane, my dream job would be to combine those two aspects — to design aircrafts and to test them."

Chitekeshe now wants to pursue a career as a chief test pilot.

"The concepts that were taught went beyond the scope of the course enabling me to learn more," he says. "Especially after flying and getting to see all the different airplanes in greater detail at the airport, it became so much easier for me to understand the concepts."

UWindsor's two-semester PPL course, offered in partnership with Journey Air housed at Windsor International Airport, is now open to mechanical engineering students in the aerospace option.

Students complete most of their ground school training during their off semester in the fall of their third year and begin to build flight time to prepare for a 150 nautical mile solo flight. Once the aspiring pilots pass the Transport Canada PPL Written Exam (PPAER) and reach at least 45 hours of flight training, they can take a final flight test to complete the course.

Dr. Jennifer Johrendt, the engineering faculty's Assistant Dean of Student Affairs, says there are future plans to condense the course so that it can be completed in its entirety in the fall semester. In addition, students can obtain one technical elective credit towards their accredited engineering degree.

"The most exciting part of this whole experience for me was getting to sit in the cockpit and to be in control," Chitekeshe says. "It's been such a breath-taking experience being in the air and getting to see Windsor and the surrounding towns from a different perspective."

ENGINEERING OUTREACH TEAM BRINGS VIRTUAL STEM ACTIVITIES TO CHILDREN'S HOMES

UWINDSOR ENGINEERING SATURDAYS

UWindsor's Faculty of Engineering Outreach Team has designed free, online workshops on Saturdays for students in Grades 3 to 7 called UWindsor Engineering Saturdays.

The interactive events take place in a UWindsor virtual classroom and walk participants through a hands-on activity that focuses on an engineering discipline.

For all events, participants will need to have their own supplies to complete the activities. Supplies include common household items readily found around the home that can also be purchased at a minimal cost.

STEM ACTIVITIES FOR GRADE K TO 12

The Outreach Team has also developed a range of free, downloadable, hands-on activities for students in Grades K to 12 that focus on engineering and STEM-based learning.

Elementary and secondary school teachers are invited to use these resources in-class or for remote STEM learning. Parents and guardians are also encouraged to download these activities as fun projects for children to do at home. All activities have been developed to meet Ontario curriculum standards and involve the design and construction of an engineering-related project that introduces engineering and other STEM concepts to participants.

For more information on Outreach workshops, visit uwindsor.ca/engineering/outreach.

STUDENT RESEARCH FOCUSES ON SECURITY OF 5G DEVICES

We live in a world where cars drive themselves, thermostats are set via smart phones, and home security systems can be armed and monitored remotely.

But how can we ensure the tiny components connecting these devices to the Internet are safe from malicious interference?

That's the problem UWindsor graduate student Sahereh Sahandabadi is probing. As part of a larger research project in collaboration with Canadian telecommunications company Telus on 5G technology, the Master's student in engineering is looking for ways to build safeguards into Internet of Things (IoT) devices.

"A crucial factor for the IoT devices is security and reliability," says Sahandabadi. "Since these devices have limited battery power and can't accommodate complicated processes in their sensors, new algorithms and methods are needed to provide this reliability."

Sahandabadi's research is being funded by the University. She is one of 107 UWindsor students receiving $6,000 grants as part of $642,000 in overall funding for research internships.

UWindsor is contributing an unprecedented $471,000 toward these research opportunities. The grants are going to undergraduate and graduate students from Canada and abroad, and are across all disciplines, said K.W. Michael Siu, UWindsor's vice-president, research and innovation.

"The COVID-19 pandemic has affected research internships for students everywhere," said Dr. Siu. "At the University of Windsor, we are trying to make sure our students continue to have exceptional research opportunities despite the current circumstances."

Sahandabadi is part of a research team in UWindsor's Research Centre for Integrated Microsystems supervised by engineering professor Rashid Rashidzadeh.

Sahereh Sahandabadi is researching multi-input single output and millimeter wave technology as a means to enhance security in new 5G IoT devices.

"5G TECHNOLOGY WILL PROVIDE FOUNDATIONAL INFRASTRUCTURE FOR SMART CITIES."

