2018
CENTRE FOR INTELLIGENT MACHINES
ANNUAL REPORT

McGill
2018 brought two new associate members to the Centre - Professors Warren Gross and Narges Armanfard, both of the Department of Electrical and Computer Engineering.

In 2018 the Centre researchers significantly enhanced their funding levels, showing a 43% increase in yearly financial support. This increase reflects the growing interest of industry in the areas of research being done by our members, particularly those related to applied Artificial Intelligence.

A message from the Centre Director

James Clark

The 33nd year of the Centre’s existence brings renewed interest in Intelligent Systems.
About the Centre

The McGill Centre for Intelligent Machines (CIM) is a multidisciplinary, inter-departmental, inter-faculty research group formed in 1985 to facilitate and promote research on intelligent systems and provide an enriched mentoring and training environment for graduate students studying in the field of robotics and intelligent systems.

For more than 3 decades, CIM has been a pioneering force in cross-disciplinary research. The Centre is primarily located in contiguous space where labs and student offices are shared. CIM’s membership and students have been universally recognized over the years for their highest standards of excellence – exceptional scientific achievements and outstanding contributions to society and industry. Intelligent systems and machines are capable of adapting their behaviour by sensing and interpreting their environment, making decisions and plans, and then carrying out those plans using physical actions. The members of CIM seek to advance the state of knowledge in such domains as – robotics, artificial intelligence, computer vision, medical imaging, haptics, systems and control, computer animation and machine and reinforcement learning.

The Centre is comprised of 22 full members from both the Faculties of Engineering and Science -- the Department of Electrical and Computer Engineering, Department of Mechanical Engineering and the School of Computer Science. CIM also has associate members representing a diversity of research collaborations, such as within the Faculty of Medicine -- the Royal Victoria Hospital and the Montreal Neurological Institute.

The Centre is home to a diverse population of researchers: in addition to the 22 full members, at the end of 2018 the centre boasted a complement more than 300 graduate students, post-docs and undergraduate students, as well as visiting scholars, research assistants and associates from various disciplines.

Professors: 22
PhD: 88
Masters: 95
Undergrad: 108
PostDoc: 22
Centre Governance

Day-to-day operation of the Centre’s activities, management of its finances, allocation of space and other resources, are carried out by the Centre’s Director, assisted by the Centre support staff.

The Centre is advised by the Centre’s Board, which meets yearly to review the Centre’s activities and budget, and to provide guidance on strategic planning.

2018 Board Members

James Clark - Centre Director, Board Chair
James Nicell - Dean, Faculty of Engineering
Bruce Lennox - Dean, Faculty of Science
Chris Manfredi - Provost and Vice Principal, Academic
Martha Crago - Vice Principal, Research and Innovation
Greg Dudek - Centre Member
Frank Ferrie - Centre Member
Kaleem Siddiqi - Alternate Centre Member
Pierre Breton - External Member, Executive Vice President, KWI Polymers.
Mohamad Afsari - Graduate Student
Centre Membership

Full Members

James Clark
Professor
Centre Director
Department of Electrical and Computer Engineering
Computer Vision

Jorge Angeles
James McGill Professor
Department of Mechanical Engineering
Robotics and Mechatronics

Tal Arbel
Professor
Department of Electrical and Computer Engineering
Computer Vision and Medical Image Analysis

Jozsef Kovecses
Associate Professor
Department of Mechanical Engineering
Robotics and Aerospace Systems

Paul Kry
Associate Professor
School of Computer Science
Computer Graphics

Michael Langer
Associate Professor
School of Computer Science
Computer Vision

Benoit Boulet
Associate Professor
Associate Dean
Department of Electrical and Computer Engineering
Systems and Control

Peter Caines
Macdonald Professor
Department of Electrical and Computer Engineering
Systems and Control

Jeremy Cooperstock
Professor
Department of Electrical and Computer Engineering
Human-Computer Interaction

Gregory Dudek
James McGill Professor
School of Computer Science
Robotics and Computer Vision

Frank Ferrie
Professor
Department of Electrical and Computer Engineering
Computer Vision

James Richard Forbes
Assistant Professor
Department of Mechanical Engineering
Robotics and Aerospace Systems

