



Centre for Intelligent Machines

Annual Report

June 1997- May 1998

Director: Professor Martin D. Levine

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The mission statement of the Centre expresses our goals of excellence in research and graduate student education:

Intelligent machines are capable of adapting their goal-oriented behaviour by sensing and interpreting their environment, making decisions and plans, and then carrying out those plans using physical actions. The mission of CIM is to excel in the field of intelligent machines, stressing basic research, technology development, and education. CIM seeks to advance the state of knowledge in such domains as robotics, automation, artificial intelligence, computer vision, and systems and control theory.

More and more of this is being achieved by collaborative efforts involving researchers with very different interests. Therefore we see that the original objective of forming the Centre -- to encourage interdisciplinary activities which transcend the traditional departmental boundaries -- is being attained.

I Highlights of 1997-1998

I.i Personnel Changes

- On May 31, CIM bid farewell to *Professor Evangelos Papadopoulos* who, after several years in Canada, decided to return to his homeland Greece with his family. He is now with the Department of Mechanical Engineering at the National Technical University of Athens but retains links with McGill as an Adjunct Professor and with CIM as supervisor of his three remaining students.
- After a brief illness, *Professor George Zames* passed away on August 10, 1997. Born in Poland in 1934 he came to McGill as an undergraduate at the age of 15 in Engineering Physics. After studying at MIT where he achieved his first breakthrough with the now classic Small Gain Theorem, Professor Zames returned to McGill in 1974. Several years later he produced his second breakthrough, the H-infinity theory with which he gained world-wide recognition and awards in the field of Control and Systems Theory. Professor Zames was a founding member of CIM. He will always be fondly remembered as a mentor, colleague and valued friend.
- On the positive side, in January, *Professor Jeremy Cooperstock* joined the Centre as an Assistant Professor in Electrical and Computer Engineering. He completed his M.Sc. and Ph.D. at the University of Toronto, and came to Montreal via Japan as a researcher at the Sony Computer Science Laboratory.
- During the 1997 - 98 year, three of CIM's members have been pursuing their research in various parts of the world. *Professor Vincent Hayward* is spending a sabbatical year at IRCAM in Paris, France. *Professor Paul Zsombor-Murray* is at the Technical University of Graz, Austria, and *Professor Peter Caines* is on leave of absence at the University of Hong Kong.
- *Francesco Callari*, a postdoctoral fellow at CIM for the past three years was appointed Lecturer for the Department of ECE. *Paul Fisette*, returned to the Department of Mechanical Engineering at l'Université Catholique de Louvain-

la-Neuve, Belgium, after ten months as a postdoctoral fellow at the Centre. In August, *Raymond Spiteri* joined the Centre for a year as a postdoctoral fellow under the supervision Professor Jorge Angeles with the support of the Centre de Recherches Mathematiques and the Institut des Sciences Mathematiques.

- Three new Research Associates are collaborating with Prof. Jorge Angeles: *Dr. Yao Jin*, from China; *Dr. Leonid Slutski*, from Ben-Gurion University of the Negev in Israel and *Oswaldo Lozano* from Peru.

I.ii Awards and Honourable Mentions

- At the Canadian Image Processing and Pattern Recognition Meeting held in Kelowna, BC, in May 1997, *Professor Martin Levine* was awarded the 1997 CIPRS Service Award for his outstanding contribution to research and education in Computer Vision.
- At the IRIS/Precarn Conference held in Ottawa on June 8-10, 1997, *Ioannis Rekleitis* (Ph.D. candidate supervised by Prof. Greg Dudek) won a Best Poster Award for his submission entitled "Multirobot Exploration of an Unknown World: Efficiently Reducing Odometry Error". The criteria were scientific merit and originality, quality of presentation, and relevance.
- In July 1997, McGill/CIM's Martian Explorer, "*Invader*", won an impressive first place at the Mobile Robot Competition of the American Association for Artificial Intelligence held in Providence Rhode Island. The team consisted of *François Bélair*, *Eric Bourque*, *Deep Jugessur* and *Robert Simi* under the supervision of *Professor Greg Dudek* and the help and support of all the members of the Mobile Robotics Lab.
- *Michael Glaum* (Ph.D. candidate), was awarded the 1998 O. Hugo Schuck Best Paper Award of the American Automatic Control Council for the paper which he co-authored with his supervisor G. Zames, "A Function Calculus for Identification and System Analysis" published in the Proceedings of the 1997 American Control Conference, Albuquerque, NM, June 1997.

