University of Toronto Research Expertise

Digital Health, Artificial Intelligence & Medical Devices

UNIVERSITY OF TORONTO

March 2023

U of T Global Rankings

#1 in Canada	#18 worldwide	#1 in Canada	#6 worldwide
THE World University Rankings (2022)		NTU World University Rankings (2022)	

A POWERHOUSE FOR INNOVATION & ENTREPRENEURSHIP

600+ Startups

More than **$2.5B** in investment secured by **600+** startups over the past decade.

350+ Private Sector Partners

U of T's global reputation as a top research university and its vibrant innovation and entrepreneurship culture attracts industry partners from across Canada and worldwide.

1100+ Patent Applications

U of T is a leader among North American universities for research-based startups, inventions, licenses and options.
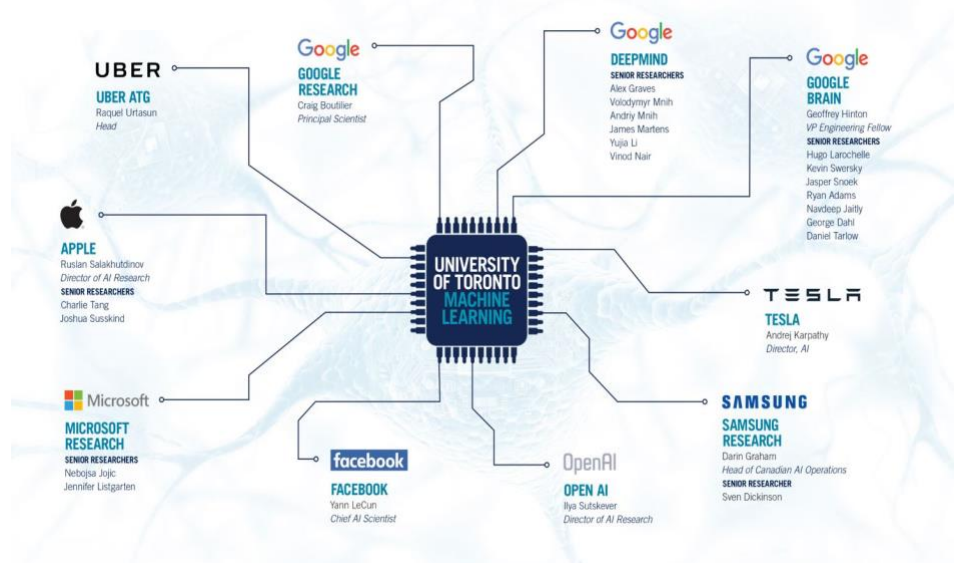

U of T & Affiliated Academic Hospitals

A Dynamic Network of Academic Health Organizations Providing Leading Edge Research, Teaching & Clinical Care

U of T Expertise Sought by Global Giants

U of T Faculty & Alumni are Hired by Some of the Most Influential Tech Companies Worldwide

*The Toronto Region is home to one of the most vibrant life sciences, human health sciences, and biotechnology ecosystems in the world. **Over half of Canada's life sciences, pharmaceutical and medical device companies are located in the region including 50 of the world's top 100 multinational corporations.***

IMPACT STORIES
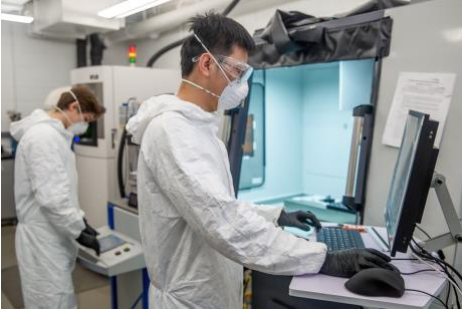
U of T researchers advance metal 3D printing for biomedical applications

Mar 14, 2023

U of T-supported startup Xanadu aims to lead quantum computing sector

Mar 09, 2023

Stars in the same constellation: How space & health fields benefit from each other's innovations

Jan 26, 2023

Smartphone app designed by U of T researchers can significantly improve memory recall

Jan 16, 2023

Advancing health science with smartphones, bio-printers and organs-on-chips

Nov 22, 2022

Researchers aim to predict cardiac events with AI technique used to analyze earthquakes
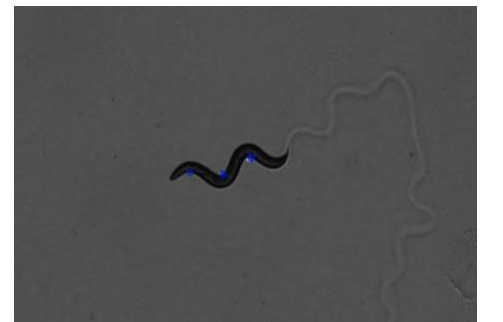
Jul 25, 2022

Public health researchers use telemedicine to manage diabetes and hypertension in rural Pakistan

Mar 02, 2022

Researchers develop stretchable sensor material to power wearable electronics – and it works in extreme cold

Aug 5, 2021

Pushing the boundaries of micro-robotics, U of T researchers create 'RoboWorm'

Jul 29, 2021

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KEY RESEARCH CENTRES & INFRASTRUCTURE

Acceleration Consortium   [Advanced Materials | Artificial Intelligence]
https://acceleration.utoronto.ca/
The **Acceleration Consortium** is leading a paradigm shift in scientific discovery through the development of self-driving artificial intelligence-guided robotic labs that accelerate the discovery of advanced materials and small molecules, from decades to years. The consortium addresses fundamental topics, such as deep learning algorithms, materials modelling, and robotics and applied challenges, such as discovering materials for a wide range of commercial applications. The **Acceleration Consortium** supports a commercialization-focused ecosystem that aims to translates materials discoveries through start-ups and industry partnerships.

AGE-WELL   [Aging | Digital Technology]
https://agewell-nce.ca/
AGE-WELL is Canada's technology and aging network and is dedicated to the creation of technologies and services that benefit older adults and caregivers. The aim of this National Centre of Excellence (NCE) is to help older Canadians maintain their independence, health and quality of life through technologies and services that increase their safety and security, support their independent living, and enhance their social participation.