RASHID RASHIDZADEH, ENGINEERING PROFESSOR

"The 5G technology and the Internet of things are predicted to profoundly affect the everyday life of many across the globe," said Dr. Rashidzadeh.

"5G technology will provide foundational infrastructure for smart cities, connected vehicles, and cybersecurity…. Working on the TELUS project in the area of 5G technology and the IoT gives students a unique opportunity to learn from industry experts and work on real-world projects."

TELUS recently announced its collaboration to transform the University of Windsor into a 5G connected campus.

Eros Spadotto, TELUS's executive vice-president, technology, strategy and business transformation and a UWindsor alumnus, said the partnership "will bring some of the most cutting-edge telecommunications technology available today and in the future to our students, building on our promise to advance higher education and science, and unlocking new ways for technology to improve Canadians' lives."

A screenshot shows the Ed Lumley Centre for Engineering Innovation students created in Minecraft.

STUDENTS BUILD VIRTUAL CAMPUS TO FOSTER SENSE OF COMMUNITY

The University of Windsor Engineering Students' Society is bringing campus to the screens of students learning from home.

The society has created a replica of the University of Windsor campus on Minecraft — a video game that allows you to create a virtual world with Java programming. Students can explore each floor of the Ed Lumley Centre for Engineering Innovation and take a stroll through UWindsor's campus peppered with lush trees, flower beds and even its Promise campaign billboards.

"Since we are all stuck inside on our computers for the remainder of the semester, it's important to keep the sense of campus community," says Theo Sancartier, president of the Engineering Students' Society.

"With this Minecraft server, we hope to have students interacting in a way no one thought of before."

Sancartier says the society's executive committee and other volunteers spent the entire summer creating the server to ensure incoming students had a memorable experience and felt connected to campus.

The server was built specifically for Orientation Week, but Sancartier says an overwhelming response from the university community encouraged the team to share the interactive server campus-wide.

Once in the server, participants have the opportunity to choose whether they would like to roam the creative world, which contains the replica of campus or join under a survival mode, where they can build their own homes and create an alternate, virtual community while interacting with other players.

Sancartier says new game features will continue to be added throughout the school year.

To learn more, please visit www.uwindsor.ca/engineering/virtualcampus.

A screenshot shows the Ed Lumley Centre for Engineering Innovation students created in Minecraft.

OPTIMIZING GREENHOUSE AGRICULTURE

Engineering professor Dr. Rupp Carriveau and UWindsor engineering alumnus Lucas Semple, Under Sun Acres greenhouse operations engineer, are part of a national effort exploring how leading-edge greenhouse technology can be delivered to remote locations and optimized to reduce energy costs and increase production.

A team of University of Windsor researchers is leading a national effort on the next frontier of sustainable and accessible food.

Working with experts from government labs and industry, the multidisciplinary team is using a new growing environment modeling tool and advanced additive manufacturing — often referred to as 3D printing — to explore how leading-edge greenhouse technology can be delivered to remote locations and optimized to reduce energy costs and increase production.

"We can explore how more radical changes, like using earthen walls or solar glass, could potentially benefit a leading-edge greenhouse without ever interrupting ongoing commercial operation," says Rupp Carriveau, the project lead and director of UWindsor's Environmental Energy Institute.

"TODAY'S YOUNG PEOPLE WILL BE FEEDING THE FUTURE – WE WANT TO START THEM EARLY."

DR. LINDSAY MILLER-BRANOVACKI,
LECTURER, FACULTY OF ENGINEERING

Dr. Carriveau says the team has created energy harvesting models to design distributed, networked, power systems to provide increased and more sustainable energy for a rapidly expanding sector.

Controlled environment agriculture (CEA) such as greenhouses, vertical farms, and plant factories can increase access, yield density, uniformity, and nutritional specificity of food production.

However, challenges over the availability and cost of energy for these facilities remains an obstacle.

"Our simulations will explore how new energy systems can link multiple growers to improve power sharing efficiencies and resiliency while reducing costs," Carriveau says about the venture, dubbed the Next-Gen Amplified Sustainable Agriculture (NASA) project.