I.iii New Research Projects

- With the beginning of the IRIS Phase 3 in April 1998, several members have embarked on new research projects in collaboration with colleagues across the country. "Virtual Environments", "Computer-Assisted Machine Operation", "Robot Partners: Collaborative Perceptual Robotic Systems", "Haptic Interfaces", "Attention in Virtual Reality", "Intelligent Tools for Diagnosis and Surgery" and "Reality-Based Modelling in Virtual Environments" are the new projects being investigated by Profs. Buehler, Clark, Dudek, Ferrie and Hayward.

- *Prof. Jeremy Cooperstock* will be constructing a Reactive Environment here at CIM, utilizing speech, gesture, and video as interaction methods, and applying these techniques to an Intelligent Hospital scenario. A specialist in human-computer interaction, Professor Cooperstock's primary research interest is making technology more usable.

I.iv Conferences and Visits Hosted

CIM has had the pleasure of hosting several long-term visitors this year. Among them were:

- *Dr. Yao Jin*, Researcher at Sechuan Union University, is spending 12 months at the Centre as a Research Associate with Prof. Jorge Angeles.
- Two students spent their final semesters here at CIM under the supervision of Prof. Jorge Angeles: *Gerhard Grabner* from the University of Graz in Austria and *Jordi Daban* from the Universidad Polytechnica de Catalunya, Barcelona, Spain.

CIM organizes three series of lectures on a regular basis throughout the year: seminars in Computer Vision, in Systems and Control and in Robotic Mechanical Systems. The latter is supported by a Seminar Grant from the Faculty of Graduate Studies and Research.

- Visiting lectures for the Systems and Control series included: *Dr. Marios Polykarpou*, University of Cincinnati; *Dr. Bassam Bamieh*, University of Illinois, Urbana
- The Robotic series hosted, among others: *Dr. Vladimir Brodsky*, Technion-Israel Institute of Technology, Israel; *Prof. Ahmad Hemami*, École Polytechnique de Montréal; *Prof. Alec Zahavi*, Ben-Gurion University of Negev, Beer-Sheva, Israel; *Prof. Leonard Maunder*, University of Newcastle upon Tyne, UK; *Prof. Monique Teillaud*, INRIA Sophia Antipolis, France.

The Centre welcomes many visitors on an ongoing basis. Some of the visits hosted during 1997-98 were:

- Throughout the summer, as of June 26, 1997, CIM gave tours and demonstrations to science students at the *Reach Summer Camp*.
- *Career Day Visits* were organized for high school students from *Explorations '97* Montreal Area High School Program; from the *Jewish Vocational Services* on November 18, 1997; from the *Protestant School Board of Greater Montreal* on May 6 and from the *West Island College* on May 12 1998 .

- Professor Lim Mong King, Deputy President (Research) visited CIM with a delegation from *Nanyang Technological University of Singapore* on August 29, 1997.
- On September 30, 1997, Dr. H.B. Matthias, Vice-Rector, and Professor P. Kopacek from the *Vienna University of Technology*, toured the CIM laboratories.
- The Haptics Laboratory welcomed *Professor Kiyoshi Komoriya*, Director of Cybernetics Division, Department of Robotics, AIST, MITI, on October 1, 1997.
- On October 17, 1997, *l'Association des professeurs de science du Québec*, toured the Centre in conjunction with their visit of the Faculty of Engineering.
- Industrial visitors to the Centre included: Ms. K. Vannesjo, and Drs. Aspulend and Gnerf from *ASEA Brown Boveri*, Stockholm, Sweden on November 17, 1997, and Craig Inker from *COM DEV* on February 4, 1998, as well as a delegation of business representatives from the *City of Bordeaux*, France, on March 12, 1998.

