UNIVERSITY OF MANITOBA
ResearchLIFE
WINTER 2019 | VOLUME 1

THE HUMAN ARCHITECT
DEVELOPING A SIXTH SENSE

TRANSFORMING POWER
Connecting the smart grid

EVER-CHANGING CLIMATE
CO_2 impact

PRESERVE AND PREDICT
Prairie languages

MESSAGE

FROM THE VICE-PRESIDENT (RESEARCH AND INTERNATIONAL)

The research enterprise at the U of M has grown considerably over the past five years, with an all-time high in sponsored research income for fiscal year 2017/18 of $211.7 million. Our allocation of Canada Research Chairs (CRCs) has also increased, and successes in recruiting a Canada 150 Chair and sponsored research chairs adds to our exemplary team of academics.

This winter issue of ResearchLIFE is a continuation of our previous issue, highlighting the research and scholarly work of three CRCs and our Canada 150 Research Chair. Danika Goosney of the CRC Program Secretariat has contributed her insights on the importance of equity, diversity and inclusion (EDI) to our research community. The U of M is committed to meeting or exceeding all of the national targets for EDI.

Our featured chair holders—Nicole Rosen, Julienne Stroeve, Carl Ho and Pourang Irani—are exploring factors that affect our society in a multitude of ways. Rosen's quest to preserve endangered Prairie languages, Stroeve's findings on the impacts of a changing climate, Ho's innovations for an ever-changing power grid and Irani's use of data to help us make better decisions, provide new knowledge and opportunities for change that will sustain and enhance people's lives.

Please explore the research activities and individuals undertaking them within this issue and their deep commitment to solving problems. Their endeavours will both inform and inspire.

—Digvir S. Jayas, PhD, OC, PhD, PEng, PAg, FRSC

On the cover: The Microsoft Hololens used in Pourang Irani's lab *(see page 24)* for creating mixed reality interfaces for ubiquitous analytics. **Photo:** Mike Latschislaw

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ACCOLADES FOR TRIO

At first glance, a world-renowned musician, ground-breaking researcher and leader of an academic institution may not appear to have much in common—but they do share one major commonality. With diverse backgrounds and accomplishments, three members of the U of M community were recently honoured by the country's most esteemed association of scholars and scientists.

Medical microbiologist **FRANK PLUMMER** was recognized for his outstanding contributions to biological science with the RSC's Flavelle Medal.

Plummer is widely known for his breakthrough discoveries concerning HIV/AIDS, unraveling the mystery surrounding a group of women in Kenya who possessed natural immunity to HIV-1, the virus that leads to AIDS. The project ultimately provided vital new information for HIV vaccine and drug development.

A graduate of the U of M's Max Rady College of Medicine, Plummer is a Distinguished Professor of medical microbiology and former Canada Research Chair in Resistance and Susceptibility to Infections. He has served as senior scientific advisor of the Public Health Agency of Canada, director general of the Centre for Infectious Disease Prevention and Control and scientific director general of the National Microbiology Laboratory.

U of M president and vice-chancellor **DAVID BARNARD** was named a Specially Elected Fellow by the Fellows of RSC, the first U of M president to receive the honour.

For 40 years, Barnard has worked in the academic community across Canada. Since taking on his current role with the U of M, he has been instrumental in increasing the university's research capacity, resulting in discoveries with significant impacts to global public health and climate change.

A champion in the principles of diversity and inclusion, he was the first university president to apologize to Residential School Survivors for Canadian universities' failure to speak out at the time. Under his leadership, the U of M has committed to advancing Indigenous achievement.

A composer, performer, producer and concert organizer, **GORDON FITZELL** was elected a member of the Royal Society of Canada (RSC) College of New Scholars, Artists and Scientists, joining seven current members from the U of M.

During his tenure in the Desautels Faculty of Music, Fitzell has received numerous commissions, grants and awards. His music is performed on stages across Canada and around the world. In 2011, he was presented with the Rh Award for Creative Works and in 2015, he was nominated for a JUNO Award in the Classical Composition of the Year category.

ENGINEERING AND SATELLITES, BY DESIGN

More accessible satellite manufacturing is on the horizon, thanks to new funding that will also see innovative design skills integrated into engineering courses at the U of M.

Two new engineering research chairs were recently announced: **PHILIP FERGUSON** taking on the role of Industrial Research Chair (IRC) in Satellite Engineering and **MARCIA FRIESEN** is the new Chair in Design Engineering.

Ferguson's chair is through a partnership between the Natural Sciences and Engineering Research Council of Canada (NSERC) and Magellan Aerospace. He will create a research program to speed up the costly and lengthy development process currently required for manufacturing satellites.

"The ManitobaSat-I team's project is designed to investigate how space weathering affects asteroids and the moon by exposing meteorites and other material to the space environment in low Earth orbit."

Ferguson has more than a decade of research and personnel training experience in the field, and has also served in both research and engineering management roles at several aerospace companies. His research focuses on satellite navigation, control and manufacturing technologies that can improve satellite reliability while reducing cost and design cycle times.

ABOVE: (L-R) Engineering professors Philip Ferguson and Marcia Friesen.

TOP: (L-R) Ferguson with graduate students Matthew Driedger and Valorie Platero show their CubeSAT model to CSA Astronaut Jenni Sidey.

He is also leading the Canadian Space Agency funded Canadian CubeSat Project. This will see university teams with secondary school students design, build and launch their own miniature satellites. The ManitobaSat-1 team's project is designed to investigate how space weathering affects asteroids and the moon by exposing meteorites and other material to the space environment in low Earth orbit and to also test a new sun sensor.

Friesen's NSERC Chair in Design Engineering for Sustainable Development and Enhanced Design Integration is a partnership between NSERC and 11 industry sponsors. She is currently associate professor and director of the Centre for Engineering Professional Practice and Engineering Education, an academic centre in the U of M's Faculty of Engineering. Her research focuses on engineering qualifications recognition for engineering newcomers, the scholarship of teaching and learning in engineering education and modeling and simulation for health-care applications.

In her new role, Friesen will work to advance students' design knowledge by integrating sustainable development into their courses, emphasizing the equity principles inherent in sustainable development through a focus on Indigenous Knowledge, perspectives and design principles.

RESEARCH LEADERS

Advances in health care and technology are at the forefront of the Canada Research Chairs (CRCs) recently awarded or renewed at the U of M, with six members of the university community joining the ranks of other research leaders from across the country. Worth $4.8 million in federal funding, these CRCs will see researchers develop ground-breaking technologies and health initiatives that will impact every Canadian.

MEGHAN AZAD

It's no secret breastfeeding provides a slew of benefits to mothers and babies. As CRC in Developmental Origins of Chronic Disease, Meghan Azad studies the early-life determinants of lifelong health. An assistant professor in the Max Rady College of Medicine and research scientist with the Children's Hospital Research Institute of Manitoba, she is focusing her current research on the impact of maternal nutrition and infant feeding practices on child health and development.

Her objective is to characterize the impact of breastfeeding on the development of childhood asthma and obesity, and to identify the human milk constituents and maternal factors that are responsible for these effects. This research will guide new strategies for child health promotion and disease prevention, as well as help optimize nutrition guidelines for mothers and babies.

POURANG IRANI

Every day, data repositories continue to grow in size and complexity. Software tools need to evolve to allow individuals or organizations to derive insight and make decisions based on these data sources. Computer scientist Pourang Irani is calling attention to an emerging field—and his vision for the next generation of analytic tools—in his role as CRC in Ubiquitous Analytics.

Irani's research will advance information visualization, navigation and manipulation interfaces on next-generation mobile and wearable technologies, the outcomes of which will lead to innovative digital systems that will enable end users to naturally interact with data to arrive at decisions. Read more about Irani's research on page 24.

LORRIE KIRSHENBAUM

Heart disease is responsible for almost half of all deaths in Canada. Lorrie Kirshenbaum, CRC in Molecular Cardiology, continues to make waves in the medical community with his ground-breaking research on cardiac muscle cells that could lead to new treatments that would dramatically improve the outcomes for heart attack patients.

Kirshenbaum, a professor of physiology and pathophysiology and director of Institute of Cardiovascular Sciences (a joint institute of the university and St. Boniface Hospital), is exploring ways to manipulate cell survival at the genetic level. Aided by gene therapy, he is using viruses to deliver genes into cardiac muscle cells, directing them how to live longer and resist injury following a heart attack.

PUYAN MOJABI

Electrical and computer engineering CRC in Electromagnetic Inversion for Characterization and Design, Puyan Mojabi, is developing new systematic algorithms and techniques to characterize objects based on their external electromagnetic signatures. All of these algorithms and techniques stem from one consistent and flexible framework—the electromagnetic inversion framework—and can be applied to a range of areas, such as imaging, remote sensing, antenna characterization and design.

With his research, Mojabi will improve our understanding of how to extract useful information from external electromagnetic responses, enhancing the achievable accuracy and resolution in characterization and providing increased flexibility in design.

ROBERTA WOODGATE

Researchers in children's health have rarely included children's voices in the research process. Enter nursing professor Roberta Woodgate, whose work actively engages children—and their families—to enhance health policy and practice.

As CRC in Child and Family Engagement in Health Research and Healthcare, Woodgate seeks to improve how children and their families participate in health research in an effort to transform health services and outcomes for vulnerable children. She and her team incorporate innovative arts-based data collection strategies to provide children and their families with a number of ways to express themselves. She believes that to improve children's health, researchers need to understand and share the experiences and needs of vulnerable children and their families with health-care professionals and other key stakeholders.

GUOZHEN ZHU

With the help of techniques to probe local structures down to the atomic scale, mechanical engineering assistant professor Guozhen Zhu is working on discovering superior nanostructured materials.

As CRC in Mechanical and Functional Design of Nanostructured Materials, she will develop a research program focused on the structural characterization and design of nanostructured materials. Her work will include the development of new methods for characterizing materials at the atomic scale, contributing to the development of advanced alloys and metal oxides with superior physical and mechanical properties for the aerospace, automotive and energy industries.

BEE-ING THE CHANGE

SWEET WIN FOR TEAM BEE BOX

The 2018 edition of Game Changer: Manitoba's Idea Competition wrapped up with an exciting round of presentations from the three finalist teams. Each had chosen to tackle a different one of the five problems identified in phase I of the competition (Education, Environmental, Societal).