The team is exploring how leading-edge greenhouse technology can be delivered to remote locations.

The team will also examine how advanced additive manufacturing can expand the capabilities of today's greenhouse sector and deliver CEA to remote locations it's never been before. Collaboration with Western University's Institute for Earth and Space Exploration will examine how the model and maker tools in the project could be used to produce growing environments in extra-terrestrial locations.

Researchers from UWindsor, Western University; Agriculture and Agri-Food Canada; the Ontario Ministry of Agriculture, Food and Rural Affairs; Ontario Greenhouse Vegetable Growers; and Under Sun Acres have partnered on the two-year, $450,000 project supported by the Weston Seeding Innovation Fund, Mitacs, and Enbridge Inc.

Researchers will start by examining the ambient environmental conditions of the remote location and desired crop and work backwards to develop new growing systems for remote regions.

Chris Patterson, a UWindsor engineering MASc student contributing to the project, says once they determine crop needs, they will use growing climate and energy models to design and 3D print a growth system specifically optimized for that crop and remote environment.

"Advanced additive manufacturing not only significantly increases the potential for creative structural solutions to challenging building applications but can provide remote locations with the ability to reproduce parts onsite without having to wait for an airplane or rocket ship to deliver a replacement," says project advisor and engineering professor Jill Urbanic.

The team will produce bench-scale printed growth enclosures and power systems for conditions in Kugluktuk, Canada — a remote community with extreme cold and high sun — and Hanksville, Utah, a dry desert-like setting. Printed models will be tested in Western University's Biotron Facility, which can simulate just about any conditions on earth, Carriveau says.

An outreach program will be delivered to Essex County schools as a new 2021 STEM module.

The module will be developed to enlighten and inspire young people about the important and exciting challenges ahead for the future of food production and potential food production on other planets, says Lindsay Miller-Branovacki, the project's outreach coordinator.

"Sustainability of a sector really depends on evolving succession," she adds. "Today's young people will be feeding the future — we want to start them early."

BANNER YEAR FOR RESEARCHERS NETS MILLIONS IN FEDERAL FUNDING

Dr. Ofelia Jianu's Intelligent Fuels and Energy Laboratory (i-FuELs) has received funding to research hydrogen as an alternative to fossil fuels in automobiles.

From cost-effective, electric vehicles with superior torque density and performance to energy-absorbing devices that can save lives in automotive crashes or bomb explosions, more than $3.2 million in federal funding is advancing University of Windsor research at the forefront of Canadian engineering innovation.

Seventeen researchers in the university's Faculty of Engineering received funding through the Natural Science and Engineering Research Council of Canada's five-year term Discovery Grants and the Research Tools and Instruments Grant program.

Dr. Bill Altenhof, who specializes in mechanical and materials engineering, is developing high performing adaptive structural energy absorbing devices that can adjust force and displacement response as needed.

These responsive materials have the potential to mitigate serious injuries or death as a result of falls, automotive crashes, pedestrian impacts, blasts or bomb explosions.

"Active adaptive energy absorbing systems will adjust or transform vehicle structures to the conditions of a crash to ensure an appropriate level of forces is transmitted to occupants resulting in a lower possibility of injury," says Dr. Altenhof.

"Current structural systems are passive in nature, meaning one design is for all crash situations."