Professor Kovecses’ leadership in the development of realistic computer simulations and his commitment to understand the industry’s technical challenges has resulted in this exemplary partnership (McGill Reporter, May 1, 2018)
Back in 1985, Martin Levine was one of the first people working on and teaching Computer Vision – back then Pattern Recognition. (McGill Reporter, Jan. 16 2018)

Pineau... is now the driving force behind promising research emerging from McGill to improve treatment of cancer and heart disease using Artificial Intelligence (AI) models, methods and applications. (McGill Reporter, May 1, 2018)
The Centre regularly hosts researchers on long-term (one month or more) visits. These include professors from other Universities on sabbatical leave research exchange students and research collaborators from industry.

**Centre Membership**

**Associate Members**

- Adamchuk, Viacheslav - Associate Professor, Bioresource Engineering, McGill University
- Armandfard, Narges - Assistant Professor, Elec. & Comp. Engineering, McGill University
- Cecere, Renzo - Associate Professor, Cardiac Surgery (RVH), McGill University
- Cheung, Jackie Chi Kit - Assistant Professor, School of Computer Science, McGill University
- Collins, Louis - Professor, Biomedical Engineering, McGill University
- Dimitrakopoulos, Roussos - Professor, Mining Engineering, McGill University
- Gross, Warren - Professor and Chair, Elec. & Comp. Engineering, McGill University
- Hamann, Marco - Professor, Math/Informatics, Dresden University of Applied Sciences
- Hayward, Vincent - Professor, ISIR, Université Pierre et Marie Curie, Paris France
- Husty, Manfred - Professor, Geometry and CAD, University of Innsbruck, Austria
- Liu, Xue - Associate Professor, Computer Science, McGill University
- Misra, Arun - Thomas Workman Professor, Mechanical Engineering, McGill University
- Mongrain, Rosaire - Associate Professor, Mechanical Engineering, McGill University
- Musallam, Sam - Associate Professor, CRC in Bioengineering, ECE, McGill University
- Panangaden, Prakash - Professor, Computer Science, McGill University
- Paranjape, Aditya - Lecturer, Department of Aeronautics, Imperial College London
- Pike, Bruce - Professor, Faculty of Medicine, University of Calgary
- Precup, Doina - Associate Professor, Computer Science, McGill University

**Visitors to the Centre - 2018**

- Andrea Sanchez Aguilar - McGill University - Hosted by David Meger
- Mandana Samiei - Concordia University - Hosted by David Meger
- Amir Molaei - Concordia University - Hosted by David Meger
- Jiantong Ma - Intern - Hosted by Jeremy Cooperstock
- Yaojun Wang - Zhejiang Sci-Tech University - Hosted by Jorge Angeles
- Byung Kwon Choi - Baylor College of Medicine - Hosted by David Meger
- Hector Garcia Garcia - Washington Hospital Centre - Hosted by Jorge Angeles
- Jingkun Zhang - Shanghai Jiao Tong University - Hosted by Jorge Angeles
- Shu-Jun Liu - Sichuan University - Hosted by Peter Caines
- A. Ghasemi Toudeshki - Simon Fraser University - Hosted by Gregory Dudek
- Christopher Salmon - McGill University - Hosted by Kaleem Siddiqi
Honours and Distinctions
Celebrating Excellence

The outstanding contributions made by the Centre's researchers are frequently recognized through awards and other distinctions. 2018 was no exception to this, with many honours bestowed on our members.

Professor James Richard Forbes became a William Dawson Scholar and was nominated for the Carrie M. Derick Award for Graduate Supervision and Teaching.

Professor Jozsef Kovecses was awarded the NSERC Synergy Award which is one of the research prizes of NSERC, presented on May 1, 2018 by the Governor General of Canada in Ottawa.

He was also awarded the Best Paper Award of the 14th ASME International Conference on Multibody Systems, Nonlinear Dynamics, and Control, DETC/CIE 2018, Quebec City, QC, Aug. 26-29, 2018, in the multibody systems category.

Professor Paul Kry was awarded the Carrie M. Derick award for graduate teaching and supervision.

