

Advances in Intelligent and Soft Computing

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Advances in Intelligent and Soft Computing

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Proceedings of an International Symposium
on the Occasion of the 25th Anniversary
of the McGill University Centre
for Intelligent Machines

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Preface

The *Centre for Intelligent Machines* (CIM), McGill University, was officially created on November 13th, 1985, upon approval by the University Senate. The mission of the centre is, since its inception, “to excel in the field of intelligent systems, stressing basic research, technology development and education.” *Intelligent machines* are understood, along these lines, as systems “capable of adapting their goal-oriented behavior by sensing and interpreting their environment, making decisions and plans, and then carrying out those plans using physical actions.” Research activities of interest to CIM include robot design, mechanical system dynamics, robot control, computer vision, visual perception, medical imaging, haptics, system theory and applications, and virtual environments. These fields can be succinctly described by the title of the international symposium recorded in this book, *Brain, Body and Machine* (BBM).

CIM’s object of research is thus reflected in the book, where readers will find that most papers cover at least two of the three main thrusts. Papers reflect the state-of-the-art of the multidiscipline of intelligent machines, nowadays highly diversified. A broad spectrum of applications is covered, from humanoid robots and autonomous planetary rovers, to innovative procedures and systems for shape-reproduction and on to systems or devices for medical diagnosis. Applications are all geared to one common goal, a better quality of life for highly challenged patients or simply for the healthy individual. Methods to face the challenges include not only sophisticated deterministic algorithms, but also their heuristic counterparts, at the roots of what is known as *soft computing*.

The reader will find here papers on human-robot interaction as well as human-safety algorithms; haptic interfaces; innovative instruments and algorithms for the sensing of motion and the identification of brain neoplasms; even a paper on a saxophone-playing robot.

In its first 25 years, CIM has produced hundreds of graduates at the Master's, Ph.D. and postdoctoral levels. These alumnae and alumni are now successful professors, researchers, developers and managers who are at the forefront of many industries, and entrepreneurs and business developers. CIM's graduates, moreover, are distributed all over the world. This rich distribution made the *International Symposium on Brain, Body and Machine* possible.

Montreal,
August 2010

The Editors
Jorge Angeles
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Kaleem Siddiqi

Acknowledgements

McGill University's Centre for Intelligent Machines (CIM) is the product of a visionary, Professor Pierre Belanger, who started promoting the idea as Chairman of Electrical Engineering in the early eighties. He gathered a group of colleagues in his department, in the School of Computer Science and in the Department of Mechanical Engineering, in an effort that culminated with the creation of "the centre" on November 13, 1985. Since 2007, CIM has been strengthened by the financial and strategic support provided by Quebec's *Fonds de recherche sur la nature et les technologies* via a grant to the *Regroupement stratégique pour l'étude des environnements partagés intelligents répartis* (RÉPARTI), a network of five Quebec universities sharing the same research interests as McGill in the domain of intelligent systems. In fact, RÉPARTI has enhanced CIM's networking activities beyond Quebec and Canada.

For the successful celebration of the first 25 years of CIM, we are indebted to the Deans of Engineering, Prof. Christophe Pierre, and of Science, Prof. Martin Grant, to the Chairmen of Electrical and Computer Engineering, Prof. David Plant, and of Mechanical Engineering, George Haller, as well as to the Director of the School of Computer Science, Prof. Gregory Dudek, who supported and encouraged our effort. The logistic support provided by Jan Binder, Systems Manager, not only during the celebration, but also during most of the past 25 years, has played a decisive role in making of CIM a success story. Marlene Gray, Manager, Cynthia Davidson, Secretary, and Patrick McLean, Systems Administrator, have provided excellent support in keeping the centre running throughout the years, and certainly during this celebratory year. The celebration activities have run through the year, with six public seminars and one Beatty Lecture, given by prominent researchers in the areas of brain, body and machine.

Last, but not least, the Editors want to acknowledge those who participated in the production of this book: all CIM members, who composed the Technical Committee of the *International Symposium on Brain, Body and Machine*; the anonymous reviewers who provided not only their expertise, but also their precious time; and the key role played by Dr. Seyedhossein Hajzargarbashi, the manager of the symposium website. All these individuals contributed to securing a high quality of our final product: this book.

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Singularity Analysis of a Six-Dof Parallel Manipulator

Using Grassmann-Cayley Algebra and Gröbner Bases 341

*Stéphane Caro, Guillaume Moroz, Thibault Gayral, Damien Chablat,
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