Centre for Analytics and Artificial Intelligence Engineering   [Artificial Intelligence | Engineering]
https://www.engineering.utoronto.ca/carte/
The **Centre for Analytics and Artificial Intelligence Engineering (CARTE)** brings together more than 30 professors with expertise in optimization, analytics and AI, as well as diverse domains such as energy, transportation and life sciences. Artificial intelligence (AI) is increasingly part of our daily lives, with applications from voice-activated assistants to self-driving cars — and its influence continues to grow. This multidisciplinary research centre leverages the power of AI to address challenges in a wide range of fields, including human health, sustainability and advanced manufacturing.

Data Science Institute   [Data Science | Computational Biology]
https://datasciences.utoronto.ca/
The *Data Sciences Institute (DSI)* is an entryway for all things data science at the University, including research, training, and partnerships. The initiative provides the leadership and capacity to catalyze the transformative nature of data sciences in disciplines, in fair and ethical ways, leveraging and strengthening U of T's pre-eminence in data sciences to solve society's complex and pressing problems. Research efforts focus on advancements in data science methodologies and tools that can be applied across a variety of fields as well as the emergent discipline of data science itself.

Institute of Biomedical Engineering   [Health | Engineering]
https://bme.utoronto.ca/
The **Institute of Biomedical Engineering (BME)** at the U of T is a multidisciplinary research community where engineering, medicine and dentistry investigators collaborate to develop innovative solutions that address global challenges in human health.

Medicine by Design   [Regenerative Medicine]
https://mbd.utoronto.ca/
Medicine by Design (MbD) brings together 130 scientists, engineers and clinicians at U of T and its affiliated hospitals to address challenges in regenerative medicine. These research teams enhance our understanding of the human body's regenerative capacities and develop clinical solutions to improve health outcomes.

PRiME   [Precision Medicine]
https://www.prime.utoronto.ca/
The **Precision Medicine Initiative at U of T (PRiME)** leverages the U of T's world-class expertise in biologics, omics, molecular chemistry, liquid biopsy, nanomedicine, biology-on-a-chip and related domains to develop new solutions to unmet needs in human disease. The multidisciplinary approach at *PRiME* goes beyond genomics and mutational profiling, to more fully understand the biology of disease, create new tools for

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disease diagnosis, and develop novel therapeutic strategies that will deliver on the promise of precision medicine.

University of Toronto Robotics Institute   [Robotics]
https://robotics.utoronto.ca

The **University of Toronto Robotics Institute** is home to the largest and most diversified robotics research program in Canada. We unite, grow, and catalyze collaborations among the many exceptional robotics research clusters at the University. Serving as the headquarters for robotics collaboration at U of T, we unite leading robotics experts from across the University around three research pillars: Autonomous Field Robotics; Healthcare Robotics; Advanced Manufacturing.

Schwartz-Reisman Institute for Technology and Society   [Artificial Intelligence | Machine Learning]
https://srinstitute.utoronto.ca/

The Schwartz Reisman Institute draws on U of T's signature strengths in the sciences, humanities and social sciences to explore the benefits and challenges that AI, biotechnology and other technological advances present for our economy, our society and our day-to-day lives.

Temerty Centre for Artificial Intelligence Research & Education in Medicine   [AI | Medicine]
https://tcairem.utoronto.ca/

The **Temerty Centre for Artificial Intelligence Research and Education in Medicine (T-CAIREM)** at the U of T seeks to establish world-class educational programs in AI in medicine, fund research opportunities that bring together experts from a range of disciplines, and create a secure data platform to house datasets for applied AI learning and research.

Transform-Heart Failure   [Cardiac | Digital Technology]
https://transformhf.ca/

TRANSFORM-Heart Failure aims to enable new healthcare models that are proactive, personalized, and decentralized to improve access to equitable, high-quality heart failure care. It unites a diverse team of experts in technology innovation and implementation, basic science, heart failure medicine, data analytics and artificial intelligence, health technology assessment, patient engagement and Indigenous health focused on working collaboratively to advance digital medicine and remote healthcare monitoring technologies in service of its mission. Together with Indigenous organizations and leaders, as well as patients, TRANSFORM-HF hopes to create such innovative models in a spirit of allyship and partnership.

Vector Institute   [Artificial Intelligence]
https://vectorinstitute.ai/

The **Vector Institute** is an independent, not-for-profit corporation dedicated to research in the field of artificial intelligence (AI), excelling in machine and deep learning. The Vector Institute launched in March 2017 with generous support from the Government of Canada, Government of Ontario, and private industry, and in partnership with the University of Toronto and other universities.

U of T RESEARCHERS

AI & MACHINE LEARNING
Dionne Aleman

University Affiliations
Mechanical & Industrial Engineering
Centre for Healthcare Engineering

Faculty Webpage
Dionne Aleman

Keywords
Operations Research, Healthcare, AI/ML

Dionne Aleman's research focuses on the application of operations research to medical and healthcare systems to improve the quality, timeliness, and efficiency of care. This research includes using optimization, simulation, machine learning, and graph theory to predict and mitigate the spread of pandemic diseases in urban populations, to design and validate radiation therapy treatment plans, to improve hospital surgical scheduling, and to optimize organ transplant matches and multi-person chains.

Professor Aleman is also a Topical Editor for the Wiley Encyclopedia of Operations Research and Management Science, Associate Editor for IIE Transactions on Healthcare Systems Engineering, Associate Editor for OMEGA, Associate Editor for the International Journal of Biomedical Data Mining, and Editorial Board Member of Operations Research in Health Care.