GAME CHANGER IS A CONTEST that gives all Manitobans an opportunity to identify global problems and work in teams to devise innovative, game-changing solutions.

Team Bee Box captured the grand prize of $5,000 as well as the People's Choice award of $500, for their proposed solution to the Environmental problem: How can we offset the mass collapse of bee colonies in a natural and sustainable way?

Their solution is a monthly subscription box—Bee Box—where consumers can sponsor a bee hive and in return, receive various bee products from local provincial partners. A portion of each Bee Box's profits will be contributed to support a local bee apiary—Beeproject Apiaries—to increase the number of bee hives in Manitoba. The Bee Box benefits the local economic community, the local bee community and the consumer.

Team members were U of M undergrad students, sisters Alexandria Townsend (Faculty of Education) and Jacquelyn Townsend (Asper School of Business), along with childhood friend Hannah McCutchon (Asper School of Business). The trio have been friends and inventors since a young age.

"Their solution is a monthly subscription box—Bee Box—where consumers can sponsor a bee hive and in return, receive various bee products from local provincial partners."

"The judges said it was a unanimous decision on this year's winner," said Jody Dexter, Technology Transfer Office at the U of M, one of the Game Changer organizers. Judges who volunteered their time to adjudicate the competition were Carine Bado (World Trade Centre), Jane McDonald (International Institute for Sustainable Development) and David Lipinski (Futurpreneur).

All teams are provided the opportunity to take their proposed solutions forward as a business with support and mentoring from the Technology Transfer Office, Stu Clark Centre for Entrepreneurship, North Forge and Futurpreneur.

What's up next for Team Bee Box? "Currently the three of us are focusing on our studies first, while keeping this idea in our back pockets. We have looked a little bit into potential partners to see if there is an opportunity to bring some boxes to local farmers' markets this summer and see how the public responds to the idea," says McCutchon. "We do really love our idea and will continue to do research and development on this project, as we believe in the mission immensely."

To learn more about the competition, visit umanitoba.ca/gamechanger

LEFT: Team Bee Box: (L-R) Alexandria Townsend, Jacquelyn Townsend and Hannah McCutchon.

RIGHT: A sample of the Bee Box contents.

REVEALING THE POWER OF STORIES

BY AMBER OSTERMANN

A SIMPLE STORY CAN HAVE THE POWER TO BRING PEOPLE TOGETHER. Warren Cariou experienced this first hand during his decade as the Canada Research Chair (CRC) in Narrative, Community and Indigenous Cultures.

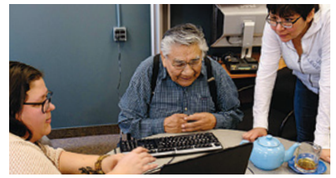
Cariou's research focus was on the interpretation of traditional and contemporary Indigenous stories. Working with Indigenous storytellers and writers, he researched how Indigenous communities are defined and sustained by their stories and through various innovative projects, he helped to preserve neglected Indigenous stories of the past and bring them to the attention of a new generation of Canadians.

His chair allowed him to create the Centre for Creative Writing and Oral Culture (CCWOC) in the Faculty of Arts. Cariou says his CRC facilitated many connections with storytellers and Elders from Cree, Métis, Lakota, Kaina and Anishinaabe communities.

As part of the research program, Cariou began a series of colloquia focused on the principles of editing texts by Indigenous writers, called the First Voices, First Texts research group. This core group was also one inspiration for the creation of the Indigenous Literary Studies Association, of which Cariou was the inaugural president. They were the foundation of the First Voices, First Texts book series (U of M Press), of which Cariou is general editor. This series publishes critical editions of "lost classics" of Indigenous literature that have been unjustly neglected or have been previously published in inaccurate or inappropriate forms. To date, there are four volumes and plans for several more volumes in the future.

LEFT: Warren Cariou, Omushkego Cree Elder Louis Bird and CCWOC technician Teddy Zegeye-Gebrehiwot.

ABOVE: Omushkego Elder Louis Bird using his Cree Syllabics keyboard with PhD students Michelle Lietz (L) and Melanie Belmore (R).



"This series publishes critical editions of "lost classics" of Indigenous literature that have been unjustly neglected or have been previously published in inaccurate or inappropriate forms."

"Perhaps the most important work I have done during the CRC has been my ongoing collaboration with Omushkego Cree Elder Louis Bird, who is renowned as one of the great storytellers in his community," says Cariou.

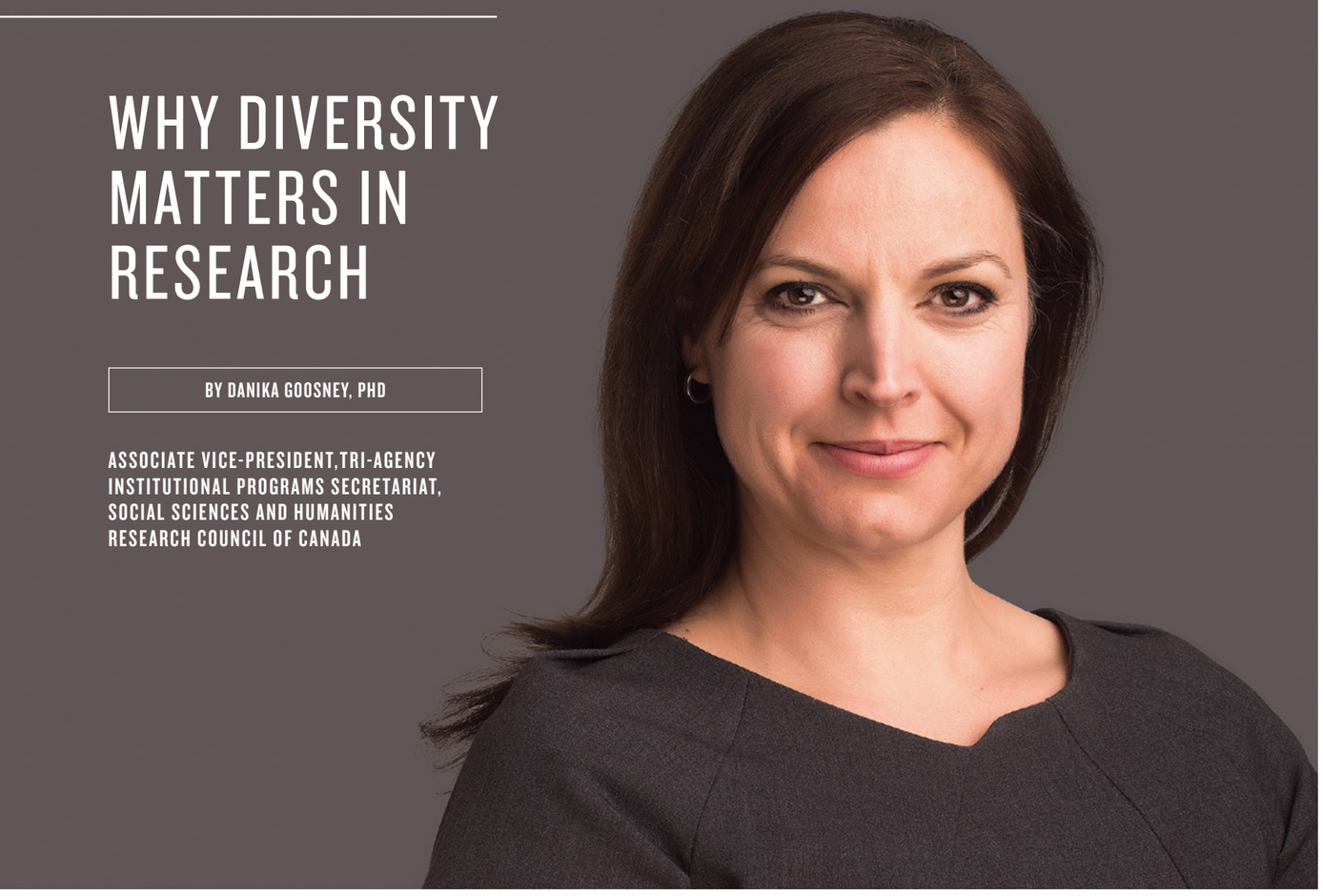
The duo have been documenting and studying the Omushkego storytelling traditions and environmental philosophies. Cariou is in the process of consolidating this large volume of work and plans to share it with Bird's community so that the Omushkego people can maintain control over the legacy of their Elders and their traditions.

"It has been a huge privilege to learn about Omushkego culture and practices on the land from Louis Bird, and to record many of his conversations and storytelling sessions. During my decade of work with him, I was very happy to see that many of my students and colleagues also developed strong connections with him. For me, research focused on Indigenous cultures is primarily about fostering and building relationships. I am so happy that the CRC position enabled me to develop this rich and fascinating relationship, and I look forward to continuing this work for as long as possible."

WHY DIVERSITY MATTERS IN RESEARCH

BY DANIKA GOOSNEY, PHD

ASSOCIATE VICE-PRESIDENT,TRI-AGENCY INSTITUTIONAL PROGRAMS SECRETARIAT, SOCIAL SCIENCES AND HUMANITIES RESEARCH COUNCIL OF CANADA



Canada's research community must become more equitable, diverse and inclusive to reach its full potential.

IN MAY 2017, the Canada Research Chairs Program (CRCP) launched the Equity, Diversity and Inclusion (EDI) Action Plan to address persistent issues with respect to chairholder diversity. The plan focuses on improving transparency, fairness and access in universities' nomination of Chairs to the program. It includes measures for enhanced transparency, public reporting and accountability, better data collection, tracking and monitoring and improved governance.

As recently announced by Minister Duncan, we have seen significant changes in response to the action plan. Nominations for members of the four designated groups have increased—for example, the percentage of women nominated to the program jumped to 43 per cent (a historic high) and the number of nominations for Indigenous Peoples, persons with disabilities, and members of visible minorities are also trending upwards. An expanded Advisory Committee on Equity, Diversity and Inclusion Policy, composed of leading EDI experts nationally and internationally, has been purposefully built into the governance of the program and is instrumental in guiding the program in EDI best practices. All institutions with five or more Chair allocations developed and posted their own EDI action plans on their respective websites. In September 2018, CRCP management issued an open letter to institutional presidents announcing that an external committee will assess progress against these plans to ensure that institutions are proactively considering EDI in the management of their chairs.