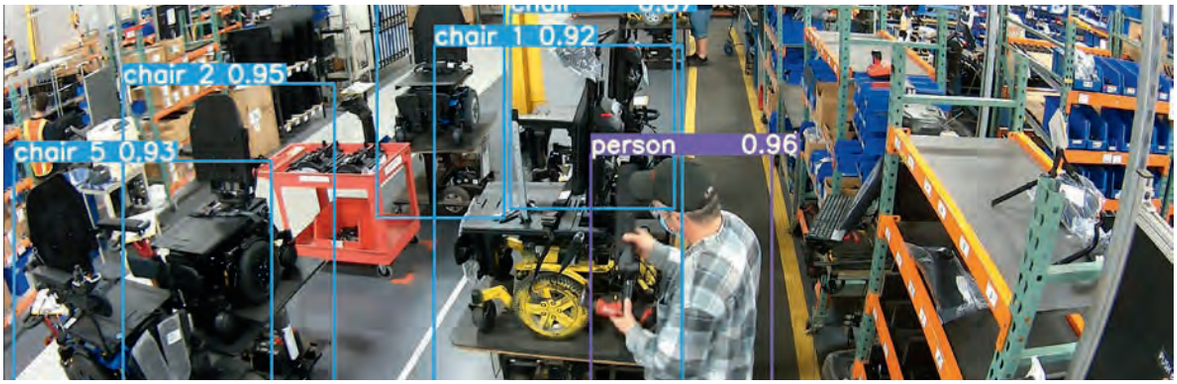
Altenhof says these advanced active adaptive systems can be thought of as "smart airbags" for vehicle structures that constantly adjust for different pre-crash conditions.

While Dr. Narayan Kar's Centre for Hybrid Automotive Research and Green Energy continues to lead advancements in electric vehicle powertrain technology, Dr. Ofelia Jianu is examining an alternate way to deliver vehicles with zero emissions — hydrogen fuel.

Dr. Jianu's research team is focusing on the use of the thermochemical copper-chlorine cycle for hydrogen production.

University-wide, 38 faculty members have been awarded more than $6.5 million in federal funding to advance research and innovation in science and engineering. UWindsor exceeded the national success rate for the 2020 Discovery Grant competition with more than 63 per cent of all applications receiving funding.

RESEARCHERS TO APPLY AI TO IMPROVE HUMAN ELEMENT, MAXIMIZE PRODUCTIVITY IN MANUFACTURING



Two UWindsor engineering researchers have received more than $715,000 in federal funding to bring cutting-edge artificial intelligence to the manufacturing floor.

Professors Jonathan Wu and Afshin Rahimi say they can mitigate human error and maximize productivity in manufacturing plants through advanced computer vision.

"Human errors were the major driver behind $22.1 billion in vehicle recalls in 2016," says Dr. Wu, a former Canada Research Chair in Automotive Sensor and Information Systems.

He and Dr. Rahimi aim to create a smart production assistant that will help manufacturing plant operators gain unprecedented visibility into their manual production operations, allowing them to optimize their worker efficiency while maximizing productivity. They will achieve this by automating data generation using computer vision, converting raw data into useable information, visualizing information using common business intelligence methodologies and prediction of future.