Michael Brudno

University Affiliations
Professor, Computer Science, Faculty of Engineering
Faculty Member, Vector Institute

Lab Website
https://brudno.uhndata.io/

Keywords
Machine Learning, Artificial Intelligence, Computational Biology, Genomics, Algorithms, Clinical Data

Prof. Brudno's research focuses on the development of computational methods for the analysis of clinical and genomic datasets that captures the precise clinical data from clinicians using effective user interfaces, and its utilization in the automated analysis of genomes. The Brudno lab works on the capture of structured phenotypic data from clinical encounters, using both refined User Interfaces, and mining of unstructured data (based on Machine Learning methodology), and the analysis of omics data (genome, transcriptome, epigenome) in the context of the structured patient phenotypes, mostly for rare diseases. His overall research goal is to enable the seamless automated analysis of patient omics data based on automatically captured information from a clinical encounter, thus streamlining clinical workflows and enabling faster and better treatments.

Prof. Brudno is the Chief Data Scientist at the University Health Network (UHN) and Director of Digital Health at the Techna Institute. He also holds the Canada CIFAR AI Chair position.

Publications: ⬃ Click here for Prof. Brudno's publications on Pubmed.

Timothy Chan

University Affiliations:
Mechanical & Industrial Engineering
Centre for Healthcare Engineering
CARTE

Website: Tim Chan

Keywords:
Operations Research, Applied Optimization, AI/ML, Healthcare

Tim Chan's primary research interests are in optimization under uncertainty and the application of optimization methods to problems in healthcare, medicine, global engineering, sustainability, and sports. He has advised leading global companies in the fields of medical device technology, travel and hospitality, telecommunications, and energy on issues of strategy, organization, technology and operations.

Professor Chan holds the Canada Research Chair in Novel Optimization and Analytics in Health. He is currently Director of both the Centre for Healthcare Engineering and CARTE.

Anna Goldenberg

University Affiliations
Assoc. Professor, Computer Science, Faculty of Engineering
Faculty Member, Vector Institute
Faculty Member, T-CAIREM

Website
http://goldenberglab.ca/

Keywords
Machine Learning, Artificial Intelligence, Biomedical Informatics, Genetics, Network Modelling, Clinical Data, Drug Response Prediction

Prof. Goldenberg's research is currently focused on developing machine learning methods that capture heterogeneity and identify disease mechanisms in complex human diseases as well as developing risk prediction and early warning clinical systems. The Goldenberg lab collaborates extensively with clinicians and is a Senior Scientist at the Hospital for Sick Children.

Prof. Goldenberg is a recipient of the Early Researcher Award from the Ministry of Research and Innovation. She also holds the Canada Research Chair in Computational Medicine and the Canada CIFAR AI Chair positions.

Publications: ↘ Click here for Prof. Goldenberg's publications.

Chi-Guhn Lee

University Affiliations
Mechanical & Industrial Engineering
Centre for Healthcare Engineering

Website
https://cglee.mie.utoronto.ca/

Keywords
Operations Research, Artificial Intelligence, Machine Learning, Healthcare

Chi-Guhn Lee studies various problems in logistics; sequential decision-making theories; financial theories applied in manufacturing and service sectors; market-driven conflict resolution; optimal pricing; marketing; information system control and design. He has done both theoretical and applied research in dynamic optimization under uncertainty. His theoretical works involve accelerated value iteration algorithm for Markov decision processes, progressive basis-function approximation for value function space, multi-variate Bayesian control chart optimization, and optimal learning using Multi-armed Bandit Model. His interest in application is diverse from supply chain optimization to financial engineering, to dynamic pricing and to healthcare optimization.

Professor Lee holds positions as Associate Editor – Enterprise Information System and International Journal of Industrial Engineering and serves on other editorial boards.

Alex Mihailidis

University Affiliations
Assoc. Vice-President – International Partnerships
Professor, Occupational Science & Occupational Therapy
Professor, Institute of Biomedical Engineering

Website
https://www.iatsl.org/

Keywords
Data Analytics, Artificial Intelligence, Health, Robotics, Occupational Sciences, Pervasive Computing, Intelligent Systems in Health

Prof. Mihailidis has been conducting research in the field of pervasive computing and intelligent systems in health for 15+ years. He has specifically focused on the development of intelligent home systems for elder care and wellness, technology for children with autism, and adaptive tools for nurses and clinical applications. He holds several major research grants from international funding agencies and collaborates extensively with researchers from Canada, the United Kingdom, and the United States, and with various industrial partners.

Prof. Mihailidis is Scientific Director and CEO of AGE-WELL, which focuses on the development of new technologies and services for older adults and caregivers. He holds the Barbara G. Stymiest Research Chair in Rehabilitation Technology at the University of Toronto and The KITE Research Institute at University Health Network.

Publications: ⬂ Click here for Prof. Mihailidis' publications.

Quyhn Pham
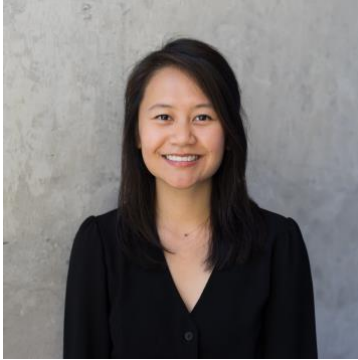
University Affiliations
Assistant Professor, Institute of Health Policy, Management & Evaluation, Dalla Lana School of Public Health
Faculty Member, Vector Institute

Faculty Webpage
https://ihpme.utoronto.ca/faculty/quynh-pham/

Keywords
Health Informatics, Digital Health Outcomes and Evaluation, Clinical Trials, Big Data, Population Health, Research Methods

Prof. Pham leads an all-star research team to design, develop, evaluate, and implement evidence-based innovations that aim to bridge the digital divide in Canada and reflect the transcultural health and social needs of all Canadians. The Pham lab's research focuses on the use of big data analytics to (1) optimize traditional methods of evidence generation, (2) derive patterns of effective engagement with technology that produce positive outcomes, and (3) create digital health products and services that provide measurable and sustained value. Prof. Pham's clinical interests lie in the digitally-mediated management of chronic conditions, particularly asthma, mental health, and cancer survivorship.

Prof. Pham is the Associate Director, Research at eHealth Innovation, University Hospital Network.