Many people support these measures and recognize that increasing diversity and accessibility is important, but there remains a crucial gap in the conversation around why this is important. There is mounting evidence that shows that diverse researchers and research perspectives mean better results, more productive and happy teams and more return on investment. In the report *Diversity Dividend: Canada's Global Advantage* by Besma Momani and Jillian Stirk, the authors demonstrated that diversity brings broad advantages to all workplaces, particularly

"THERE IS MOUNTING EVIDENCE THAT SHOWS THAT DIVERSE RESEARCHERS AND RESEARCH PERSPECTIVES MEAN BETTER RESULTS, MORE PRODUCTIVE AND HAPPY TEAMS AND MORE RETURN ON INVESTMENT."

in sectors requiring creativity and innovation. Using the Statistics Canada Workplace Employee Survey, they showed a "significant, positive relationship between ethnocultural diversity and increased productivity and revenue." Additional research has shown collective intelligence and innovation potential increases when research teams are diverse (Woolley et al, 2010). Bibliometric analysis has further demonstrated papers with ethnically diverse authors are more likely to be cited (Freeman and Huang, 2015).

Evidence that shows systemic barriers persist—particularly when the focus is on the researcher and not the research—underscores the importance of embedding EDI in all facets of research. For example, last year, researchers demonstrated that peer reviewers evaluated women less favourably than men

"EVIDENCE THAT SHOWS SYSTEMIC BARRIERS PERSIST—PARTICULARLY WHEN THE FOCUS IS ON THE RESEARCHER AND NOT THE RESEARCH—UNDERSCORES THE IMPORTANCE OF EMBEDDING EDI IN ALL FACETS OF RESEARCH."

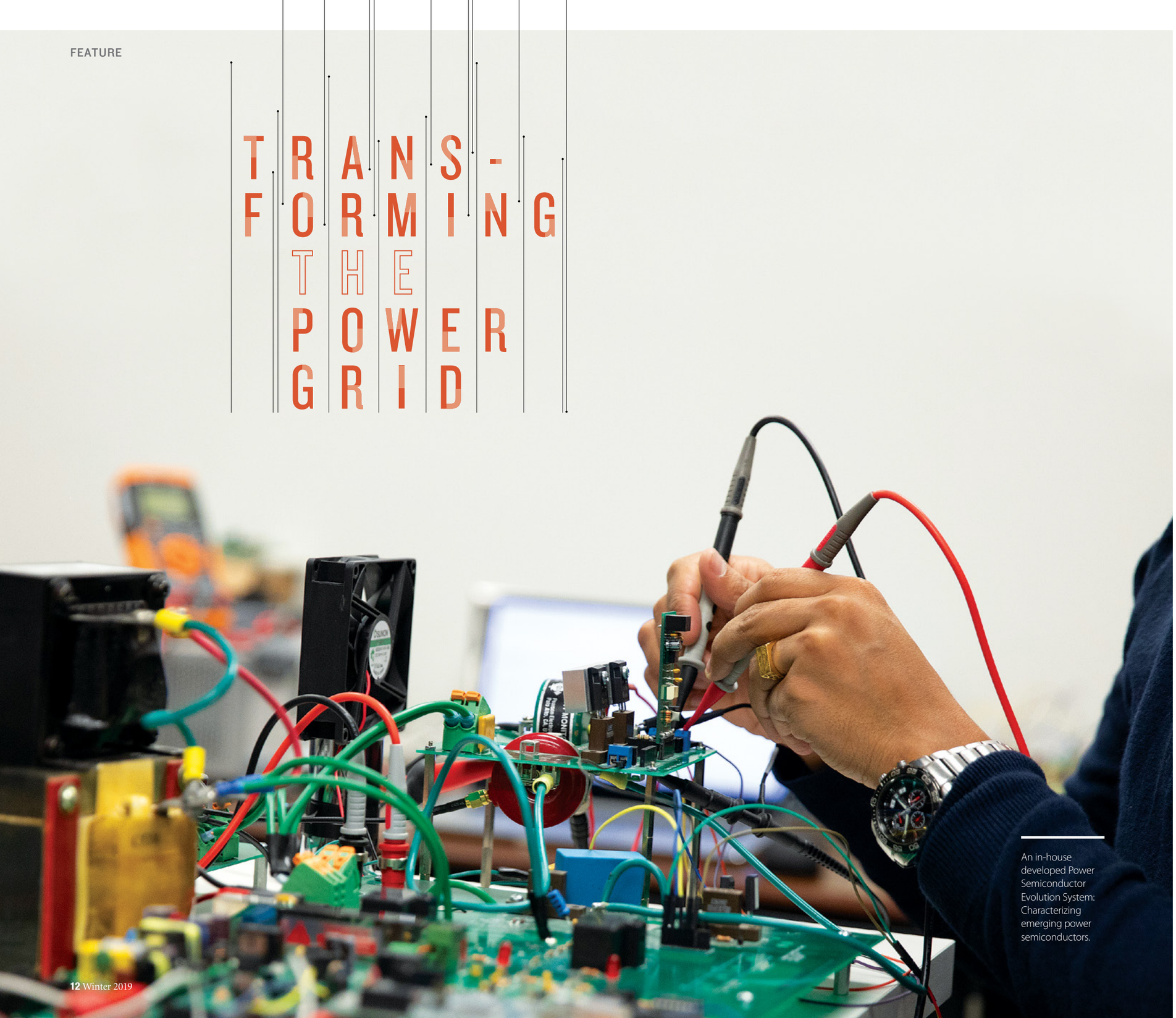
when assessing CVs and perceived leadership, whereas no differences were observed when the review focused on the quality of the science led by women and men (Witteman et al, 2017). The leadership bias is seen not just in peer review, but also in the hiring and promotion processes within universities. Research also highlights a continued gender gap across all rankings, job descriptions and research disciplines, and emphasizes the need to improve transparency of academic hiring and promotion and diverse representation on the hiring panels (Mascarenhas et al, 2017). Dynamics such as unconscious bias and the challenges faced by underrepresented groups in fully integrating into universities have also been shown to result in a lack of diversity in the postsecondary sector (Henry et al, 2017).

Ensuring that all excellent and meritorious researchers have access to research funding isn't just the "right thing to do," it is absolutely critical to ensure the most innovative, creative and impactful research. Only when there is buy-in from all of us in the research enterprise, will we truly remove barriers and reap the benefits of diversity.

TRANS-FORMING THE POWER GRID

BY
CURT
CHEREWAYKO

CARL HO'S RESEARCH IS HELPING POWER PRODUCERS TRANSITION TO THE ERA OF THE SMART GRID.



An in-house developed Power Semiconductor Evolution System: Characterizing emerging power semiconductors.

WITHIN THE OLD testament lies a metaphor for the modern-day power grid: the story of the Tower of Babel.

God smites the tower's workforce with multilingualism, preventing its labourers from communicating among themselves and as a result halting construction of the idolic structure.

As new energy sources are developed, and as traditional ones are modernized, the power grid is becoming ever-more populated with new energy communication devices, new unstable electricity and new entrance points for electricity.

As a result, power producers are having to overcome the same multilinguistic conundrum as Tower of Babel labourers.

Researchers such as the U of M's Carl Ho are ensuring that electricity isn't lost in translation before reaching the grid and, ultimately, consumers and industry.

Nearing the end of a five-year term as Canada Research Chair (CRC) in Efficient Utilization of Electric Power in the Faculty of Engineering, Ho is developing technologies that improve the efficiency, stability and costs of power grids and the power electronic systems that run them.

"RESEARCHERS SUCH AS THE U OF M'S CARL HO ARE ENSURING THAT ELECTRICITY ISN'T LOST IN TRANSLATION BEFORE REACHING THE GRID AND, ULTIMATELY, CONSUMERS AND INDUSTRY."

On the heels of his CRC appointment in 2014, Ho formed the Renewable-energy Interface and Grid Automation (RIGA) Lab—his main vehicle for research.

In addition to the CRC program, the RIGA lab is funded through the Canada Foundation for Innovation (CFI) and Research Manitoba.

Ho and his research team tackle issues that often arise from multiple unstable power systems vying for space on the same grid at once.

These can include load loss, power surges, voltage fluctuations and inefficient power conversion.

"The power systems industry is changing from using only passive devices and conventional energy sources to using more high-frequency switch-mode power electronics devices and renewable energy sources," said Ho.

He noted that the once-conceptual "smart grid" is becoming a reality. He described the smart grid as the convergence of traditional and renewable energies, energy storage elements, power electronics, and new advanced communications and control devices for power systems.

"The university and I would like to keep the advantage that Manitoba has and to be technological pioneers in the future smart grid era–that's why I created the RIGA lab," said Ho.

Each particular power source, whether traditional or renewable, has its own idiosyncratic problems.

Take solar for example, which is a focal point of Ho's research.