I.v Public Relations

- The CIM's Home Pages at: <http://www.cim.mcgill.ca/> have been redesigned and now features not only all the academic, technical and student members of CIM and their group's research activities but also the Centre's Technical Reports, Annual Reports, Seminar Announcements, and Internal Newsletters.
- CIM faculty and students represented CIM with posters and seminars at several conferences throughout the year. Some of the ones attended were: the 1997 IRIS/PRECARN Conference in Ottawa in June; AAI National Conference on Artificial Intelligence, July 1997 in Providence, RI.; the IJCAI (International Joint Conference in artificial Intelligence in Nagoya, Japan in August; the IEEE Intelligent Robotic Systems Conference in Grenoble, France held in September; the Seventh IFToMM International Symposium on Linkages and Computer Design Methods conference in Bucharest in August; the 1997 Decision and Control Conference in San Diego, CA. in December and the IEEE International Conference on Robotics and Automation in Leuven Belgium held in May 1998.
- On April 30, 1998, CIM hosted the first meeting of it's Advisory Board. Members of the Board in attendance were *Prof. John Dealy*, Dean of the Faculty of Engineering at McGill; *Ms Carol Ann Davidson*, Senior Program Manager, Discovery Channel; *Dr. Toby Gilsig*, Consulting Partner of Secor Inc. and co-founder and CEO of M3i; and *Dr. Albert Aguayo*, Director of the Centre for Research in Neuroscience at the Montreal General Hospital.

II Evaluation of the Past Academic Year

II.i Goals and Objectives

Well trained, highly skilled graduates in the electrical and mechanical engineering and computer fields are critical to Canada's ability to respond to the demands of a very lucrative global marketplace.

CIM has been making a vital contribution to the mentoring and development of hundreds of graduate students in engineering and computer science for over a decade. It is also an international venue for showcasing McGill's prominent scientists and their work in intelligent systems. Ranked among the top 10 of its kind in the world, CIM is arguably one of the most prestigious centre in Canada devoted to the study of intelligent systems.

As CIM moves into its second decade, the Centre is facing new challenges and fresh directions. Both internal and external factors have influenced the departure of several prominent members. There have been drastic government cutbacks in funding for research and development. Moreover, with increased urgency, granting agencies are tying research monies to industrial partnering. All of these factors have impacted CIM directly.

Responding to these challenges has become the impetus driving CIM into the millennium. Armed with a formidable team of researchers, students and dedicated staff, the Centre has seized these challenges as opportunities for renewed growth and diversification.

II.ii Research and Contributions to Teaching

As in the previous years, CIM continued to play a leading role in research at the global scale. CIM faculty and students contributed original research work at local, national and international forums. Internationally, our presence in the community of researchers in areas related to intelligent machines was prominent, as per our list of papers presented at conferences the world over. Needless to say, the training aspect of this participation is key in the teaching of our graduate students, who are thus encouraged to face a community of international scholars early in their research careers.

CIM's culture provides many benefits to these students. Because of the emphasis on teamwork, the Centre's students develop a multi-faceted and creative approach to project management. They gain hands-on experience in giving presentations and popular lab "demos" to a diverse and challenging audience ranging from renowned scientists and high ranking corporate executives to grade school students, thus refining their leadership and interpersonal skills. They participate in an

environment where, on a day-to-day basis, considerable attention is paid to coaching by supervisors and senior research engineers alike. Equally important, through interaction with industry, they develop a keen awareness of business issues and concerns. Thus, the spirit of entrepreneurship is alive and well at the Centre, as evidenced by the many spin-off companies that have been born of CIM graduates.