Publications: ⬑ Click here for Prof. Pham's publications.

Frank Rudzicz

University Affiliations
Associate Professor, Computer Science, U of T
Member, Vector Institute for AI
Member, Temerty Centre for AI Research and Education in Medicine

Lab Website
http://www.cs.toronto.edu/~frank/index.html

Keywords
Machine Learning, AI, Healthcare, Surgery, Speech, Language Processing, Brain-Computer Interfaces

Frank Rudzicz is a scientist at the Li Ka Shing Knowledge Institute at Unity Health Toronto, Director of Artificial Intelligence at Surgical Safety Technologies Inc., an associate professor of Computer Science at the University of Toronto, co-founder of WinterLight Labs Inc., faculty member at the Vector Institute for Artificial Intelligence, and CIFAR Chair in Artificial Intelligence. His work is in machine learning in healthcare, especially in natural language processing, speech recognition, and surgical safety.

His research has appeared in popular media such as Scientific American, Wired, CBC, and the Globe and Mail, and in scientific press such as Nature.

Publications: ⬑ Click here for Prof. Rudzicz's publications.

Bo Wang

University Affiliations
Assistant Professor, Laboratory Medicine & Pathobiology, Temerty Faculty of Medicine
Faculty Member, Vector Institute

Website
https://wanglab.ml/

Keywords
Computational Biology, AI/ML, Healthcare, Cancer, Genomics, Proteomics

Prof. Bo Wang's primary research areas are artificial intelligence/machine learning, computational biology, natural language processing and computer vision. The Wang lab follows a multidisciplinary and collaborative research program focused on developing machine learning tools for healthcare related applications, ranging from cancer analysis to cardiovascular disease treatment. The lab's long-term research goals aim to develop integrative and interpretable machine learning algorithms that can help clinicians with predictive models and decision support to tailor patients' care to their unique clinical and genomic traits.

Prof. Wang holds the Canada CIFAR AI Chair position and is also the Lead Artificial Intelligence Scientist at the Peter Mun Cardiac Centre at the University Health Network (UHN) and the Techna Institute.

Publications: ⬉ Click here for Prof. Wang's publications.

HEALTH TECH & MEDICAL DEVICES
Michael Carter

University Affiliations
Mechanical & Industrial Engineering
Centre for Healthcare Engineering
Institute of Health Policy Management
Institute for Clinical Evaluative Sciences

Faculty Webpage
https://che.utoronto.ca/professor-michael-w-carter/

Keywords
Operations Research, Applied Optimization, Healthcare

Mike Carter's research focus has been in the area of health care resource modeling. Specific interests include Healthcare human resource planning and forecasting; capacity planning; operating room planning and scheduling; wait list management; healthcare system modelling; patient flow simulation; cancer screening capacity; and clinic planning.

Professor Carter was the Founding Director of the Centre for Healthcare Engineering and is a Fellow of the Canadian Academy of Engineering and the Canadian Academy of Health Sciences.

Warren Chan

University Affiliations
Institute of Biomedical Engineering
Donnelly Centre for Cellular & Biomolecular Research

Lab Website
https://inbs.med.utoronto.ca/

Keywords
Nanotechnology, Cancer, Infectious Diseases, Nanoparticles, Diagnostic Devices, Smartphone, Quantum Dot

Prof. Chan's lab is primarily interested in studying and understanding nanomaterial interactions with biological systems, fundamental basis of key molecular processes, and bio-molecule sensing, and using that knowledge to design innovative diagnostic and therapeutic strategies. The Chan lab aims to solve biological questions through engineering of novel nanomaterials (e.g., inorganic and polymeric nanostructures) as well as the development of microtechnology (e.g., micro-electromechanical systems and capillary flow systems).

Prof. Chan is the Distinguished Professor of Nanobioengineering at U of T, and holds the Canada Research Chair in Nanobioengineering since 2018.

Publications: ↘ Click here for Prof. Chan's publications on Pubmed.

Axel Guenther

University Affiliations
Associate Professor, Mechanical & Industrial Engineering
Associate Professor, Institute of Biomedical Engineering
Co-Lead, Centre for Research & Applications in Fluidic Technologies

Website
https://guentherlab.mie.utoronto.ca/

Keywords
Microfluidics, Nanofabrication, HT Screening, Biomaterials, Bioprinter, 3D Microenvironments, Protein-Based Constructs, Organs-on-a-chip

Prof. Guenther's lab works in the areas of fluid mechanics, colloidal material synthesis, as well as micro/nanofabrication. The Guenther lab is particularly interested in realizing dynamically changing microenvironments for applications in materials science and biomedicine. Current applications include the controlled preparation of colloidal nanostructures in microreactors, high-throughput platforms for functional tests of small blood vessels with relevance to biopharmaceutical drug discovery, and microfluidic strategies for probing cellular decision processes.

Prof. Guenther has co-founded "Ontario-on-a-Chip", an annual event on microfluidics, microreactors, and labs-on-a-chip, which facilitates contact between university researchers and chemical, pharma, biotech, advanced materials, and analytical device companies. He is a recipient of the Ontario Early Researcher Award (2009), and the I.W. Smith Award of the Canadian Society of Mechanical Engineers (2010) and has held the Wallace G. Chalmers Chair of Engineering Design (2012 to 2018).

Publications: ↘ Click here for Prof. Guenther's publications.

Xinyu Liu

University Affiliations
Associate Professor, Mechanical & Industrial Engineering
Member, Toronto Nanofabrication Centre
Member, University of Toronto Robotics Institute

Lab Website
https://sites.google.com/site/biomedmicrolab/

Keywords
Robotics, Automation, Advanced Manufacturing, Data Analytics, AI, Thermofluids, Nanomaterials, Microfabrication, Nanofabrication, Microfluidics, Lab-on-a-chip, Biosensors, Wearables, Point-of-Care Diagnostics

Prof. Liu's research interests lie at the interfaces of microfluidics, bioMEMS (bio-microelectromechanical systems), and robotics. His research group is developing integrated micro/nanodevices and systems to target a variety of exciting applications primarily in biology and medicine. Applications of their recent technologies include point-of-care diagnostics, large-scale gene screening, neural basis of behaviour, high-throughput drug screening, and environmental pollution monitoring.