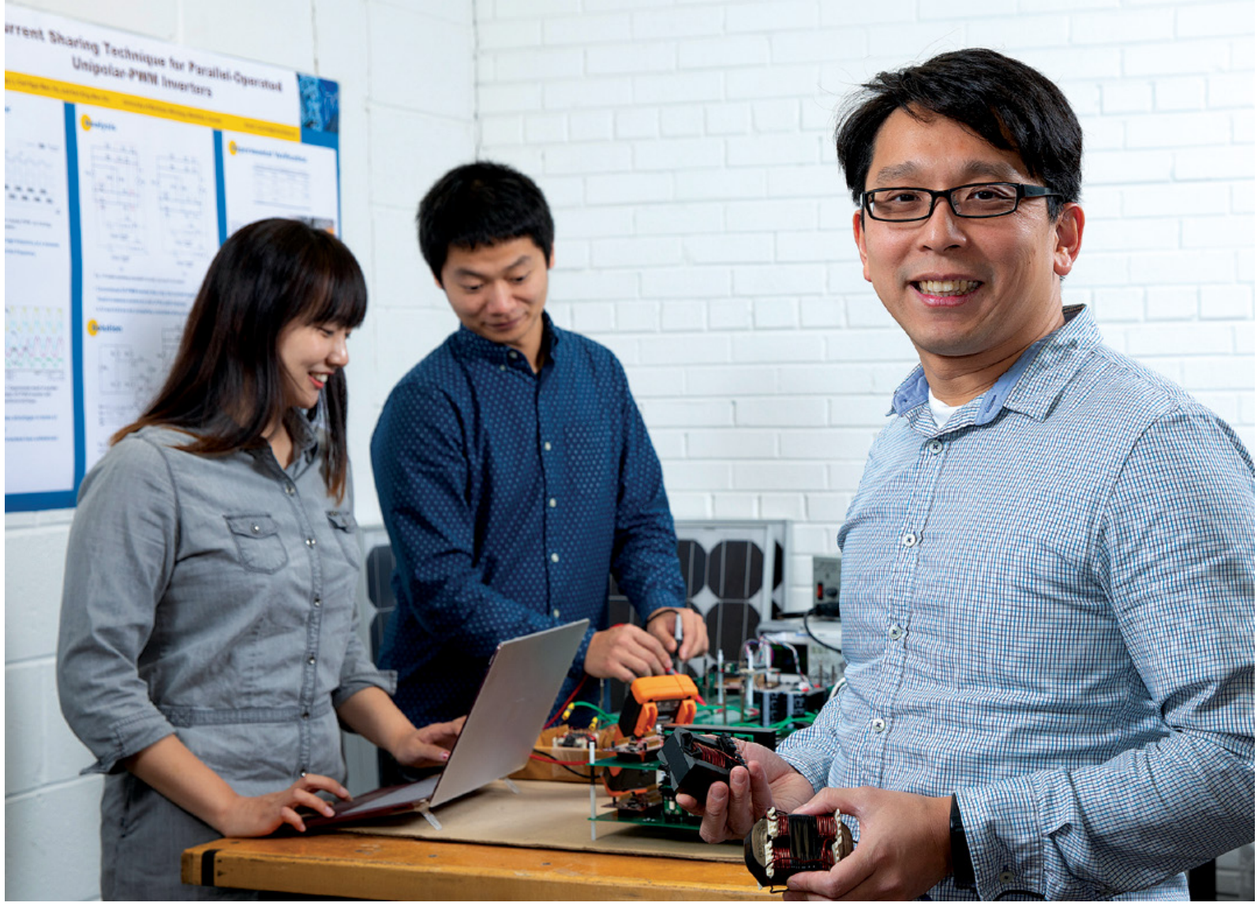
Sunlight's transformation from radiant energy to, say, electricity in a countertop plug, is arduous: When sunlight hits a solar panel, that panel converts radiating light into energy by essentially jostling electrons free from conductive plates. The electrons are collected as direct current (DC) power.

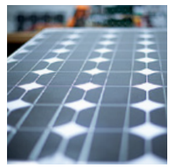
The panel's DC power output is unstable and changing all the time, depending on factors such as the panel's surface temperature, radiation levels (which are higher in the afternoon) and cloud cover.

The RIGA lab is developing energy conversion technologies that can better stabilize solar-generated DC power, and more efficiently convert DC power into alternating current (AC) power—the form that power needs to take to enter the grid.

For example, Ho's team is developing so-called "intelligent" communication devices, that can allow solar-power converters to speak to each other digitally.

These devices can improve and better control the flow of multiple power sources at once.





ABOVE: Ho (R) guiding research with PhD student Dong Li (L-R) and undergraduate student Qiyan Li to prepare an experimental setup.

BELOW: A solar panel, used to convert solar energy to electricity.

"THE UNIVERSITY AND I WOULD LIKE TO KEEP THE ADVANTAGE THAT MANITOBA HAS AND TO BE TECHNOLOGICAL PIONEERS IN THE FUTURE SMART GRID ERA–THAT'S WHY I CREATED THE RIGA LAB."

MOTHER OF INVENTION

CARL HO PLACES AN EMPHASIS on researching solutions for marketplace problems. The first application of his research came in the 1990s while he was still a technical college student. He invented a heart-rate monitor that could wirelessly transmit data and display heartbeat waveform in real-time, without any data-loss, to archaic 1990s computer technology.

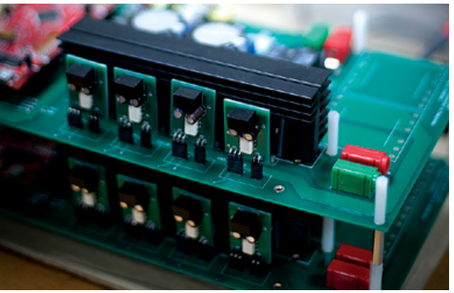
He developed his second important invention as a PhD student. A municipal government approached a professor of his regarding over-voltage and surges it was experiencing at night, after the city's factory shutdown for the evening. He found a way to control and ultimately stabilize this reactive power. A private firm eventually took ownership of his system and sells it worldwide.

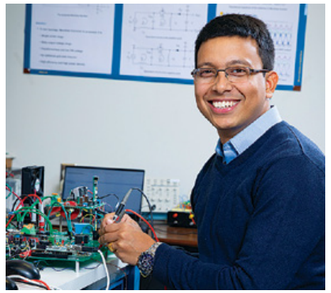
Ho's RIGA lab has filed two patent applications for technologies developed so far in his time at the U of M.

The Manitoba Inverter is a single-stage grid-connected conversion device. It uses the novel concept of "shaping" electrical waveforms to convert and connect energy from solar panels to the grid. As a single-stage converter (the market standard is two-stage converters), it can reduce material costs for solar power generation.

The second patent application is for a system called Transformerless Unified Power Quality Conditioner (UPQC). The system's development stemmed from an issue Manitoba Hydro customers were experiencing with dimmable LED light bulbs: flickering light.

The lab found a way to harmonize power flowing to LED lights to eliminate the flickering, ultimately reducing energy costs and extending the life of the bulbs.





TOP: Ho with PhD student Radwa Abdalaal, conducting an experiment to evaluate their patented Power Quality Conditioning Technology.

BOTTOM LEFT: Smart inverter modules

BOTTOM RIGHT: MSc student Avishek Ghosh in the lab.

"RIGA'S INTELLIGENT DEVICES CAN ALSO REDUCE ENERGY CONSUMPTION BY TURNING DEVICES OFF OR PLACING THEM IN STANDBY DURING PERIODS OF INACTIVITY."

RIGA's intelligent devices can also reduce energy consumption by turning devices off or placing them in standby during periods of inactivity.

Currently, Ho leads a team of seven PhD students, three Masters students and one visiting professor. He also typically has a handful of undergraduate students working in the lab during the summer.

Educated in Hong Kong, Ho completed his PhD there in 2007 and relocated to Switzerland to do applied research for power-electronics giant ABB Switzerland Ltd.

There, he led a research team on the development of the company's solar conversion technology.

With a career that has crossed from academia to industry and back again, Ho appreciates the need to balance fundamental research and applied research.

"You can do basic research in a corporate setting, but you really need to produce," said Ho.

Looking to the future, Ho wants to explore the idea of the "Energy Internet."

It's the idea that power systems will evolve from being uni-directional systems into ones in which electricity and information can flow two ways—in much the same way television has evolved in recent years.

"TV viewers passively received programs from central producers," explains Ho. "But now people can broadcast their own videos in, for example, YouTube—everyone can be a producer."

Similarly, the control of electricity remains largely at the moment with centralized producers.

"I foresee consumers generating power by themselves," said Ho, "but controlling the flow of that power will be challenging."

And while at the academic level, research tends to follow a linear path from theory to eventual application, research in a business setting occurs in reverse.

First, a potential application or need in the marketplace is identified (along with the potential profits stemming from it).

Secondly, researchers follow the breadcrumbs back to the theory needed for invention.

"In the field of engineering, you cannot decouple from industry. If you do, you're closing the door to having your research develop into an outdoor application or product."

CONTINUING THE LEGACY

DISCOVERING NEW INSIGHTS INTO THE ROLE OF GENES AND THE ENVIRONMENT IN TYPE 2 DIABETES IN OJI-CREE YOUTH

BY TAYLOR MORRISEAU

IN THE 1980'S, U OF M PROFESSORS Heather Dean, Ronald Mundy and Michael Moffatt shifted the medical landscape with twenty—highly-contested but carefully diagnosed—cases of type 2 diabetes (T2D) in school-age children. Surprisingly, these young Oji-Cree patients were united by their heritage to four First Nations communities in northeastern Manitoba. Given the localization and pervasiveness of this disease in coming years, a unique genetic variant (known as HNF-1 G319S) was soon identified.

"It is important to understand, however, that the diabetes epidemic coincided with a shift away from land-based food strategies towards Western-based diets."

Hailed as the strongest genetic predictor of T2D currently known, it remains unclear why Manitoban Indigenous youth have the highest rates of T2D in Canada, when incidences were incredibly low just two generations ago.

It is important to understand, however, that the diabetes epidemic coincided with a shift away from land-based food strategies towards Western-based diets; a consequence of colonization that cannot be accounted for by one's genetic status. Hence, it is unknown how the rapid dietary transformation has influenced diabetes development, particularly in those who carry the HNF-1 G319S variant.

To test this relationship, we used state-of-the-art gene-editing technology to generate the HNF-1 G319S mouse expressing the G319S variant. Under the direction of Max Rady College of Medicine professors Christine Doucette and Vernon Dolinsky who work at the university's affiliated research institute, the Children's Hospital Research Institute of Manitoba, my Vanier Scholarship-supported research investigates cellular mechanisms responsible for T2D development. By modifying experimental diets to mirror nutrient intakes of modern vs. historical Oji-Cree diets, we then assess markers of diabetes development to better understand the relationship between genetics, diet and diabetes in the Oji-Cree population.

Importantly, this project opens the dialogue on race, genetics and disease while contributing prerequisite information to facilitate this larger discussion. To refine our methodologies, we continually seek consultation with an established Indigenous stakeholder committee within the Diabetes Research Envisioned and Accomplished in Manitoba (DREAM) theme. By centering Indigenous voices, we not only provide a greater understanding on diabetes development in Indigenous youth, but locate our science within the greater social, cultural and historical context. It is our hope that this research contributes another strand in the long history woven by dedicated patients, community members, caregivers, and researchers—bound by the hope that these young people will leave their own legacies unburdened by disease.

Taylor Morriseau is a member of the Peguis First Nation with mixed British and Cree ancestry. A recent graduate of a Faculty of Science (double honours) degree, she is now pursuing a PhD in Pharmacology to study early-onset Type 2 Diabetes among Oji-Cree youth. Taylor's personal and academic ambitions act in synergy, fueled by a desire to redress the staggering gaps in health and disease that continue to dominate the narrative of Indigenous peoples.

FORECASTING AN EVER-CHANGING CLIMATE

BY
SHARON
CHISVIN

JULIENNE STROEVE ONCE DREAMED OF TRAVELLING TO OUTER SPACE. INSTEAD, SHE HAS LIMITED HER TRAVELS TO THE ENDS OF THE EARTH.