While CIM's role in graduate teaching is well recognized both within and outside the university, we must emphasize that, at the undergraduate level, CIM contributes substantially in various ways (besides the fifteen or so undergrad courses taught by the CIM faculty members) namely: a) by making its research facilities available to CIM research personnel for purposes of developing courses, whereby our rich stock of hardware and software is second to none; b) by providing the academic departments with excellent teaching assistants drawn from our rich pool of graduate students; and c) by providing a continuous source of undergraduate projects, and the facilities to conduct them, to the various departments.

II.iii Inter-University Collaboration

This is an aspect where CIM is at its best: locally, Professor Angeles collaborating joint venture with colleagues from the Faculty of Science, Profs. Georg Schmidt (Mathematics & Statistics) and Chris Paige (Computer Science), in which all three are supporting Raymond Spiteri, a full-time Postdoctoral Fellow working in the area of the numerics of dynamical systems.

We can cite collaboration between Prof. Angeles' group and Concordia's Prof. Patel's group in the area of robot design and control in two projects: STEAR5 and an NSERC-supported CRD involving Bombardier as an industrial partner. The CRD objective is to build a Dual-Arm Robotic Workcell for the development of algorithms for the control and trajectory-planning in the context of the space Station, in which Canada's contribution is the Mobile Servicing System.

At the national level, collaboration is quite intensive by virtue of IRIS, the Network of Centres of Excellence in Robotics and Intelligent Systems which links the Centre to the Universities of Laval, Montreal, Toronto, York and BC.

At the international level, formal collaboration agreements, sponsored by either the McGill Office of International Relations or Quebec's Ministère des affaires internationales, exist between CIM researchers and Mexico's Universidad Iberoamericana at León, Université de Liege, Belgium, IMEC in Louvain, Belgium, and the Fachhochschule Münster, Germany.

More informally, collaboration is quite active with l'Ecole Centrale de Nantes, in France, the Laboratoire d'Analyse et d'Architecture des Systèmes, of Toulouse, in France, and the University of Leoben, Austria. Every spring, for the past five years, two to three students in their last year of studies at l'Ecole Centrale de Nantes, have

visited CIM in order to receive training in the area of robot design. Two students spend their final semesters here at CIM thanks to Prof. Angeles's collaboration with their respective universities. From the University of Graz's one of Professor Andr s Kecskemethy's student, Mr. Gerhard Grabner, spent the fall term in the lab working on the modelling of flexible bodies using cubic splines, and attending robotics course. Mr. Jordi Daban, came to work on his final project at CIM from the Universidad Polytechnica de Catalunya. Mr. Daban's work aims at developing a completely novel technology for the design of bevel gears. This latter project also involved the support of an industrial partner, Alta Precision Inc., who paid Mr. Daban's salary.

III CIM Staff

Director: M.D. Levine
Manager: M. Gray

Members: J. Angeles
P.R. Bélanger
M. Buehler
P.E. Caines
C. Charalambous
J.J. Clark
J. Cooperstock
G. Dudek
F. Ferrie
V. Hayward
M.D. Levine
H. Michalska
A. Misra
B. Romanchuk
P.J. Zsombor-Murray

CIM Associates:	H. Galiana	McGill University
	N. Hori	McGill University
	R.V. Patel	Concordia University
	M. Husty	Mining Univ., Austria

Technical Staff:	T. Baron	Research Engineer
	J. Binder	Systems Administrator
	P. Ciaravola	Research Engineer
	M. Doyon	Research Engineer
	D. Grant	Research Engineer
	M. Parker	Systems Programmer
	G. Soucy	Research Engineer

IV CIM Students and Postdoctoral Fellows

The students at CIM are all graduate students associated with either Electrical or Mechanical Engineering or with the School of Computer Science. During the 1997-98 academic year the statistics were as follows:

	Masters	Ph.D.	Total
Electrical Eng.	18	21	39
Mechanical Eng.	17	16	33
SOCS	12	2	14
Total	47	39	86

	Postdocs
Electrical Eng.	1
Mechanical Eng.	1
SOCS	1
Total	3

C I M Students

Name	Degree	Supervisor	Dept.	Status	Employer
Han, Lan Qing	M.Eng	Bélanger	EE	continuing	
Hayes, John	Ph.D	Zsombor-Murray	ME	continuing	
Hernandez-Alonso, Diana	Ph.D	Levine	EE	continuing	
Hubbard, Paul	Ph.D	Caines	EE	continuing	
Ignatova, Maria	M.Sc.	Levine	CS	continuing	
Jelonek, Thomas	Ph.D	Ferrie	EE	continuing	Deus Ex Machina
Jugessur, Deeptiman	M.Sc.	Dudek	CS	continuing	
Karakusevic, Vladimir	M.Eng	Zsombor-Murray	ME	continuing	
Kim, Sun-Wook	Ph.D	Misra	ME	continuing	
Lange, Christian	M.Eng	Angeles	ME	09-97	PhD in Gratz, Austria
Lau, Hang Fai (Anthony)	M.Eng	Levine	EE	continuing	
Leblanc, Marc	M.Eng	Buehler	ME	09-97	Nortel
Lemch, Ekaterina	Ph.D	Caines	EE	continuing	
Lucyshyn, Robert	M.Eng	Angeles	ME	05-98	Nortel
Mackling, Thomas	Ph.D	Caines	EE	12-97	Optimal Robotics
Martin, Eric	Ph.D	Ang. & Papado.	ME	continuing	Pratt & Whitney
Martinez-Mascarua, Carlos	Ph.D	Caines	EE	07-97	ESCA
Menemenlis, Nickie	Ph.D	Charalambous	EE	continuing	IREQ
Min, Byung No	Ph.D	Misra	ME	continuing	
Montagnier, Pierre	Ph.D	Angeles	ME	continuing	
Navarro-Martinez, Oscar	M.Eng	Angeles	ME	continuing	
Ng, Romney Ka-Ho	M.Eng	LEVINE	EE	continuing	Nortel
O'Reilly, Philippe	M.Eng	Buehler	ME	08-97	IREQ
Obaid, Sami	M.Eng	BUEHLER	ME	continuing	
Ostrovskaya, Svetlana	Ph.D	Angeles	ME	continuing	
Parsa, Kourosh	Ph.D	Angeles & Misra	ME	continuing	
Polieroni, Sandra	M.Sc.	Ferr. & Dudek	CS	continuing	
Qing, Shuping	Ph.D	Zames/Charalambous	EE	continuing	
Qumsieh, Ala	M.Eng	Clark	EE	05-98	
Rekleitis, Ioannis	Ph.D	Dudek	CS	continuing	
Rey, Daniel	Ph.D	Papadopoulos	ME	continuing	ISE Ltd
Roy, Nicholas	M.Sc.	Dudek	CS	08-97	Ph.D. at CMU
Sandoli, Laurent	M.Eng	Angeles	ME	07-97	Ret'd to France
Sarkis, Joseph	M.Eng	Buehler	ME	continuing	Johnson & Johnson
Shen, Gang	Ph.D	Caines	EE	continuing	
Sim, Robert	M.Sc.	Dudek	CS	continuing	
Simhon, Saul	M.Sc	Dudek	CS	continuing	