Prof. Liu has received the Canadian Rising Star in Global Health Award (2012), the Douglas R. Colton Medal for Research Excellence (2012), the McGill Christophe Pierre Award for Research Excellence (2017), the MINE Outstanding Young Researcher Award (2018), and 7 best paper awards at major engineering and biomedical conferences. He is also a co-inventor of more than a dozen US/PCT patents (issued or pending). He currently serves as a Senior Editor of IEEE Robotics and Automation Letters and an Associate Editor of IEEE Transactions on Automation Science and Engineering, IEEE Transactions on Nanotechnology, IET Cyber-Systems and Robotics, Journal of Advanced Robotic Systems, and Journal of Sensors.

Keith Pardee

University Affiliations
Professor, Faculty of Pharmacy, U of T
PRiME, Co-Director

Lab Website
https://www.pardeelab.org/

Keywords
Synthetic Biology, Point-Of-Care Diagnostics, Sensors, Gene Circuits, Cell-Free, Portable, Virology, Bioproduction, Protein, Biomanufacturing

The Pardee lab is dedicated to the development of molecular technologies to manipulate & probe genetic material, with a focus in portable sensing & manufacturing (e.g. vaccines, small molecules, cell/gene based therapies). In addition to Dr. Pardee's previous work, the past few years have also seen the development of other point-of-use molecular sensing technologies with impressive features such as: pathogen detection at clinically relevant concentrations & potential for the multiplexed detection of diseases.

Prof. Pardee holds the Canada Research Chair in Synthetic Biology & Human Health and is co-founder of three biotech startups.

Publications: ➘ Click here for Prof. Pardee's publications on Pubmed.

Milica Radisic

University Affiliations
Professor, Chemical Engineering & Applied Chemistry; Institute of Biomedical Engineering
Member, PRiME

Lab Website
https://www.labs.chem-eng.utoronto.ca/radisic/

Keywords
Tissue Engineering, Bioengineering, Cardiovascular Biomaterials, Myocardial Infarction, Regenerative Medicine, Cardiac Regeneration, Biomaterials, Organ-on-a-Chip

Prof. Radisic's research programs broadly fall under the cardiac tissue engineering and regenerative medicine umbrella. The Radisic lab is focused on pursuing molecular mechanisms governing the formation of contractile cardiac tissue *in vitro* as well as on practical strategies for treatment of myocardial infarction and heart failure through development of new biomaterials. They pursue the research programs alone (e.g. advanced bioreactors and cell tri-culture) or in collaboration with other PIs (e.g. microfluidic separation of heart cells). The research programs are categorized as: tissue engineering of cardiac patches; injectable biomaterials; microfluidic cell separation; and microfabricated systems for cell culture.

Prof. Radisic holds the prestigious Canada Research Chair position in Functional Cardiovascular Tissue Engineering and is the co-founder of two biotech startup companies, Quthero Inc. and TARA Biosystems.

Publications: ↘ Click here for Prof. Radisic's publications on Pubmed.

Vahid Sarhangian

University Affiliations
Mechanical & Industrial Engineering
Centre for Healthcare Engineering

Faculty Website
Vahid Sarhangian

Keywords
Operations Research
Healthcare

Vahid Sarhangian's primary research interests are in data-driven modelling and optimal control of stochastic processing networks arising in healthcare and service delivery systems. His current research focuses on supply chain management of blood products and developing analytical models of patient flow in hospitals with the goal of reducing patients' waiting times and improving health outcomes.

Aaron Wheeler

University Affiliations
Professor, Chemistry
Professor, Institute of Biomedical Engineering
Director, Microfluidics Lab

Website
https://microfluidics.utoronto.ca/index.php

Keywords
Microfluidics, Digital Chemical Reactors, Fabrication, Lab-on-a-chip

Prof. Wheeler's research is focused on the development of lab-on-a-chip techniques for high throughput proteomics and drug discovery. This concept is meant to reduce reagent consumption and analysis time, the capacity to integrate multiple functions onto a single device, and the potential for high throughput analysis. One of the main technologies used in his research is digital microfluidics (or "DMF"). In DMF, discrete fluidic droplets are manipulated on the surface of an array of electrodes coated with a hydrophobic insulator. Currently, the Wheeler lab is developing methods of microchannels and digital microfluidics for high-throughput bioanalytical applications.

Prof. Aaron Wheeler holds the Canada Research Chair in Bioanalytical Chemistry. He holds a number of honors including the E.W.R. Steacie Memorial Fellowship from the Canadian National Sciences and Engineering Research Council, the Arthur F. Findeis Award from the American Chemical Society, and the Joseph Black Award from the Royal Society of Chemistry. He has also been an Associate Editor for the journal, Lab on a Chip since 2013.

Publications: ↘ Click here for Prof. Wheeler's publications.

Shirley X. Y. Wu

University Affiliations
Professor, Leslie Dan Faculty of Pharmacy
Member, PRiME

Lab Website
https://www.shirleywulab.com/

Keywords
Drug Delivery, Cancer, Nanotechnology, Computer Simulation, Pharmaceutical, Pharmacological, Blood Brain Barrier, Multidrug Resistant, Metastatic Cancers, Nanomaterials

Shirley Wu's lab conducts research centered on advanced pharmaceutics and drug delivery technologies for unmet medical needs. Their current projects include blood-brain barrier-penetrating nanoparticles for treatment and diagnosis of brain cancer and CNS diseases; synergistic drug combination nanomedicine for enhancing chemotherapy; bioreactive hybrid metal oxide nanoparticles for modulating tumor microenvironment and enhancing cancer therapies; rational and computer-aided design of controlled release dosage forms; and stimulus-responsive systems for closed-loop delivery of therapeutic hormones for diabetes.