Professor Michael Langer won the Canadian Image Processing and Pattern Recognition Society (CIPPRS) Lifetime Achievement Award for Service. The award was announced at the CRV conference in Toronto in May 2018.

Professor Joelle Pineau won the NSERC E.W.R. Steacie Memorial Fellowship which is awarded annually to enhance the career development of outstanding and highly promising scientists and engineers who are faculty members of Canadian universities.

Additionally, she was elected an AAAI Fellow which recognizes individuals who have made significant, sustained contributions to the field of artificial intelligence, awarded by the Association for the Advancement of Artificial Intelligence.

She was also named as a Canada CIFAR AI Chair.

Prof. Pineau was also named one of Canada's Inspiring Fifty 2018. "InspiringFifty is a non-profit that aims to increase diversity in tech by making female role models in tech more visible."

Professor Emeritus Jorge Angeles was awarded the 2018 McGill Medal for Lifetime Achievements.

Tanya Nair, MICCAI 2018 Young Scientist Award Recipient. Awarded to Tanya Nair, a Master's student under the supervision of Prof. Arbel for their paper entitled: "Exploring Uncertainty Measures in Deep Networks for Multiple Sclerosis Lesion Detection and Segmentation". Awarded at the 2018 MICCAI Conference, Granada, Spain, September 2018.

The MICCAI Young Scientist Awards recognize the highest quality papers (based on ranking) that are first authored by a student at the International Conference on Medical Image Computing and Computer Aided Intervention (MICCAI). A maximum of five YSAs are issued each year. Master’s students are rarely (perhaps never) selected for this prize. The monetary value of the YSA is $500 USD.

Tanya Nair was also awarded the MICCAI 2018 Student Travel Award Recipient. Award given to students who are first authors of papers submitted to the MICCAI conference to subsidize their attendance at the conference. Award is given based on the ranking of the paper based on its quality.

Brennan Nichyporuk, supervised by Prof. Arbel, was awarded the McGill Summer Undergraduate Research in Engineering Award, 2018. Award given for his undergraduate summer research internship poster presentation for his project entitled: "Deep Learning for Prediction of Multiple Sclerosis Disease Activity".

Professors James Clark and Joelle Pineau were named as "Ambassadors" of the Palais des Congres in Montreal, for their efforts in bring large conferences to Montreal (ICCV21 and IJCAI21).

Mike Langer at the CRV 2018 conference, where he was awarded the CIPPRS Lifetime Achievement Award for his service to the Canadian Image Processing community.

M.Eng. student Tanya Nair being awarded the MICCAI Young Scientist Award.
Industrial Affiliates Program

Connecting with Industry

The Industrial Affiliates Program provides companies with access to students for recruiting purposes as well as a way to keep up-to-date on the exciting research going on in the Centre.

Industrial Affiliates in 2018

C2RO
Element AI
Envision
Huawei
Imagia
SimActive
SportlogiQ

Former CIM PhD student Mehrsan Javan, co-founder of IAP member SPORTLOGiQ in the exhibition hall at the 2019 Neurips conference.

PhD student Amir Haji-Abolhassani, representing IAP member C2RO at the Student Research Showcase.
Centre Activities
Student Research Showcase

On November 13th, 2018, the annual Student Research Showcase was held, with 30+ students presenting short overviews of their research projects. This year the showcase was attended by a number of members of the CIM Industrial Affiliates Program (IAP), some of whom gave short presentations on their company’s research activities. Coffee breaks allowed for networking opportunities between students and IAP representatives.
Centre Activities

Visitors

The high reputation of the research and researchers of the Centre attracts a regular stream of visitors interested in knowing more about our work.

Visitors include academic researchers, government officials, industry representatives and high school students.

CIM is on the radar of governments around the world, known for its excellence in research and for production of top-quality researchers.

In January the Canadian Minister of Transport, Marc Garneau visited CIM to discuss AI and its applications to transportation.

In March CIM was visited by US Consul General Robert Thomas, who wanted to know what was going on in robotics research at CIM.