C I M Students

Name	Degree	Supervisor	Dept.	Status	Employer
Abdul-Baki, Iyad	M.Eng	Buehler	EE	08-97	CAE
Aghili, Farhad	Ph.D	Buehler	ME	11-97	Canadian Space Agency
Ahmadi, Mojtaba	Ph.D	Buehler	ME	continuing	
Arbel, Taly	Ph.D	Ferrie	EE	continuing	
Asamoah-Attiah, Samuel	M.Eng	Zsombor-Murray	ME	continuing	
Astley, Oliver	Ph.D	Hayward	EE	continuing	
Ayoung-Chee, Nigel	M.Eng	Ferrie & Dudek	EE	continuing	McGill Networking Eng
Battaglia, Robert	M.Eng	Buehler	ME	continuing	
Bélair, François	M.Sc.	Dudek	CS	continuing	
Benameur, Kaouthar	Ph.D	Bélanger	EE	02-98	Industry Canada
Benoit, Stephen	Ph.D	Ferrie	EE	continuing	
Benzacar, Eric	M.Eng	Ferrie	EE	continuing	
Bérubé-Lauzière, Yves	Ph.D	Ferrie	EE	continuing	
Beyrouti, Fadi	M.Eng	Ferrie	EE	continuing	
Bhanji, Altaz	M.Eng	Levine	EE	08-97	AutoVu Technologies
Bilodeau, Glen	Ph.D	Papadopoulos	ME	continuing	
Bitton, Michel	M.Eng	Michalska	EE	08-98	
Bourque, Eric	M.Sc	Dudek	CS	continuing	
Bui, Don	M.Eng	Levine	EE	05-98	CAE
Bulca, Ferhan	Ph.D	Ang. & Z-M.	ME	12-97	COM DEV, ON
Burlington, Scott	M.Eng	Dudek	CS	continuing	
Cebula, Andrzej	Ph.D	Zsombor-Murray	ME	continuing	
Ciaravola, Philippe	M.Sc.	Dudek	CS	08-97	Auto Vu Technologies
Cocosco, Anca	M.Eng	Buehler	ME	continuing	CAE
Cruz-Hernandez, Manuel	Ph.D	Hayward	EE	continuing	
Damianakis, John	M.Eng	Buehler	ME	07-97	CAE, Anderssen Consults.
Daum, Michael	M.Sc.	Dudek	CS	continuing	Originalsim
Djouadi, M. Seddik	Ph.D	Zames/Charalambous	EE	continuing	
Dupuis, Erick	Ph.D	Hayw. & Papado.	ME	continuing	CSA, Mtl
Fazal-Ur-Rehman,	Ph.D	Michalska	EE	12-97	University of Pakistan
Gendron, Sylvain	Ph.D	Bélanger	EE	02-98	Paprican, Mtl
Gervasi, Pasquale	M.Eng	Zsombor-Murray	ME	continuing	General Electric, Canada
Glaum, Michael	Ph.D	Zames/Charalambous	EE	continuing	KVH Industries, RI
Grant, Danny	Ph.D	Hayward	EE	continuing	
Greenish, Stephanie	M.Eng	Hayward	EE	continuing	
Guenov, Valentin	Ph.D	Zsombor-Murray	ME	continuing	
Hafed, Ziad	M.Eng	Clark	EE	continuing	

C I M Students

Name	Degree	Supervisor	Dept.	Status	Employer
Siu, Dixon	M.Eng	Michalska	EE	12-97	
Teng, Chin-Pun (Amy)	Ph.D	Angeles	ME	continuing	
Tremblay, Pierre-Jules	M.Eng	Ferrie	EE	05-98	Deus ex Machina
Unger, Richard	M.Sc.	Dudek	CS	continuing	
Valois, Jean-Sebastien	M.Eng	Ferrie	EE	on leave	NASA/CSA-Houston,
Wang, Di	M.Eng	Angeles	ME	08-97	
Whaite, Peter	Ph.D	Ferrie	EE	02-98	Deus Ex Machina
Wu, Chu-Jen	M.Eng	Papadopoulos	ME	continuing	
Xu, Aoxiang	M.Eng	Cooperstock	EE	continuing	
Yamazaki, Kenneth	M.Eng	Buehler	ME	continuing	
Zhang, Chi	Ph.D	Dudek	CS	continuing	
Zia, Lilian	M.Eng	Michalska	EE	07-97	CAE then Los Angeles