Prof. Wu is a co-inventor on multiple patents worldwide and is a co-founder of a BBB crossing drug delivery platform technology startup, called Nanology Labs.

Publications: ↘ Click here for Prof. Wu's publications on Pubmed.

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For the latest on active investment opportunities and developments at companies emerging from U of T Research, sign up for the Deep Tech Download newsletter.

Adaptive Neural Implant for Modulation and Observation (ANIMO)
https://research.utoronto.ca/technology-opportunities/db/adaptive-neural-implant-modulation-and-observation-animo

A new implantable closed-loop neural interface, the adaptive neural interface for modulation and observation (ANIMO) is being developed to address the challenges and requirements typically associated with implantable electronics and neurostimulators.

Autoscribe: AI-Powered Voice Assistant for Clinicians
https://research.utoronto.ca/technology-opportunities/db/autoscribe-ai-powered-voice-assistant-clinicians

AutoScribe uses hands-free speech recognition and Artificial Intelligence to help reduce time consuming manual clinical documentation, freeing clinicians to place their focus where it should be – on their patients.

AI-Powered Remote Patient Monitoring Platform
https://research.utoronto.ca/technology-opportunities/db/ai-powered-remote-patient-monitoring-platform

The platform allows for clinical-grade data analysis from wearable sensors (e.g. smartwatches, mobile devices) through proprietary machine learning (ML)-based algorithms that extract clinically relevant data and filter out unreliable sensor data. This platform can provide real-time feedback on patient health, generate more accurate predictions, and enable actionable insights and recommendations to improve care.

Automatic learning filters to improve the accuracy of sensing algorithms
https://research.utoronto.ca/technology-opportunities/db/automatic-learning-filters-improve-accuracy-sensing-algorithms

The technology combines novel filters and a convolutional neural network model to automatically learn what kind of data will make an algorithm produce inaccurate results. In-the-wild continuous sensing on mobile devices has the potential to revolutionize fields such as personalized healthcare. However, a key problem with current methods is the diverse nature and noise associated with incoming sensor data. Running sensor data processing algorithms on this diverse data can lead to unexpected and poor results because it is difficult for algorithms to anticipate the variety of data that can occur. Our tunable system is able to achieve error rates significantly lower than existing approaches.

Centivizer: An Interactive, Modular Approach to Dementia Care
https://research.utoronto.ca/technology-opportunities/db/centivizer-interactive-modular-approach-dementia-care

Centivizer is a modular system that physically, cognitively, and socially stimulates individuals with dementia by providing self-initiated, reward-based activities that can be used 24/7 without needing caregiver support.
The system can be customized based on individual needs and care settings, and can incorporate games, levers, sliders, reward dispensers, lights and buttons. User data can also be analysed to determine changes in behaviour and the best mix of activities.

EEG-Based Image Reconstruction
https://research.utoronto.ca/technology-opportunities/db/eeg-based-image-reconstruction

A ground-breaking new technique has been developed to digitally reconstruct images of what people see based on their brain activity. By interpolating neural data in comparison with a known visual source, the research team has developed a way to extract, assess, and visualize information from electroencephalography (EEG) readings. This first-of-its-kind technique has been proven on face processing using a known visual source, and the next phases of development will explore image reconstruction based on memories and dreams.

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Electrochemical Antibiotic Susceptibility Testing Device

https://research.utoronto.ca/technology-opportunities/db/electrochemical-antibiotic-susceptibility-testing-device

Rapid administration of the correct antibiotic regimen is critical for improving the chance of survival of a patient with a bacterial infection while limiting the further spread of antibiotic resistance. This invention is a novel device that allows rapid electronic readout of the antibiotic susceptibility profile of a bacterial infection within an hour.

Glucose Meter as a Detection System for Point-of-Care Gene Circuit Diagnostics

https://research.utoronto.ca/technology-opportunities/db/glucose-meter-detection-system-point-care-gene-circuit-diagnostics

Our inventors have demonstrated the use of a glucose meter as a convenient and universal reader for cell free gene circuit sensors. The overall system can be housed in a portable container and includes several capabilities

Glucose-Responsive Microgels and Microneedle Patch to Prevent Hypoglycemia in Diabetics

https://research.utoronto.ca/technology-opportunities/db/glucose-responsive-microgels-and-microneedle-patch-prevent-hypoglycemia

This device is a composite transdermal microneedle patch comprising a microneedle array and embedded microgel particles. The microparticles are made from three types of monomers – one provides glucose-responsive volume change, one for stabilizing native glucagon, and one for facilitating glucagon encapsulation.

HippoCamera: Digital Memory Augmentation

https://research.utoronto.ca/technology-opportunities/db/hippocamera-digital-memory-augmentation

One promising approach to mitigate age-related memory loss is to augment memories of personally experienced events with corresponding digital memories captured by a portable electronic device. These digital memories are saved for later replay. Prior digital memory augmentation studies conducted in small samples of AD and MCI patients have demonstrated substantial memory benefits (lasting up to 6 months) over alternative approaches such as keeping a diary.

Nurogram: EEG-Based Image Reconstruction

http://www.research.utoronto.ca/tech-opps/eeg-based-image-reconstruction/

NuroGram will provide EEG-based mind-reading technology for visual mental capture able to recreate the visual experience of individual users using proprietary methods for EEG signal processing and machine learning approaches to image synthesis.

Portable Automated Biomanufacturing of Protein-Based Therapeutics

https://research.utoronto.ca/technology-opportunities/db/portable-automated-manufacturing-protein-based-therapeutics

We have developed molecular and hardware technologies for automated production and purification of these protein-based products. Importantly, the production platform is programmable and can be used to produce virtually any protein-based therapeutic (e.g. vaccines), countermeasure (e.g. toxin neutralizing antibodies and antivenoms) or lab reagent (e.g. cytokines and polymerases). This automated cell-free protein manufacturing platform can rapidly produce and purify cytokines and antibodies at various scales and within a few hours.