The growing importance of Artificial Intelligence (AI) to industry, led to frequent expressions of interest from companies in the expertise of CIM researchers. Many representatives of companies, such as DiDi Chuxing and Huawei came to visit the Centre in 2018 and expressing interest in working with the Centre.
A vigorous exchange of ideas is the lifeblood of any active research Centre. Spearheaded by the long-running Informal Systems Seminar series, the Centre regularly hosts talks by eminent scholars from around the world.

**SPEAKERS**

- Dena Firoozi  
  McGill University
- Benjamin Van Roy  
  Stanford University
- Alex Daskalov  
  KNOX Industries, Montreal
- Simon Blackmore  
  Robotics & Automation Institute, Harper Adams University
- Kei Nakatsuma  
  Kumamoto University
- Yanyan Mu  
  McGill University
- Sean Meyn  
  University of Florida
- Katherine Driggs-Campbell  
  Stanford University
- Rodolphe Sepulchre  
  Cambridge University
- Leila Bridgeman  
  Duke University
- Abhinoy Kumar Singh  
  McGill University
- Aditya Mahajan  
  McGill University
- Berk Calli  
  Yale University
- Narges Armanfard  
  University of Toronto
- Sylvain Baillet  
  McGill University
- Ravi R. Mazumdar  
  University of Waterloo
- Paul Zsombor-Murray  
  McGill University
- Vicente Ordonez  
  University of Virginia
- David Levanony  
  Ben Gurion University
- Rinel Foguen Tchuendom  
  GERAD
- Kurt S. Anderson  
  Rensselaer Polytechnic Institute
- Bernard Brogliato  
  INRIA Rhone-Alpes, Genoble, France
- Jayakumar Subramanian  
  McGill University
- Kenny Erleben  
  University of Copenhagen
- Izchak Lewkowicz  
  Ben Gurion University
- Ashutosh Nayyar  
  University of Southern California
- Christian Desrosiers  
  Ecole de Technologie Superieure
- Yi Ouyang  
  Preferred Networks, Inc.
- Richard Y. Zhang  
  University of California, Berkeley
- Andrew Lamperski  
  University of Minnesota
The research carried out in the Centre is funded from a wide range of sources, including the Governments of Canada and Quebec (primarily through NSERC Discovery and Partnership grants and FRQNT grants) as well as industry (through research contracts and contributions to governmental partnership programs).

In 2018 the Centre’s research funding was buttressed by three large inter-university collaborative programs - the FRQNT-funded Regroupement REPARTI, the NSERC-funded CREATE program in Medical Image Analysis, and the NSERC funded Canadian Field Robotics Network.

Details on these cornerstone programs are provided over the next few pages.
The Regroupement pour l'étude des environnements partagés intelligents répartis (REPARTI) is a $2.6M inter-institutional, interdisciplinary collaborative venture comprised of 8 Quebec institutions, 35 members and over 300 students. The McGill node of REPARTI is represented by 13 members from the McGill Centre for Intelligent Machines (CIM). The members of the McGill node collaborate in grants and contracts valued in excess of $5M annually. This FRQNT regroupement is a primary funding source for the McGill Centre for Intelligent machines (CIM).

The institutions participating in REPARTI are: Université Laval (host institution), McGill University, Université de Sherbrooke, École Polytechnique, Université de Montréal, Université du Québec à Chicoutimi and École de technologie supérieure (ÉTS).

Supported by the Quebec government's Fonds de recherche Nature et technologies (FQRNT), this regroupement stratégique builds on some unique precedents:

(1) The historical and concrete partnership that developed over the past 25 years between prominent researchers in U. Laval and McGill (CIM) as a result of the NSERC National Centres of Excellence program, the interuniversity-industrial consortium IRIS-Precarn, and the FQRNT Réseau QERRAnet.

(2) The long and productive relationship established between the McGill Centre for Intelligent Machines (CIM) and the Quebec government through the former FCAR Centre de recherche programme.

The regroupement REPARTI was successfully renewed in 2013 for 6 years until 2019 and was renewed in 2019 for another 6 years until 2025. The new theme of the regroupement is cyberphysical systems.

NSERC Canadian Field Robotics Network

The NCFRN is a Canada-wide network spanning 8 universities and 14 partner organizations. The network brings together academic, government, and industrial researchers in the area of field robotics, to develop the science and technologies to eventually allow teams of heterogeneous robots (on land, in the air, on the surface of or under water) to work collaboratively in outdoor environments, and to communicate critical information to humans who operate them or use them.