STROEVE IS A CLIMATOLOGIST, Arctic ice expert and a world leader in the integration of large scale observations and satellite remote sensing data used to study sea ice dynamic and thermodynamic processes. As of September 2018, she is also the U of M's new Canada 150 Chair in Sea Ice-Climate Coupling.

In her new role, Stroeve will receive seven million dollars in federal funding over seven years to continue and extrapolate on the research that has brought her global acclaim, briefings with the CIA and with former American vice-president Al Gore, and recurring appearances on both the History and Weather Channels.

Stroeve's research focuses primarily on the changes occurring in the seasonal snow and sea ice cover in the Arctic Ocean as a result of climate change. Her work predicts, observes, measures and interprets those changes, and cautions the world about the way in which those changes are impacting the Arctic marine ecosystem, the atmosphere and northern communities.

It is research that is timely, vital and all encompassing.

"STROEVE'S RESEARCH FOCUSES PRIMARILY ON THE CHANGES OCCURRING IN THE SEASONAL SNOW AND SEA ICE COVER IN THE ARCTIC OCEAN AS A RESULT OF CLIMATE CHANGE."

"Sea ice," Stroeve explains, "is an important component of our climate system, influencing all aspects of climate, biological, ecological and human systems."

Much of Stroeve's inquiry aims to understand what an Arctic Ocean without summer sea ice will mean for the rest of the planet. It is research that she began as a PhD student in geography at the University of Colorado at Boulder, and pursued while working at the National Snow and Ice Data Centre at the University College London.

Now she is attempting to reach that understanding before the Arctic summer sea ice fully disappears.

The Arctic Ocean ice cover has been shrinking for decades. Currently, its average thickness is half of what it was 30 years ago, and its summer melt is now greater than its winter growth.

"One of the biggest surprises of my research to date," Stroeve says, "is that sea ice loss is outpacing climate model forecasts, with the real possibility of an ice free Arctic Ocean in the next 20 years."

It is that recognition that infuses a sense of urgency into Stroeve's research and her plans for the next few years.

"I have two main areas I want to focus on," she says. "One is to better model and understand the role of snow on ice thickness retrievals from laser and radar altimetry."

ABOVE: Stroeve working in the Arctic.

RIGHT: Summer Ice Camp.

The second one, she adds, is to understand how precipitation may change, and the climatological and biological impacts of those changes.

"One of the key difficulties we face in understanding the effect of Arctic climate change is in the timing and delivery and consequences of snow fall on sea ice," explains David Barber.

"ONE OF THE KEY DIFFICULTIES WE FACE IN UNDERSTANDING THE EFFECT OF ARCTIC CLIMATE CHANGE IS IN THE TIMING AND DELIVERY AND CONSEQUENCES OF SNOW FALL ON SEA ICE."

Barber is a Canada Research Chair in Arctic System Science and an associate dean at the U of M's Centre for Earth Observation Science (CEOS) in the Clayton H. Riddell Faculty of Environment, Earth, and Resources, where Stroeve is now based.

"Her research," he elaborates, "seeks to understand how climate change affects the timing and amount of snow through a range of time and space scales, using both in situ observations and surface and satellite borne microwave remote sensing."

Stroeve will be collaborating with Barber, as well as other CEOS scientists, on several projects. She also will supervise about 10 graduate students each year and teach one graduate level course during the fall and winter semesters. She will conduct her field work, primarily in Baffin Bay and Hudson's Bay, during the spring and summer seasons.

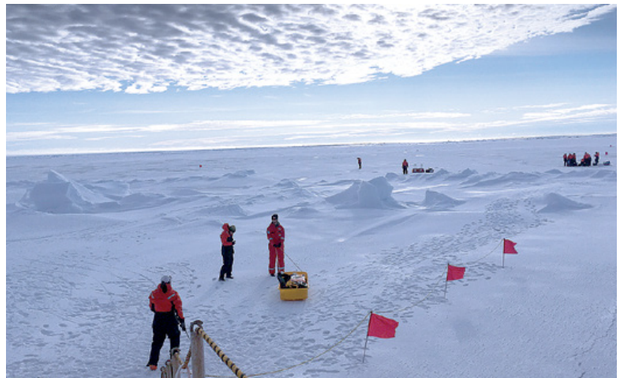
"When I am in the field, I collect observations to either validate satellite observations or better understand some physical process," she explains. "At other times, I'm deploying instruments to collect data over a longer time-period than when we are physically there."

Stroeve also plans to enlist the assistance of northern Indigenous communities with this data collection.

"I've never been part of a community monitoring program," she admits, "so I don't fully know how it will work, but the idea is to get communities to collect useful data for satellite validation and regional forecasts when they are out on the ice for hunting or traveling."

The data retrieved from that community monitoring program, as well as the data collected from her colleagues, her students and her own efforts, will help Stroeve better understand the sea ice dynamic, the changes resulting from that dynamic, and the negative consequences of those changes.

In abandoning her youthful ambition to become an astronaut, Stroeve became a scientist working to save her planet instead.



CO_2 IMPACT

THE ARCTIC SEA ICE IS RETREATING at an alarming pace. And much of that retreat is a result of CO_2 emissions.

"As CO_2 increases, so does the amount of downwelling long wave radiation reaching the surface of the ice," explains Stroeve.

Downwelling occurs when a higher density material sinks beneath a lower density material.

"Basically," Stroeve says, "CO_2 increases warming, which increases ice melt."

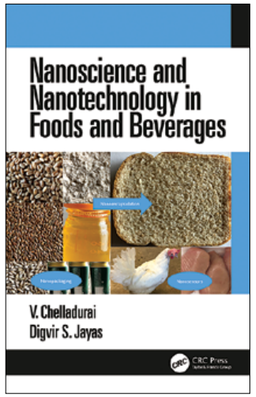
That relationship between CO_2 and sea ice melt was the subject of a major paper co-authored by Stroeve and Dick Notz, from the Max Planck Institute for Meteorology, in 2016. And it remains a major issue of interest and concern for Stroeve today.

In their paper, Stroeve and Notz observed that every tonne of CO_2 that was emitted into the atmosphere resulted in the disappearance of three square miles of the Arctic Ocean sea ice. This means that everyday actions taken thousands of kilometers away—like driving a car to a shopping centre, travelling by plane to an out-of-province conference, or turning up the heat at home instead of putting on a sweater—contributes directly to the melting of the sea ice in the northernmost edge of the world.

Stroeve has been monitoring the Arctic sea ice melting since she was a PhD student in the 1990s, but admits that she is still alarmed and amazed by how quickly it is occurring. She remains optimistic, however, that the research she is undertaking in her new role at the U of M will help temper that melting and convince people everywhere of the need to reduce their carbon emissions.

NANOSCIENCE AND NANOTECHNOLOGY
IN FOODS AND BEVERAGES

VELLAICHAMY CHELLADURAI, DIGVIR S. JAYAS (CRC PRESS, 2019)



THIS BOOK PROVIDES a basic understanding of the nanoscience and nanotechnology and their applications to different food industry sectors, covering both benefits and drawbacks using nanotechnology in food processing and discussing the development of an international regulatory framework.

Materials behave uniquely when their particle size is reduced to the nano level (10^{-9} m). These unique properties have led to extensive applications of nanoscience and nanotechnology in many fields such as electronics, electrical engineering, communication, construction, manufacturing, pharmaceuticals, cosmetics, and water treatment sectors and the rate of applications has been accelerating in recent years.

Similar to these industries, nanoscience and nanotechnology are being used in the food industry for developing innovative products and processes. For example, nanoparticles can be used as food ingredients to enhance food characteristics, in food packaging to preserve food products, as nanoemulsions for decontamination of equipment and facilities, in nanosensors to detect incipient spoilage of food and alert consumers and can be used as "nanobarcodes for identification.

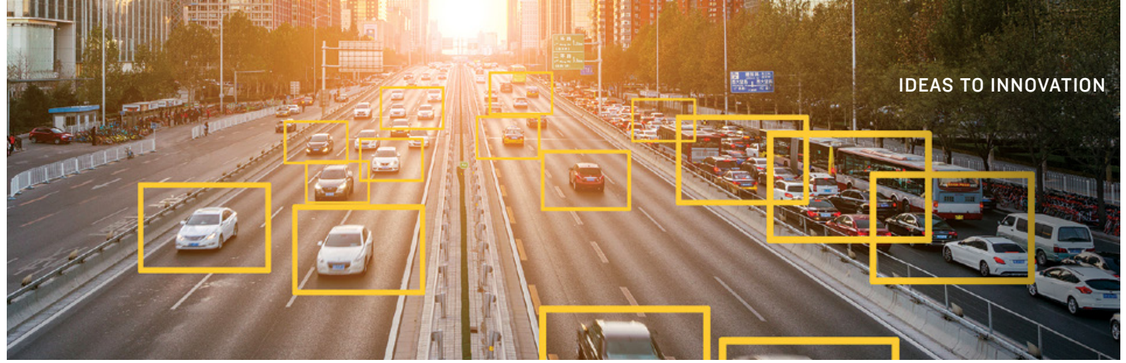
> "Similar to these industries, nanoscience and nanotechnology are being used in the food industry for developing innovative products and processes."

Potential applications of nanotechnology in the food industry include: encapsulation and delivery of substances in targeted sites, increasing flavour, introducing antibacterial nanoparticles into food, enhancing shelf life, sensing contamination, improved food storage, tracking, tracing and brand protection.

ABOUT THE AUTHORS

VELLAICHAMY CHELLADURAI was educated at the Tamil Nadu Agricultural University and the U of M. He is currently an associate professor, agricultural and food processing engineering at the Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu, India. He completed his postdoctoral training at the U of M, where he conducted research on applications of imaging and spectroscopy for agricultural and food products, hermetic storage of cereal grains and oilseeds, drying and non-chemical methods for stored grain management.

DISTINGUISHED PROFESSOR DIGVIR S. JAYAS was educated at the G.B. Pant University of Agriculture and Technology in Pantnagar, India; the U of M and the University of Saskatchewan. He is currently vice-president (research and international), since 2009, at the U of M. He is a former Tier I (Senior) Canada Research Chair in Stored-Grain Ecosystems. He conducts research related to drying, handling and storing grains and oilseeds and digital image processing for grading and processing operations in the agri-food industry. He has authored or co-authored over 900 technical articles in scientific journals, conference proceedings and books dealing with issues of storing, drying, handling and quality monitoring of grains and processed foods.