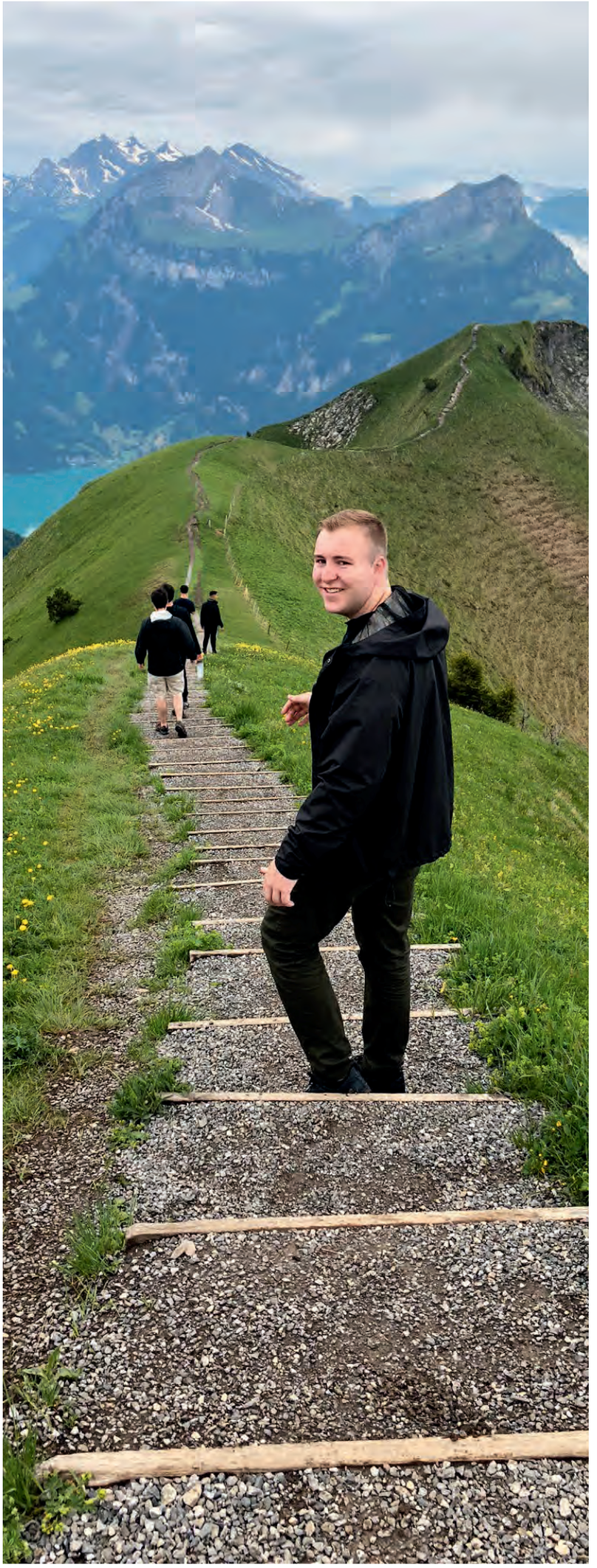
The professors have received $717,450 of support from the Mitacs Accelerate program and additional support from Smart Computing for Innovation (SOSCIP) in partnership with i-5O, an early stage Silicon Valley based start-up that has developed a proprietary computer vision powered digital twin to help manufacturers track, measure, and improve their manual production processes. Headquartered in San Francisco with operations in Toronto and Windsor, the company works with large Fortune 500 manufacturers in North America and Asia.

Khizer Hayat, chief innovation officer of i-5O, says its collaboration with Wu and Rahimi will bring the latest in artificial intelligence for improving human performance to the manufacturing industry.

"Thanks to their expertise, our collaboration has created a cutting-edge artificial intelligence product that delivers double digit percentage increases in human performance to our clients," Hayat says.

Rahimi's team focus on three major components of the project, including data extraction and processing for object detection and classification using computer vision, deep learning, and neural networks; hardware design and optimization for fast data-processing on-site; and data visualization for information translation and user interactions.

Wu's team will develop a computer vision and deep learning based temporal action detection model and apply it to the video collected from manufacturing floors to obtain the start time and end time of each process in the operation.



OVERSEAS CO-OP PLACEMENT PROVIDES LIFE-CHANGING EXPERIENCE

A life-changing experience wasn't exactly what Dustin Rivard was expecting when he embarked upon a co-op placement as a test engineer in a bearing department.

The mechanical engineering student jumped at the chance to work in Germany for a year with the Schaeffler Group, a global automotive and industrial supplier, figuring it would be a great opportunity to work and travel.

"I rave about this opportunity to every engineering student I know," says Rivard BASc '17. "First, I tell everyone they need to do co-op; It provides you with the connections that help you get the career you want, not to mention just giving you experience. Second, the chance to live and work in another country for a year turned into an incredible, life-changing experience."

The Schaeffler Group co-op partnership with the University of Windsor, established in 1998 by the Faculty of Engineering's Dr. Peter Frise, is one of many unique industrial relationships at UWindsor that offers students education that goes beyond the traditional classroom. Since its inception, more than 200 engineering, business and computer science students have ventured to the company's German headquarters in the small town of Herzogenaurach in central Bavaria to gain 12 months of real-word experience.

While completing a co-op placement with the Schaeffler Group in Germany, Lucas Dodson explored more than 20 countries in just under a year. Dodson is pictured (left) in Stoos, Switzerland.

Frise says sending students to Schaeffler and other employers in Germany has been one of the most rewarding initiatives he's worked on at the University of Windsor.

"It has given so many of our students a chance to live and work abroad and learn a new language as well as hone their technical skills with top-notch companies," says Frise.

"Many of them have gone on to full-time employment and built rewarding and challenging professional careers, which is really the goal for us here at the University of Windsor."

