Lecture Notes in Computational Vision and Biomechanics

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Lecture Notes in Computational Vision and Biomechanics

Volume 1

This book is the first to be published under the Book Series “Lecture Notes in Computational Vision and Biomechanics (LNCV&B)”.

The research related to the analysis of living structures (Biomechanics) has been a source of recent research in several distinct areas of science, for example, Mathematics, Mechanical Engineering, Physics, Informatics, Medicine and Sport. However, for its successful achievement, numerous research topics should be considered, such as image processing and analysis, geometric and numerical modelling, biomechanics, experimental analysis, mechanobiology and enhanced visualization, and their application to real cases must be developed and more investigation is needed. Additionally, enhanced hardware solutions and less invasive devices are demanded.

On the other hand, Image Analysis (Computational Vision) is used for the extraction of high level information from static images or dynamic image sequences. Examples of applications involving image analysis can be the study of motion of structures from image sequences, shape reconstruction from images and medical diagnosis. As a multidisciplinary area, Computational Vision considers techniques and methods from other disciplines, such as Artificial Intelligence, Signal Processing, Mathematics, Physics and Informatics. Despite the many research projects in this area, more robust and efficient methods of Computational Imaging are still demanded in many application domains in Medicine, and their validation in real scenarios is matter of urgency.

These two important and predominant branches of Science are increasingly considered to be strongly connected and related. Hence, the main goal of the LNCV&B book series consists of the provision of a comprehensive forum for discussion on the current state-of-the-art in these fields by emphasizing their connection. The book series covers (but is not limited to):

- Applications of Computational Vision and Biomechanics
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- Computational Biology in Biomedical Imaging
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- Virtual Reality in Biomechanics
- Vision Systems

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Marcos Pinotti Barbosa • A.P. Slade
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Technologies for Medical Sciences

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ISSN 2212-9391

ISBN 978-94-007-4067-9

DOI 10.1007/978-94-007-4068-6

Springer Dordrecht Heidelberg New York London

ISSN 2212-9413 (electronic)

ISBN 978-94-007-4068-6 (eBook)

Library of Congress Control Number: 2012936068

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Preface

This book presents novel and advanced Technologies for Medical Sciences in order to solidify knowledge in the related fields and define their key stakeholders.

The 15 chapters included in this book were written by invited experts of international recognition and address important Technologies for Medical Sciences, including: Computational Modeling and Simulation, Image Processing and Analysis, Medical Imaging, Human Motion and Posture, Tissue Engineering, Design and Development Medical Devices, and Mechanic Biology.

Different applications are addressed and described along the book, comprising: Biomechanical Studies, Prosthesis and Orthosis, Medical Diagnosis, Sport, and Virtual Reality.

Therefore, this book is of crucial effectiveness for Researchers, Students and Manufacturers from several multidisciplinary fields, as the ones related with Bioengineering, Biomechanics, Computational Mechanics, Computational Vision, Human Motion, Mathematics, Medical Devices, Medical Image, Medicine and Physics.

The Editors would like to take this opportunity to thank to all invited authors for sharing their works, experiences and knowledge, making possible their dissemination through this book.

Renato M. Natal Jorge
João Manuel R.S. Tavares
Marcos Pinotti Barbosa
A.P. Slade

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Associate Professor at the Faculty of Engineering, University of Porto (FEUP); Mechanical Engineer from the University of Porto, 1987; MSc from the University of Porto, 1991; Ph.D. from the University of Porto, 1999.

Present teaching and research interests: Computational methods in applied mechanics and engineering; New product development; Biomechanics and mechanobiology; Computational vision and medical image processing.

Between 2007 and 2011 was the Director of the “Structural Integrity Unit” research group of the Institute of Mechanical Engineering at FEUP (IDMEC – a R & D non-profit, private Research Institute). Member of the executive board of IDMEC-FEUP.

Responsible for the Supervision or Co-supervision of 12 Ph.D. students.

Co-chair of the following conferences: CompIMAGE; 14th International Product Development Management; VIPIMAGE; Fourteenth Annual Scientific Conference on WEB Technology, New Media, Communications and Telematics Theory, Methods, Tools and Applications; VIPIMAGE 2009; CompIMAGE 2010; Biodental;

iDEMi'09; Sixth International Conference on Technology and Medical Sciences, CIBEM 2011, among other mini-symposia within conferences.

Founder and Editor of the International Journal for Computational Vision and Biomechanics. Guest editor of several scientific journals.

Principal Investigator for several national and European scientific projects.

Co-author of more than 80 papers in international journals and more than 250 publications in international conferences.