DATA IN THE DRIVER'S SEAT

BY HEATHER OLYNICK

What keeps you safe when you're in a car? Airbags, for sure. Seatbelts, definitely. If you're in a newer model, maybe automatic emergency braking or blind spot detection. How about big data?

IN THE U OF M'S SMARTPARK, Craig Milligan [BSc(CE)/07, PhD/15] and his company, MicroTraffic, are using deep learning artificial intelligence to analyse traffic video for the position, speed, acceleration, and bearing of vehicles. From this, they track trajectories and detect the future risk of collisions at intersections.

"The idea is to be more proactive. To set up a lot of cameras at a lot of intersections and find where serious near-misses are happening before the fatal accidents happen. That lets the traffic engineers reconfigure an intersection before it's too late."

Working from a library of nearly 5,000 intersection improvement concepts, Milligan and his team are like doctors selecting the right treatment for a diagnosis.

If an intersection is shown to have a risk for drivers making left turns, for example, they might suggest prohibiting those turns at specific times of the day, adding a turning lane, or reducing the speed on the road.

"We had one government in Canada who was able to get political support to reconfigure 28 intersections after our study. So in an area they were having a hard time making positive change, analytics kind of cleared the way. Those changes are predicted to save multiple lives in the next 10 years."

MicroTraffic is not limiting its focus to Canada. The company is currently undertaking the world's largest video-based surrogate studies, to compile a global database of near-miss data. The U.S. is a big market (32,000 Americans die on roads every year, mostly at intersections), as is the Middle East (the UAE has banned the dangerous left turn), and developing countries who are seeing road fatalities increase as income levels and motorization rise.

ABOVE: Milligan, CEO of MicroTraffic, is a former Vanier Scholar.

TOP: MicroTrafffic's computer vision software tracks road user movements.

BOTTOM: MicroTraffic's road safety data classifies near-misses by risk-level.

> "We had one government in Canada who was able to get political support to reconfigure 28 intersections after our study."

In transportation—an industry where physical infrastructure reigns—data is fast becoming an invaluable resource. Entrepreneurs like Milligan are finding new ways to harness it to improve road safety now, and into the future, where humans may not even be the ones driving.

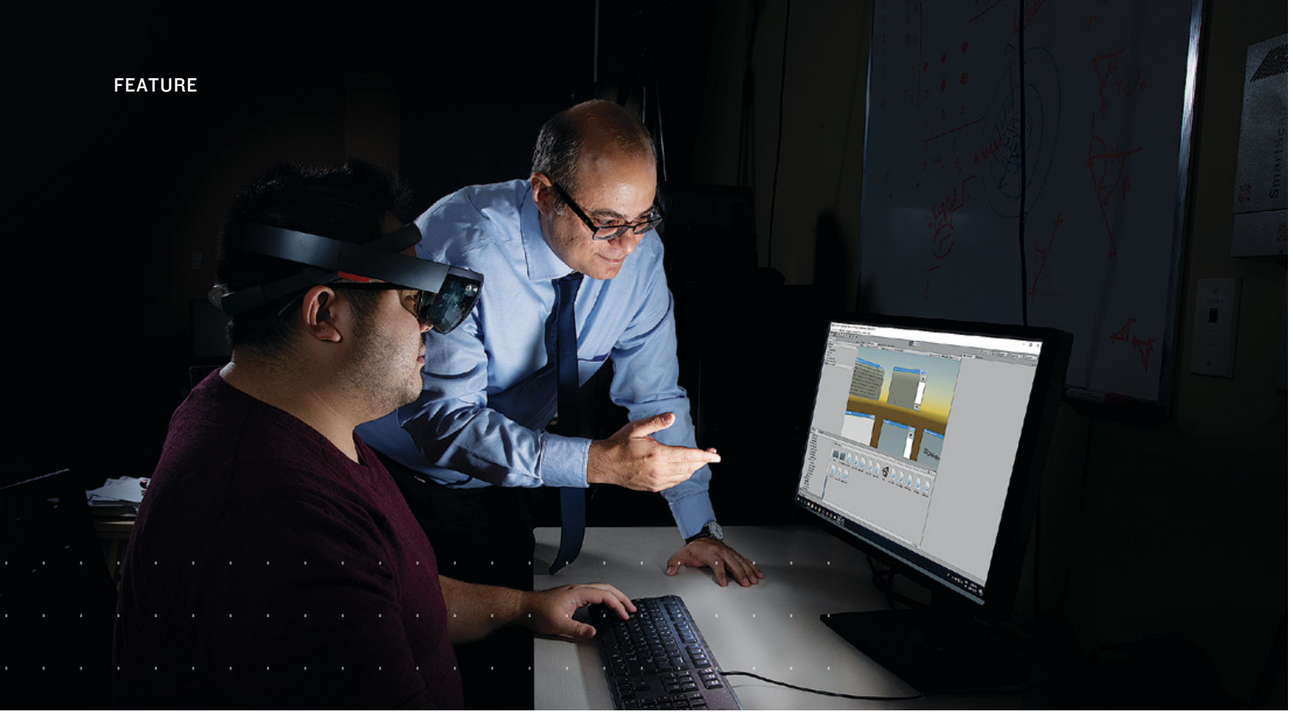
"It's our hope that the behavioural patterns we observe can feed the risk anticipation models in self-driving cars," says Milligan. "If a self-driving car going 80km/h is approaching a sidestreet, they don't know if that car is going to jump out in front of them. Maybe nine out of 10 days it doesn't, but that tenth day it does. What are the factors that will make it more likely to jump out? How can that car predict that kind of erratic behaviour and manage that risk?"

THE HUMAN ARCHITECT

LEFT: Pourang Irani (R) with students inspecting a spatio-temporal dataset on a large screen display.

BY
HEATHER
OLYNICK

SINCE THE DAWN OF TIME, HUMANS HAVE NAVIGATED THE WORLD THROUGH OUR FIVE SENSES. USING PERVASIVE TECHNOLOGIES ALREADY AT OUR DISPOSAL, COMPUTER SCIENTIST POURANG IRANI IS DEVELOPING A SIXTH—ONE THAT HE BELIEVES WILL MAKE US "TRULY HUMAN."



TRUE TO ITS NAME, ubiquitous computing and its devices are everywhere—our phones, appliances, vehicles—gathering data about us and our environment. As the presence of computing has evolved from the mainframe, to the desktop computer, then to mobile devices and the Internet of Things, it has created a need for people to access information anywhere and at any time.

As a Tier 2 Canada Research Chair in Ubiquitous Analytics funded by the Natural Sciences and Engineering Research Council of Canada, Irani is focused on enhancing our human capabilities by providing data in ways that will help us make better decisions and navigate our day-to-day.

"We say we're a very data-intensive society, but we are really only scratching the surface because we don't have the tools to actually be able to look at that information and get it when we need it to be able to change something. Theoretically, it can be collected; but in reality, it's a far cry."

"... IRANI IS FOCUSED ON ENHANCING OUR HUMAN CAPABILITIES BY PROVIDING DATA IN WAYS THAT WILL HELP US MAKE BETTER DECISIONS AND NAVIGATE OUR DAY-TO-DAY."

Wouldn't it be nice, for example, if cutlery informed you when you're eating too quickly? There's already a related device on the market, but Irani's students aim to take it one step further: by subtlety discouraging the behaviour, through what he is terming as 'stubborn' feedback. "If it was a spoon, you could inflate the base so it could carry less food in it. We're interested in incorporating these sorts of minimally invasive cues so we can make a person aware but also assist them."

ABOVE: The Microsoft Hololens used in the lab for creating mixed reality interfaces for ubiquitous analytics.

TOP: MSc student Kenny Hong working on augmented reality/ virtual reality training tools for neo-natal resuscitation with professor Irani.

Irani's goal is to augment devices so they can provide data that will help us in every aspect of our lives—from the practical to the consequential. His lab is currently in the middle of a multi-year project looking at how to summarize video content, then sync it with a person's tasks for situations that require following instructions—like baking a cake, or performing CPR.

A lengthy how-to video would be pared down to shorter clips that isolate each step in the process and are activated by the user's activity. Once your device recognizes you've called 911, only then would it play the video for delivering chest compressions.

Irani's lab has already leveraged omni-directional cameras on mobiles, called SurroundSee, that gives smartphones peripheral vision to detect objects and user activity that "only comes in play when we're in the environment and in the context of that task."

Given the nature of his work, Irani is often mistaken for a "techy guy". Yet while the Human-Computer Interaction Lab is filled with electronics, his office is anchored by a wall of books. There's an old Moleskine notebook on his desk, along with a smartphone—his first and only—which he purchased two years ago.

He wanted to study architecture at university, but the program was full so he chose computer science. Now, he observes people instead of buildings for clues to his next project. It's how CrashAlert came about: by watching hapless attempts to walk and text. The app, developed with post-doctoral researcher Juan David Hincapié-Ramos, uses a distance-sensing camera to scan the path ahead and alert users to approaching obstacles.

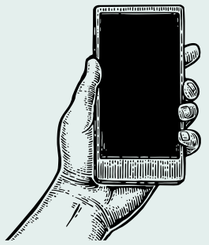
"It's not something I want to encourage," Irani explains, "but the reality is we need knowledge as humans and we're thirsty for having a social life. Any tool that will get us closer to that will be used in every single way possible. Humans are very good at adapting tools for their own uses. The person who came up with the smartphone didn't expect people to walk and type. If they had, their interfaces would have looked different."

"IT'S NOT ENOUGH TO SIMPLY LOOK AT THE TECHNICAL ASPECTS, BUT ALSO THE SOCIAL ASPECTS AND HOW THAT PLAYS OUT WITH OUR INTERACTION WITH ONE ANOTHER."

This is why Irani wants to know how his prototypes will fare in human hands. For that, he needs to bring his technology outside the lab and into people's everyday lives. The support he has received through his CRC appointment will allow him to conduct such longitudinal field studies.

"It's not enough to simply look at the technical aspects, but also the social aspects and how that plays out with our interaction with one another. If it does have a negative impact, then let's find a way to mitigate that before the technology is actually deployed. Let's become a bit more aware of our actions, our thoughts, and our interactions with other people and the environment. I think by doing that you can resolve lots of issues in our society."