The NCFRN supports the work of 11 researchers from 8 different universities. It connects the academic participants with 10 industrial partners and 4 government agencies to leverage their complementary experience and capabilities. The network investigates fundamental issues in robotics science as well as develops technologies developed addressing particularly Canadian problems such as environmental monitoring and maintenance, border surveillance, cleanup of environmental disasters, and assisting and caring for senior citizens.

The NCFRN primarily provides direct support for students, thereby training highly qualified new researchers, engineers and technicians able to work in robotics-related industry.

The NCFRN network management is hosted by McGill and CIM, with CIM member Greg Dudek serving as scientific director. CIM member Joelle Pineau serves as the leader of the thematic area “Human”. CIM member Inna Sharf is also a research member of the NCFRN.

The NCFRN is a 5-year program that started on June 30, 2012 and ended on June 29, 2018. A renewal of the network was submitted and approved. The network will now be called the NSERC Canadian Robotics Network, and is funded through 2024, and provides a national framework for 11 research groups from 8 Canadian universities as well as 9 industrial partners and 3 government agencies, while also engaging 5 international partners.
## Funding Breakdown by Source

### Collaborative Programs

<table>
<thead>
<tr>
<th>FUNDING SOURCE</th>
<th>Start Date</th>
<th>End Date</th>
<th>Grant Total</th>
<th>CIM 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>REPARTI (FRQNT Regroupement)</td>
<td>APRIL 2006</td>
<td>MARCH 2019</td>
<td>$4,000,000</td>
<td>$160,000</td>
</tr>
<tr>
<td>NSERC CREATE (Medical Image Analysis)</td>
<td>APRIL 2012</td>
<td>MARCH 2018</td>
<td>$1,650,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>NSERC Canadian Field Robotics Network</td>
<td>JUNE 2012</td>
<td>JUNE 2018</td>
<td>$5,000,000</td>
<td>$270,000</td>
</tr>
</tbody>
</table>

### Individual Grants

| NSERC Discovery                     | $4,628,000 | $962,000 |
| NSERC CRD+Engage                    | $2,202,068 | $811,175 |
| MITACS                               | $320,383   | $267,583 |
| CFI JELF & LOF                      | $289,500   | $112,900 |
| FRONT                               | $557,453   | $168,369 |
| Others (including McGill contributions) | $8,714,819 | $3,107,414 |

**TOTALS OF ALL FUNDING SOURCES** | $36,004,223 | $6,232,578 |

## Publications

**ANGELES, Jorge**


in Proceedings of the Brain Lesions (Brainsles) Workshop, held in conjunction with the 21st International Conference on Medical Imaging Computing and Computer Assisted Intervention (MICCAI 2018), Grenada, Spain, September 2018.


BOULET, Benoît


CAINES, Peter


S. Gao and P. E. Caines, “Graphon Linear Quadratic Regulation of Large-scale Networks of Linear Systems”, Proceedings of the 57th IEEE Conference on Decision and Control, Miami Beach, FL, December, 2018, pp 5882-5897


S. Gao and P. E. Caines, “Graphon-LQR Control of Arbitrary Size Networks of Linear Systems.” The 23rd International Symposium on Mathematical Theory of Networks and Systems, Hong Kong, China, July 16-20, 2018, pp. 120 127


CLARK, James


COOPERSTOCK, Jeremy


DUDEK, Gregory


FERRIE, Frank


FORBES, James Richard


KOVECSES, Jozsef


KRY, Paul

A Virtual-Reality System for Interacting with Three-Dimensional Models Using a Haptic Device and a Head-Mounted Display, E Saad, WRJ Funnell, PG Kry, NM Ventura, 2018 IEEE Life Sciences Conference (LSC), 191-194, doi:10.1109/LSC.2018.8572120


LANGER, Michael


Signs of depth-luminance covariance in 3D cluttered scenes M. Scaccia, M.S. Langer Journal of Vision March 2018, 18 (5)
Density discrimination in 3D clutter: Are we up-front about it? M, Scaccia, M.S. Langer European Conference on Visual Perception Trieste, Italy, Aug. 2018