Rapid, HiFi MRI Data Processing

https://research.utoronto.ca/technology-opportunities/db/rapid-hifi-mri-data-processing

Our product is a DCE-MRI acquisition and reconstruction package that enables more accurate quantification of physiological parameters in larger volumes than any state-of-the-art method. By first performing a high-temporal (rapid), high spatial (hifi) acquisition of anatomical details in the image set, each time frame is reconstructed with a high degree of precision and accuracy. IP has been filed around creating a small number of low temporal resolution image frames with high spatial resolution, which is then augmented to a full reconstruction with high temporal and spatial resolution.

Rapid, remote vital sign monitoring and screening

https://research.utoronto.ca/technology-opportunities/db/rapid-remote-vital-sign-monitoring-and-screening

Based on thermal and optical sensing analysis of digital imaging, this technology allows for rapid measurement of photoplethysmogram (PPG), temperature, respiratory rate, and heart rate beyond conventional distance limitations (e.g. at distances more than 1m), with the ability to add other components (e.g. tissue oxygenation and blood pressure) in the future. This solution enables contactless screening and monitoring of vital signs in kiosk, multicamera, or handheld approaches

RHEA: Digital Wellness Platform for Personalized Brain Rehabilitation

https://research.utoronto.ca/technology-opportunities/db/rhea-digital-wellness-platform-personalized-brain-rehabilitation

RHEA is a digital wellness platform that provides individuals with an easy-to-follow, personalized rehab plan for a more effective recovery from brain injuries. RHEA's simple directions, personalized exercise videos, and self-monitoring tools are drawn from well-established empirical evidence and clinical guidelines.

Through novel machine learning algorithms that leverage self-reported information such as demographics, symptoms, and fitness level with wearable data (sleep patterns, daily activity, and heart rate), RHEA recommends the most effective mix of structured activities and exercises to facilitate the rehabilitation process following concussion.

Scalable Sensing Platform for Point-of-Need Testing

http://www.hattonlab.org/

Microchip-based digital sensor technology platform that is highly scalable, flexible, and cost-effective. The researchers enable improved sensitivity by placing sensor microchips directly into liquid samples to perform rapid multiplexed measurements. The platform reduces product complexity, size, and costs, and improves performance.

U of T ENTREPRENEURSHIP

The U of T Entrepreneurship community is Canada's leading engine for research-based startups and a global leader in transforming ideas into products and services that create jobs and impact the world. More than 500 research-based startups have been launched from U of T, outpacing every other Canadian university, and generating more than $1.5 billion (CAD) in investment in the past 10 years.

The University of Toronto is also home to 11 accelerator/incubator programs that serve students, alumni, and faculty from all disciplines and levels of experience.

UTEST
http://utest.to/

The University Early Stage Technology (UTEST) is a startup development program for nascent companies supported in partnership by the University of Toronto Connaught Fund and MaRS Innovation. UTEST provides investments of up to $100,000 per company in addition to intensive entrepreneurial education, advisory support, and dedicated incubation space.

↰ Click here for a list of all UTEST companies.

Health Innovation Hub
http://h2i.utoronto.ca/

The Health Innovation Hub (H2i) facilitates early-stage entrepreneurs with translation and commercialization of ideas into problem-solving designs on health matters. It works to align, connect, and leverage the significant mass of life science research expertise, facilities, programs and funds of the University and its partners towards effective and efficient health innovation ventures. H2i provides open and flexible educational and mentorship opportunities and serves as a conduit for innovation throughout the Toronto Academic Health Science Network.

↰ Click here for a list of all H2i companies.

SELECT HEALTHCARE COMPANIES

AI & MACHINE LEARNING

16Bit
https://www.16bit.ai/

16Bit develop artificially intelligent medical image analysis systems intended to augment physician's diagnostic. The company is in the process of creating a screening algorithm to triage mammograms, tomography of the head and paediatric bone age, enabling physicians and radiologist interpret the results efficiently.

bridge7
https://www.bridge7.ai/

bridge7 is the developer of an AI-powered consultation software designed to ensure patients receive the best care possible from cancer treatment centers. The company's software applies machine learning algorithms to provide the clinical team with AI-derived decision-making metrics utilizing data from thousands of patients, enabling them to gain instant consultation and insights on the quality of cancer care before patients begin their treatment course and hospitals to increase clinical efficiency and improve quality of delivery of cancer care.

Cerebtalk
Cerebtalk offers a brain-computer interface (BCI) that provides a communication tool for individuals with severe motor impairments who have limited voluntary movements, e.g., people with amyotrophic lateral sclerosis (ALS), spinal cord injury, stroke, cerebral palsy, and non-verbal autism.

Deep Genomics

https://www.deepgenomics.com/

Deep Genomics is developing a universe of individualized genetic medicines by creating AI systems that are used to accelerate all steps of drug discovery and development, including target discovery, lead optimization, toxicity assessment and innovative trial design.

MedStack

https://medstack.co/

MedStack is a platform for app-enabled healthcare. MedStack delivers automation-powered developer-flexible cloud hosting with built-in security protocols backed by real-time HIPAA and PIPEDA auditable privacy policies.

Mutuo Health

https://mutuohealth.com/

Mutuo Health's state-of-the-art artificial intelligence (AI) technology enables highly-enriched and structured patient data to be automatically recorded as the patient and clinician are interacting. Specifically, our AutoScribe platform transcribes the dialogue between healthcare provider and patient into high quality electronic medical record (EMR) data in real-time. Our Privacy-by-Design, point-of-care solutions improve the patient-clinician experience, and unleash the endless possibilities of big data analytics in healthcare.

ODAIA

https://www.odaia.ai/

ODAIA is a leader in life sciences predictive analytics and commercial insights. ODAIA's AI-powered platform, MAPTUAL, leverages a proprietary analytics engine to help pharma companies prospect, qualify and engage HCPs, which helps reduce patients' time to therapy.

Pathcore

https://www.pathcore.com/

Pathcore strives to streamline digital pathology for researchers and pathologists. Their solutions bridge complex workflows, connecting pathologists with their data faster and easier than ever before.