UPGRADING



POURANG IRANI AND HIS TEAM of graduate students are enhancing the technologies we interact with on a daily basis. His recently launched NSERC CREATE (Collaborative Research and Training Experience) program, designed to train graduate students in Visual and Automated Disease Analytics. Other projects, funded by NSERC include the following:

SPATIAL ANALYTICS INTERFACES

Smartphones give us access to a wealth of information, but the actual window we have to view the data is limited. While screens have increased in size to combat this problem, Irani and Barrett Ens have designed wearable user interfaces, on smart glasses, that project interactive digital screens onto a person's physical environment, expanding the amount of viewing space available.

AROUND-DEVICE INPUT

Advances in motion sensing technology have allowed researchers to explore how we can interact with mobile devices beyond their physical space. Irani and Khalad Hasan have worked on expanding the capability of devices to sense all around them, turning common tables into interactive surfaces, or recognizing mid-air thumb gestures to make it easier to use smartphones one-handedly.

DATA VIDEOS

Watch any news story and you'll likely see journalists use data videos and motion graphics that incorporate visualizations about facts to illustrate stories. The effects are persuasive and compelling. Irani and Fereshteh Amini deconstructed such videos to understand what components are used and why they are so impactful. Their research, while Amini interned at Microsoft Research, led to a new tool that will help the average person make data videos.

NEW APPROACHES | NET DISCOVERIES

THE UNDERGRAD RESEARCH POSTER COMPETITION

MORE THAN 125 UNDERGRADUATE STUDENTS at the U of M had the opportunity to practice their presentation skills and share their research at the 2018 Undergraduate Research Poster Competition. Judges assess each project based on official judging criteria determining winners for cash prizes in five different categories: applied sciences, creative works, health sciences, natural sciences, and social sciences and humanities.

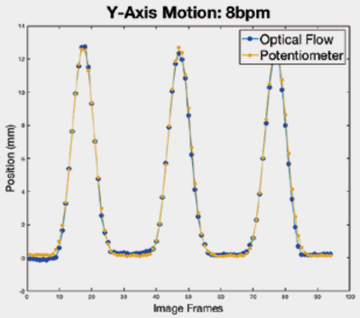
LUNG TUMOUR MOTION TRACKING:

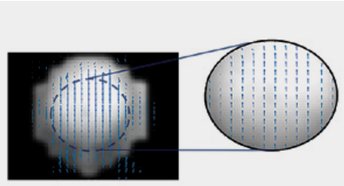
Compensation with an Optical Flow Algorithm.

GABRIELLE FONTAINE is an undergraduate research student under the mentorship of physics and astronomy professor Stephen Pistorius (Faculty of Science and CancerCare Manitoba). She was the first place winner in the Applied Health Sciences category.

Tell us about your research
My research is testing a technique that will be able to track lung tumour motion during radiation therapy sessions. The method is based on an optical flow algorithm that can track pixel-by-pixel motion between two successive images.

Why is this research important?
Radiation therapy is a widely used treatment technique for cancer patients. Problems with this technique arise if the tumour is moving out of the radiation field due to respiratory breathing patterns. Current techniques for monitoring and tracking motion during radiation sessions can increase treatment time, overexpose healthy tissue and be invasive for the patient. Our method is a non-invasive technique that can minimize treatment time and reduce radiation induced side effects by decreasing the field margins.





TOP: Optical flow tracking results compared to the actual breathing pattern (potentiometer) for eight breathes per minute.

BOTTOM: Optical flow velocity vectors generated from two successive images depicting upward tumour motion.

Did anything surprise you?
Many tracking techniques require prior information on the lung tumour before the motion can be tracked. I was surprised that our technique requires no prior information of the tumour. The algorithm is able to track any shaped/sized tumour for various patterns of motion.

What did you enjoy?
I gained experience in the medical physics field which is a career I wish to pursue in the future. I enjoyed being able to drive my own research project with the guidance and help of my supervisor. I had much freedom when deciding the direction I wanted to take the project in and this allowed me to work independently and gain problem solving techniques.

OLD ORDER; NEW ORDER:

The creative process behind a ceramic sculpture about chaos.

ALEXANDRA ROSS is an undergraduate student in the School of Art who was mentored through an Undergraduate Research Award by professor Grace Nickel. She was the first place winner in the Creative Works category.

Tell us about your research and creative work
I am interested in the interactive process inherent within the medium of ceramics. In my research, for example, I spent time "breaking the rules" by mixing together clay that is traditionally fired separately and applying glazes as a powder rather than with a brush.

Why is this research important?
It will help me to develop techniques in my art practice that are both innovative and give me the opportunity to apply material metaphors to significant themes within my work such as chaos and order. Pushing the limits, finding the liminal and breaking traditions has always been an important feature of creative work.

Did anything surprise you?
I was surprised how much the material helped to determine my next step. When working with untried techniques and experimenting with material, it is not possible to imagine the results so it was important to take stock at every point and adjust my plan moving forward. I had to quickly learn that sometimes it is better to abandon an idea part way through and be open to the unpredictable.

What did you enjoy most?
It would have to be the excitement of pulling something altogether surprising and satisfying from the kiln. That excitement helps to fuel my curiosity to tackle the next challenge, problem solve what is unresolved, and, most of all, made me exceedingly grateful for the opportunity to spend my summer in research.

TOP (L): Artist, Alexandra Ross.

ABOVE: Experimental ceramic flowers

BOTTOM (R): Final work, "Old Order, New Order"

PHOTOS: Top left: Taylor Summach; Centre, Alexandra Ross; Bottom Right, Grace Nickel.

PRESERVE AND PREDICT

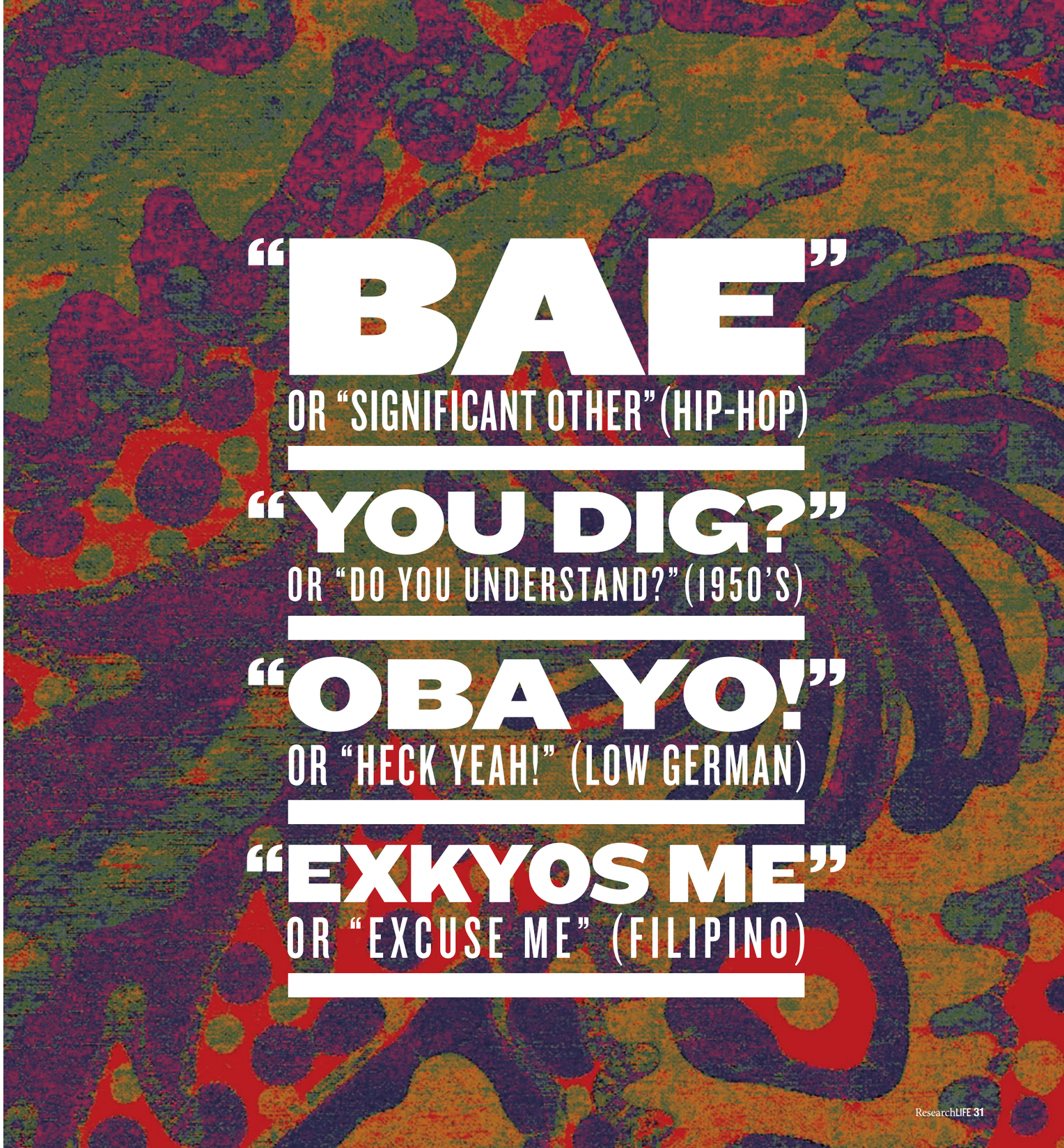
ADDING PRAIRIE LANGUAGES TO THE CANADIAN ATLAS

BY AMBER OSTERMANN

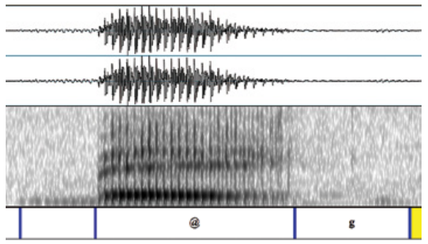
SOME INSTANCES OF LANGUAGE VARIATION ARE definitely simpler to spot than others. We know an eighty-year-old uses language differently than an eighteen-year-old. We can hear and recognize clear differences in what males and females say and between groups in rural and urban settings. The number of slang, translation or pronunciation variations just across Canada is staggering.

The study of linguistics reminds us that there is more to language than just the accents or the words used. Differences in language can impact what we hear and understand. They can also influence attitudes, behaviour, education and even lead to discrimination.