MAHAJAN, Aditya


J. Subramanian* and A. Mahajan, “A policy gradient algorithm to compute boundedly rational stationary mean field equilibria,” ICML/ICML/AAMAS Workshop on Planning and Learning (PAL-18), Stockholm, Sweden, July 13–15, 2018

MEGER, David


MICHALSARA, Hannah


NAHON, Meyer


INVITED LECTURES

ARBEL, Tal
Invited speaker, “Machine Learning for Lesion and Tumour Detection, Segmentation and Disease Prediction in Medical Images”, Machine Learning for Biomedical Data Workshop, Montreal, Quebec, Canada, December 2018.

BOULET, Benoît

BOULET, Benoît
Invited speaker, “Machine Learning for Lesion and Tumour Detection, Segmentation and Disease Prediction in Medical Images”, Google Brain, Montreal, Quebec, October 2018.


COOPERSTOCK, Jeremy

Ami-Télé, Ça me regarde, television broadcast on lab’s activities for the visually impaired community, February 8, 2018


“Learning from sparse feedback: Adapting an environmental awareness app to visually impaired user preferences”, ACM-SIGCHI sponsored summer school on Intelligent User Interfaces in the Era of IoT and Smart Environments, Haifa, Israel, October 3, 2018.

DUDEK, Greg


Invited Keynote Presentation, J Tsotsos Honorary Symposium, York University, Toronto, May 2018.


FORBES, James Richard


KOVECSES, Jozsef


Kövecses, J.: “Mechanical Modelling in the Simulation and Analysis of Dynamic Systems”, research seminar at the University of La Coruna, Ferrol, Spain, June 7, 2018.

Kövecses, J.: “Mechanical Modelling in the Simulation and Analysis of Dynamic Systems”, research seminar at Keio University, Yokohama, Japan, July 9, 2018.


KRY, Paul
Shenzhen Visual Computing Summer School, invited presentation, Shenzhen, China, 16 July 2018; Physics Based Computer Animation Fundamentals.

Beijing Film Academy, invited presentation, Beijing, China, 23 July 2018; Geometric Stiffness for Real-time Constrained Multi-body Dynamics

LANGER, Michael
Depth Perception in 3D Clutter, Justus-Liebig-Universitats Giessen (University of Giessen), Germany, Invited Department colloquium Aug 20, 2018

Depth Perception in 3D Clutter: Cues and Priors, Max-Planck-Institute for Biological Cybernetics, Tuebingen, Germany (Invited talk at Colloquium celebrating retirement...
MAHAJAN, Aditya

MEGER, David
IEEE Canadian Ambassador at the IEEE Convene Conference, panel speaker for Montreal’s AI Revolution, Berlin, Germany, 2018/7/20.
Panel speaker on the Demystify AI Panel, Desautels Faculty of Management Technology Club. Montreal, Quebec. 2018/11/20

NAHON, Meyer
‘Dynamics and Control of Agile Fixed-Wing UAVs’, Dec. 7, 2018, the Centre for Aerial Robotics Research and Education, University of Toronto

NOWROUZEZAHRAI, Derek

PINEAU, Joelle
Feb.22 2018: Invited Talk, Machine Learning @ Georgia Tech Spring Lecture Event. Atlanta, GA.
May 9 2018: Invited Talk, MIT. Boston, MA.
Aug.9 2018: Keynote Talk, UAI 2018: Association for Uncertainty in Artificial Intelligence, Monterey Bay, CA.
Oct.3 2018: Keynote Talk, EWRL 2018: European Workshop on Reinforcement Learning, Lille, France.
Oct.31 2018: Invited Talk, EPFL IC Colloquia, Lausanne, Switzerland

SHARF, Inna
“My research at McGill,” Invited Presentation at MAME Annual Industry dinner, February 6, 2018
Invited speaker and panellist at the Quebec-Bavaria International Collaboration in Advanced Mobility and Artificial Intelligence workshop, May 15, 2018 McGill Faculty Club
* Robots in the Sky: Drones, Space Clean-up and Beyond*, Invited presentation at Talk at Pint of Science, Montreal, May 16, 2018