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João Manuel R.S. Tavares graduated in Mechanical Engineering from the University of Porto – Portugal (1992); MSc in Electronic and Computer Engineering, in the field of Industrial Informatics, University of Porto (1995); Ph.D. in Electrical and Computer, University of Porto (2001). From 1995 to 2000 he was a researcher at the Institute of Biomedical Engineering (INEB).

Since 2001 he has been senior researcher and project coordinator at the Laboratory of Optical and Experimental Mechanics (LOME) at the Institute of Mechanical Engineering and Industrial Management (INEGI). Also, since 2001, he has been Assistant Professor at the Department of Mechanical Engineering (DEMec) of the Engineering Faculty of the University of Porto (FEUP).

He is co-author of more than 350 scientific papers in national and international journals and conferences and co-editor of 17 international books and guest-editor of several special issues of international journals. In addition, he is Co-Editor-in-Chief of the International Journal for Computational Vision and Biomechanics (IJCV&B) and of the International Journal of Imaging and Robotics (IJIR); Editor-in-Chief of the International Journal of Biometrics and Bioinformatics (IJBB); Associate Editor of the EURASIP Journal on Advances in Signal Processing (JASP), ISRN Machine Vision, and of the Journal of Computer Science (INFOCOMP) and reviewer of several international scientific journals.

Since 2001, he has been Supervisor and Co-Supervisor of several MSc and Ph.D. thesis and involved in several research projects, both as researcher and as scientific coordinator. Additionally, he is co-author of three international patents.

He has been Co-Chairman of various international conferences, such as: CompIMAGE 2006/2010/2012, VipIMAGE 2007/2009/2011, CIBEM 2011, BioDENTAL 2009/2012, TMSi 2010, IMAGAPP 2009 and EUROMEDIA 2008; and of numerous mini-symposia, workshops and thematic sessions. In addition, he has been a member of scientific and organizing committees of several national and international conferences.

His main research areas include Computational Vision, Computational Mechanics, Scientific Visualization, Human-Computer Interaction and New Product Development.

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Neural Vision Applied Research Laboratory (LAPAN, in partnership with Eye Hospital – Dr. Ricardo Guimarães' clinic) is a multidisciplinary laboratory devoted to study and devise new technology on the field of neurosciences, specially related to the visual system. LAPAN is a unique experience of a public research laboratory located in a private hospital. This successful experience has catalyzed a new

technological platform to perform screening tests for elementary school students – The Right Star Project. It aggregates a team of engineers, ophthalmologists, psychiatrists, speech therapists, psychologists, neuroscientists, computer scientists and physicists. Marcos Pinotti has been supervisor and co-supervisor of more than 30 MSc and 20 Ph.D. thesis. He is author of more than 30 scientific papers in national and international journals and conferences. Additionally, he is co-author of 38 patents. He has been invited and given seminars, or invited plenary talks, apart from Brazil, to scientific audiences in United States, China, Italy, Scotland and Argentina. Currently, he is second vice-chairman of the Latin American Society of Biomaterials, Artificial Organs and Tissue Engineering (SLABO); member of the Brazilian National Triennial Evaluation of the Mechanical Engineering Graduate Courses from Ministry of Education and chairman of the Technical Consultant Board of Assistive Technology – Brazilian Presidential's Office for Human Rights.

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1994 – M.Phil. Loughborough University of Technology.

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1974–1994 – Loughborough University of Technology, Department of Mechanical Engineering.

Started in the I.C.E. Laboratory as general laboratory and workshop technician. Moved to Dynamics Laboratory in 1978 and was responsible for its rebuilding and supervision of student laboratory exercises. Started the Departments Mechatronic Research group with Professor J.R. Hewit in 1986.

During my time at Loughborough I was able to develop my skills in the machine shop and would now describe myself as a semi-skilled fitter with a knowledge of a wide range of machine tools and engineering principles. Since moving to the Dynamics, and latterly Mechatronics Group, I was able to pursue my interest in computers and robotics and was involved in a number of student projects which grew into full research projects over the years. The two which I consider to have been of the most importance to the department and myself are a robotic device

for turning and sorting fabric garments and an FMS manufacturing/painting cell for the model industry. In both of these projects I was responsible for the design and building of the electronics and the basic computing elements, and also closely involved in the mechanical design and manufacture. From this last project a number of spin-off ideas have arisen and I am still involved with them with Professor Hewit. The area of medical mechatronic research is a relatively new field and I can see that there are many problems to be overcome. It is these areas which excite me and I believe that bringing an original mechatronic approach to them is the best way forward. Between 1984 and 1994 I was the First Aid Officer for the Department of Mechanical Engineering with responsibility for keeping the First Aid records up to date and dealing with accident reports.

1994 – University of Dundee Department of Applied Physics, Electronics and Mechanical Engineering.

Moved to the University of Dundee in October 1994 to undertake a Ph.D. in “Teleoperated manipulator for minimal access surgery”.

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