In 2019, the 20-year partnership was recognized with an award by the German-Canadian Association (DKG) — a non-profit organization that aims to promote economic, cultural and interpersonal relations between Germany and Canada.

Rivard said he easily transitioned into his career after graduation thanks to his rigorous training at Schaeffler and landed a job within the company's product development department in Troy, Mich.

But working across the river wasn't enough. Rivard wanted to return overseas.

"I realized I wanted to come back to Germany; I loved the country so much — especially the people and automotive focus," he says while sitting in his apartment nestled in a small Bavarian town lined with cobble-stoned paths and bustling cafes.

Rivard's Canadian wife joined him when he accepted a job back at Schaeffler's headquarters, leaving friends and family behind and carving out a life abroad together.

When Rivard isn't busy designing thermal control systems that help reduce vehicle emissions and improve fuel economy, the couple spends their time traveling across Europe.

Lucas Dodson, a third-year industrial engineering student, just completed his co-op placement in Schaeffler's advanced development department where he assisted in the project management and testing of some of the company's latest initiatives, such as e-mobility, mechatronics and material development.

Dr. Peter Frise (far left), the founder of UWindsor's co-op program with the Schaeffler Group, is presented with an award from the German-Canadian Association (DKG) recognizing the 20-year partnership.

"One of the best parts about working for a large company abroad is getting to learn about and experience a whole new culture in the professional world," he says.

"Another great part is how much Germans value a strong work-life balance. This means flexible working hours, no after work calls and more vacation time per year than most North Americans could hope for in their entire working life."

Starting with 30 days of paid vacation, Dodson has explored more than 20 countries in just under a year. He's also learned German through language training provided on the Schaeffler campus.

"I've seen some of the world's most beautiful and historic places," he says.

"Being able to visit places so rich with culture is a priceless experience."

Kristen Morris, UWindsor's manager of co-operative education and workplace partnerships, says the Schaeffler work abroad experience is truly transformative.

"Students come back forever changed; more open to new cultures and able to see their life and career through a new lens while gaining a year's worth of paid, relevant work experience at an organization that is committed to student learning and growth."

UWINDSOR ENGINEERING COVID-19 ACTION FUND

From our students and professors who have pivoted to remote learning and teaching, to the rapid response of our researchers who have joined the fight against a global pandemic, COVID-19 has had a far-reaching impact across campus.

In response to the growing needs of the Faculty of Engineering amid this uncertain time, we have established the UWindsor Engineering COVID-19 Action Fund. With your support, we can accelerate time-critical research, help students who are experiencing hardships and maximize curriculum resources for online distance learning.

INVEST IN TIME-CRITICAL RESEARCH

Engineers are essential to finding innovative solutions to problems that are critical to society. As you've read in this issue of WE, our researchers, students and community partners have come together to tackle the global pandemic. You can join us by supporting their innovative solutions to challenges sweeping the globe.

HELP STUDENTS IN NEED

Many students are experiencing hardships as a result of the pandemic. They are now dealing with the uncertainty of employment and internships, a reduction or loss of part-time work and many are struggling as family members also deal with job loss. You can help students who are in need of financial support, so that they can focus on their studies.

SUPPORT NEW REMOTE LEARNING TECHNOLOGY

Transitioning the curriculum online and maximizing resources for distance learning has become vital to ensuring our students continue to have access to a high-quality engineering education.

This includes adapting traditional labs to interactive online platforms so that our students have the technology they need to learn safely from home. New cloud-based, virtual labs allow students to access engineering software they normally have access to in our labs on campus.

Your donations can help our faculty continue to invest in remote tools to enrich the engineering education.

The world will continue to face enormous challenges for the foreseeable future as a result of the pandemic. You can support our engineering students today by making a donation to this Action Fund at www.uwindsor.ca/donate - designate to "Engineering COVID-19 Action Fund."

To make a greater gift, or learn more about how you can support urgent funding priorities during these challenging times, please contact Katie Mazzuca, major gift officer, at katie.mazzuca@uwindsor.ca or 519-253-3000, Ext. 5959.

University of Windsor
Faculty of Engineering