Pearl Interactives

https://pearlinteractives.com/

Pearl Interactives specializes in co-creating interactive media for children of all abilities for wellness, play, and learning. Our flagship product, a video game system called Bootle BlastTM, uses an innovative mixed reality technology to engage children and youth with neuromotor conditions in exercises that improve functional abilities.

Phenomic AI

https://phenomic.ai/

Phenomic AI is leveraging computer vision and high-content screening to develop the next wave of therapeutic antibodies against cancer and fibrosis. Specifically, the deep neural networks that we've developed allow us to screen and analyse much more physiologically relevant disease models.

PhenoTips

https://phenotips.com/

PhenoTips is a B2B digital health spinout from U of T and SickKids, helping healthcare systems prepare for a future when genetics is a critical part of every patient's routine care. Healthcare workers use PhenoTips through their existing EHRs to manage critical data for genomic medicine, reducing staff workload by up to 50%. PhenoTips powers clinical genetics at 21 leading institutions in the US, UK, Canada, and EU.

Structura Biotechnology

https://structura.bio

Structura is the developer of machine-learning algorithms for drug testing. The company develops machine-learning algorithms to help researchers study and reconstruct 3D atomic structures of proteins, bio-molecule complexes, viruses and similar components in drugs.

Tabiat Research
https://tabiatresearch.com/
Tabiat Research is a digital health research company intended to provide medical data. The platform allows for clinical-grade data analysis from wearable sensors (e.g. smartwatches, mobile devices) through proprietary machine learning (ML)-based algorithms that extract clinically relevant data and filter out unreliable sensor data. This platform can provide real-time feedback on patient health, generate more accurate predictions, and enable actionable insights and recommendations to improve care.

WinterLight Labs
https://winterlightlabs.com/
Machine learning and speech analysis to detect cognitive decline in patients.

HEALTH TECH & MEDICAL DEVICES

Able Innovations
https://www.ableinnovations.ca/
Able Innovations is developing cutting edge technology to transfer individuals with restricted mobility, such as elderly or disabled individuals, from one surface to another (ex. bed to wheelchair, etc.).

AfimaCheck
https://afimacheck.com/
AfimaCheck has developed a rapid, yet sensitive, device that allows workplace drug testing companies to detect the presence of cannabis in the oral fluid at the cut-off level and reliability required by drug regulating bodies, a task not achievable by any of the existing on-site solutions in the market.

Arma Biosciences
https://www.arma-bio.com/
Arma Biosciences has developed a first-in-class sensing technology that represents the foundation for a new collection of portable, wearable and implantable monitoring devices. Arma's reagent-free sensor technology is versatile and adaptable to the analysis of biomarkers for chronic disease, infectious disease, or personal wellness in biological fluids including blood, saliva, or urine. The initial product line will focus on remote monitoring of biomarkers to manage chronic cardiovascular, renal or metabolic diseases to prevent rehospitalizations and improve patient outcomes.

Braze Mobility
https://brazemobility.com/
Braze develops innovative solutions to increase independent and safe mobility. Their first product is an add-on for mobility devices such as wheelchairs and scooters that can detect obstacles and offer feedback to the driver, which transforms any wheelchair into a smart wheelchair. Their technology is blind spot sensors and alerts.

Centivizer
https://www.centivizer.com/
Centivizer is designed to combat the functional decline in the aging population through a platform of interactive and rewarding physical and cognitive activities. Centivizer is a modular system that provides self-initiated, reward-based activities that can be used 24/7 without needing caregiver support.

ChipCare
https://www.chipcare.ca/

ChipCare is developing a highly versatile point-of-care (POC) diagnostic platform, which will enable unparalleled sample-to-action workflow in the clinic. Healthcare workers in medical clinics, STI clinics, pharmacy clinics, physicians' offices and remote health locations will be able to rapidly and accurately perform lab quality tests to aid in the diagnosis or monitoring of a wide range of infectious diseases.

COSM
https://www.cosm.care/
By combining ultrasound, data science and 3D Printing, Cosm Medical is creating the world's first custom gynecological prosthetic to treat pelvic floor disorders such as incontinence and prolapse.

EBT Medical
https://ebtmedical.com/
EBT Medical is developing novel, discreet neuromodulation therapies restoring dignity and control to those with overactive bladder and other pelvic health issues.

Hypercare
http://www.hypercare.ca
Hypercare is a mobile first communication & collaboration app meant for healthcare professionals within hospitals. Their primary goal is to alleviate many of the time wasting frustrations that healthcare professionals face daily including ineffective communication methods as well as difficulty with task management.

Liberum Bio
http://www.liberumbio.com/
Liberum Bio is developing a portable automated device for the production and purification of protein-based products by leveraging their suite of proprietary molecular and hardware technologies.

Nutrigenomix
https://www.nutrigenomix.com/
Nutrigenomix offers comprehensive tests for Health & Wellness, Athletic Performance and Fertility. Their kits test how genes impact weight loss & body composition, nutrient metabolism, heart health, performance, fertility, food intolerances, and eating habits.

SanoMetrics
https://www.sanometrics.com/
SanoMetrics is a start-up born from a sleep research group at the University of Toronto. Using inexpensive consumer wearable sensors that measure activity, heart rate, oxygen saturation, sound and light, clinical-grade health indicators are generated with a focus on sleep and sleep disease using proprietary AI systems.

Shiphrah Biomedical
https://shiphrahbiomedical.com/
Shiphrah Biomedical developed the PrenaBelt – an innovative, evidence-based solution to reduce the risk of stillbirth and low birth weight. The PrenaBelt leverages the body's natural biomechanics and physiology to modify sleep position, thereby optimizing maternal-fetal hemodynamics and promoting healthy, comfortable sleep behaviours throughout pregnancy.

XPAN Inc.
http://xpanmedical.com/
Xpan Inc. is developing novel and less invasive yet expandable surgical access ports (trocars) which will significantly increase the safety and efficiency of minimally invasive surgeries.