Nicole Rosen, associate professor of linguistics and Canada Research Chair in Language Interactions in the Faculty of Arts, is leading the charge to dispel longstanding Canadian language myths and add Prairie languages and language differences to the overall Canadian language atlas.



"LINGUISTICS PROVIDES THE OPPORTUNITY TO SCIENTIFICALLY ANALYZE LANGUAGE AND ITS STRUCTURE, PREDICTING PATTERNS AND CHANGES IN LANGUAGE AND STUDYING THE SOCIAL IMPLICATIONS THAT RESULT."



Rosen has always been interested in the study of language. From the very beginning however, she knew that she wanted to investigate language beyond the context of literature.

"I have always liked both sciences like chemistry and math and arts like English and French. I discovered that Linguistics was the best way for me to marry my interests in language and math," says Rosen.

"Linguistics provides the opportunity to scientifically analyze language and its structure, predicting patterns and changes in language and studying the social implications that result."

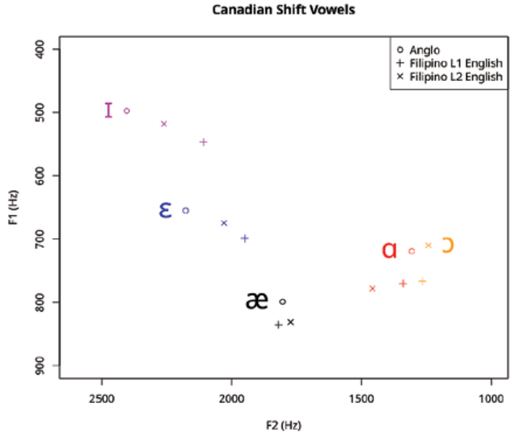
"People have a view of what language is and how to use it in the standard way or 'right' way. Linguists look at language in context to the situation. There is no better language, no right language. I want to help break down the view of people thinking that something different is wrong. It's not wrong. It's just different and worth documenting."

STUDYING SOCIAL SCIENCE

Sociolinguists, like Rosen, are interested in more than just the words each group uses. They study differences in pronunciation, accents and how words are formed in the mouth. Software is used to transcribe interviews and to measure the acoustic parameters of the sounds, that are then displayed on spectrograms, a visual representation of the spectrum of frequencies of the sound signal as they vary with time. Distributional and statistical analyses help to plot and define speech differences as well as predict future changes to language.

Then, consideration is given to differences in sentence structure, the phonetic transcription and meanings of words and how this all relates to the individual's social status, economic status, ethnic background, religion, geography or age.

The findings often make an important impact on other fields as diverse as psychology, philosophy, education, language teaching, sociology, anthropology, speech pathology, computer science and artificial intelligence.



LEFT: Spectrogram showing vowel formants for /æ/.

ABOVE: Faculty of Arts, linguistics professor Nicole Rosen.

RIGHT: F1/F2 Canadian shift vowel plot by ethnolinguistic group.

PRESERVING LANGUAGE

Perhaps because of the geography, settlement patterns and ethnic make-up of the Canadian Prairies, very little is known about Prairies English and how it fits into the standard template of Canadian English nationally. Rosen's research focuses on Canadian Prairie Settler Populations, both new and old, including Filipinos, Mormons, Mennonites, Hutterites and Ukrainians, investigating the influence of geographic, social and linguistic isolation on language variation, change and transmission on the Canadian Prairies.

Early Prairie settler populations were largely isolated, developing their own linguistic and social identity over decades, but switched to English mid-twentieth century, due primarily to societal and economic pressures. "We are currently at a point in history where we can still interview generations who spoke a heritage language as their first language," says Rosen, "but this population is aging. It is urgent to gather data on second language transfer, language use, and identity now, before only standard Canadian English speakers remain."

It is hoped that this research will break new ground in the study of Canadian English, as the bulk of sociolinguistic work in Canada has traditionally taken place in urban areas or in the Maritimes.

OBSERVING DIFFERENCES

Rosen and her team augment their study of early settler groups with recent immigrant groups who tell us very different things about language and society today. Rosen explains that "Filipinos are a huge part of Winnipeg's current fabric, as the largest immigrant group, and the population is growing. Tagalog is by far the next most-spoken language after English in Manitoba. We have Winnipeg-born Filipino Canadians with English as their only language, others that have recently immigrated who are just learning English, and others who immigrated decades ago who speak both Filipino language(s) and English regularly. This is an extremely rich and interesting sociolinguistic situation where we hope to learn about developing language change at an earlier stage rather than what we find after generations of change."

"WE CAN HELP REDUCE DISCRIMINATION, INFLUENCE EDUCATIONAL DIRECTION, LOWER THE MISDIAGNOSIS OF SPEECH DEFICITS IN CHILDREN, EDUCATE THE PUBLIC AND CHANGE ATTITUDES SO THAT LANGUAGE IS NO LONGER A LIMITING FACTOR SOCIALLY OR ECONOMICALLY."

DISPELLING MYTHS

In addition to the dialect maps and language dictionaries produced, Rosen hopes her work can provide a bridge between differences in pronunciation and standard versus non-standard language. "If someone speaks with an accent or uses non-standard language," says Rosen, "it's important to identify and remind both professionals and the public that this is not wrong. We can help reduce discrimination, influence educational direction, lower the misdiagnosis of speech deficits in children, educate the public and change attitudes so that language is no longer a limiting factor socially or economically for these groups."

DOCUMENTING ENDANGERED LANGUAGES

IN THE DISCOVERY AND MAPPING of language differences, Linguistics has found a role in the documenting and preservation of endangered languages. This includes working with the Michif, Ojibwe, Cree and Innu Peoples.

The U of M has led the way publishing research, dialect maps and dictionaries of Prairie and Indigenous languages helping to not only capture and record the languages before they are gone, but also use the findings to help predict the future of the language and its place in society.

Support from the CRC Program and SSHRC is instrumental in bringing this research to life.

The CRC award has been crucial for collecting the amount and breadth of data necessary to do such large-scale cross-linguistic and cross-cultural comparisons. It has allowed researchers to collect large amounts of data and to then bring the local interplay of Prairie linguistic diversity to an international audience. It has permitted Rosen to offer research assistantships to 14 undergraduate students and fund eight graduate students. The support continues to provide the opportunity for collaboration with researchers from across Canada including collaborations with researchers in Ottawa to create exciting new methods in data visualization that will help bring linguistic variation into the public sphere.

As a result, Prairie languages now hold a place in the overall fabric of Canadian language. And, the university has become a hub for Michif language and linguistic research, attracting graduate and postgraduate students to work on this endangered contact language, helping to preserve and revitalize it for generations to come.

UNIVERSITY OF MANITOBA SPEAKER SERIES

THE UNIVERSITY OF MANITOBA HOSTS SEVERAL ENGAGING SPEAKER SERIES AND STUDENT COMPETITIONS, BOTH ON AND OFF CAMPUS, ENGAGING AND INFORMING THE COMMUNITY ABOUT ONGOING RESEARCH AND ISSUES OF INTEREST.

CAFÉ SCIENTIFIQUE

Join us in talking and learning about different topics and related research. These Café Scientifiques bring together experts with non-researchers (you, me, neighbours and friends) in a relaxed atmosphere at McNally Robinson Booksellers, to talk about their research and the questions it raises. Come and join the discussion!

VISIT: UMANITOBA.CA/CAFESCIENTIFIQUE

THREE MINUTE THESIS

Hear our innovative, trailblazing graduate students explain their research—in three minutes or less. Challenging? You bet it is. It takes years for a thesis to be researched and finalized, never mind condensing it and presenting in front of our panel of judges and a live audience. Cheer on the competitors and vote for the people's choice winner!

VISIT: UMANITOBA.CA/3MT

VISIONARY CONVERSATIONS

What is more powerful than a good conversation? Join us on campus or in the community: Come learn, debate and discuss alongside experts and community leaders.

VISIT: UMANITOBA.CA/VISIONARYCONVERSATIONS

BY THE NUMBERS

29,620
students (Fall 2018)
25,135 undergraduate; 3,753 graduate;
732 post-graduate medical education

5,461
academic staff (2017/18)
1,146 full-time faculty;
3,951 support staff

67
Endowed and sponsored research chairs;
46 Canada Research Chairs, a Canada 150 Research Chair and CERC Laureate

8
National Synergy Awards for Innovation

55
research centres, institutes and shared research facilities

8.5%
of students are self-declared Indigenous students (2,409)

16
Canadian Academy of Engineering Fellows

53
Royal Society of Canada Fellows (45) and Members (8)

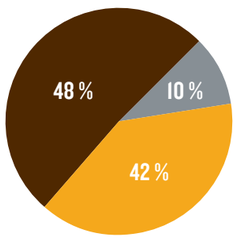
18.9%
of students are international students, representing 123 countries (5,589)

45
Canadian Academy of Health Sciences Fellows

SPONSORED RESEARCH INCOME BY SOURCE (2017/18)

TOTAL: $211.7 MILLION

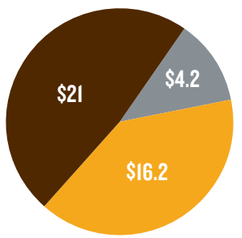
- **OTHER** 48%
- **FEDERAL GOVERNMENT** 42%
- **PROVINCIAL GOVERNMENT** 10%



TRI-COUNCIL FUNDING 2017/18

TOTAL: $41.4 MILLION

- **CIHR** (Canadian Institutes of Health Research) **$21M**
- **NSERC** (Natural Sciences & Engineering Research Council of Canada) **$16.2M**
- **SSHRC** (Social Sciences & Humanities Research Council of Canada) **$4.2M**



CANADA RESEARCH CHAIRS: EQUITY, DIVERSITY AND INCLUSION REPORTING 2018

The University of Manitoba is firmly committed to ensuring equity, diversity and inclusion within the Canada Research Chairs program. This statement expresses our ongoing commitment to fostering a culture where all people feel valued, respected and included. Three of our institutional priorities—Creating Pathways to Indigenous Achievement, Building Community that creates an outstanding learning and working environment, Forging Connections to foster high impact community engagement—guide and direct our approaches to creating an inclusive and diverse environment.

TARGETS FROM 2017

Equity Target Category	National Target	U of M Target	U of M Current
Women	31%	32%	43%
Visible Minorities	15%	15%	28%
Persons with Disabilities	1%	4%	3%
Indigenous Peoples	1%	1%	5%