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Biomedical Image Registration

Second International Workshop, WBIR 2003
Philadelphia, PA, USA, June 23-24, 2003
Revised Papers



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Preface

The 2nd International Workshop on Biomedical Image Registration (WBIR) was held June 23–24, 2003, at the University of Pennsylvania, Philadelphia. Following the success of the first workshop in Bled, Slovenia, this meeting aimed to once again bring together leading researchers in the area of biomedical image registration to present and discuss recent developments in the field.

The theory, implementation and application of image registration in medicine have become major themes in nearly every scientific forum dedicated to image processing and analysis. This intense interest reflects the field's important role in the conduct of a broad and continually growing range of studies. Indeed, the techniques have enabled some of the most exciting contemporary developments in the clinical and research application of medical imaging, including fusion of multimodality data to assist clinical interpretation; change detection in longitudinal studies; brain shift modeling to improve anatomic localization in neurosurgical procedures; cardiac motion quantification; construction of probabilistic atlases of organ structure and function; and large-scale phenotyping in animal models.

WBIR was conceived to provide the burgeoning community of investigators in biomedical image registration an opportunity to share, discuss and stimulate developments in registration research and application at a meeting exclusively devoted to the topic. The format of this year's workshop consisted of invited talks, author presentations and ample opportunities for discussion, the latter including an elegant reception and dinner hosted at the Mütter Museum. A representation of the best work in the field, selected by peer review from full manuscripts, was presented in single-track sessions. The papers, which addressed the full diversity of registration topics, are reproduced in this volume, along with enlightening essays by some of the invited speakers. The special lectures were given by David Hawkes from King's College, London, Ron Kikinis from Brigham and Women's Hospital, and Klaus Klingenbeck-Regn from Siemens Medical Solutions. David's dazzling presentation highlighted several of the aforementioned applications of registration that are generating such tremendous excitement in the field. Klaus envisaged that this level of interest will only intensify as innovations in registration methodology are leveraged to advance the conduct of interventional procedures. Against this backdrop of unfettered optimism, Ron reminded the algorithm developers to keep sight of practical considerations in their work and the ever-present challenge of clinical validation of novel results.

As well as convening the primary researchers in the field, this year's meeting also served as a tribute to Ruzena Bajcsy on the occasion of her 70th birthday. Ruzena's landmark research on elastic registration and digital anatomy atlases is the foundation on which the most important work in this discipline is built. She continues to build upon her long and distinguished career in computer science, in her roles as a scientist and academic leader. In the latter position, Ruzena served as the head of the Directorate for Computer and Information Science

and Engineering at the National Science Foundation, where she spearheaded the Information Technology Research Program, before moving to Berkeley to lead the Center for Information Technology Research in the Interest of Society. Prior to these positions, Ruzena was faculty at the University of Pennsylvania, where she founded the renowned GRASP Laboratory. Throughout her career, her influence has extended beyond the reach of her personal research, continually exemplifying the best in scientific investigation.

A special session led by Jim Gee from the University of Pennsylvania gathered several distinguished colleagues who had participated in some of the milestone events that marked Ruzena's career in medical imaging. Martin Reivich, Director of the Cerebrovascular Research Center at the University of Pennsylvania, discussed his group's development of the radiotracer fluorine-labeled deoxyglucose (FDG) – which has been hailed as the “molecule of the 20th century” for its unparalleled and unique impact on the evolution of the field of nuclear medicine – and their demonstration for the first time of FDG-PET's potential for quantifying regional cerebral function such as blood flow and volume. The need to correlate this information with anatomy led to a collaboration with Ruzena and directly motivated her conception of a digital brain atlas that could be individualized to label the neuroanatomy of any subject. Stanley Baum, Editor of *Academic Radiology*, described the Institute of Medicine's recognition of this seminal development in its citation honoring Ruzena's induction into the institute. Siegfried Stiehl, Dean of the Department of Informatics at the University of Hamburg, and Alok Gupta, Head of the Computer-Aided Diagnosis and Therapy Group at Siemens Medical Solutions, both reflected on the remarkable experience of having Ruzena as a mentor and being the beneficiaries of the profound affection she has for and empathy she shares with her trainees. Eduardo Glandt, Dean of the School of Engineering and Applied Science at the University of Pennsylvania, concluded the tribute by presenting Ruzena with a certificate from the school “in recognition of her seminal research contributions in the field of medical imaging and for her outstanding mentorship of students and young colleagues.”

There was an overwhelming level of interest in WBIR 2003, and, despite adjusting upward the attendance limit, we were still forced to turn down many registration requests from all over the world. We were delighted to welcome participants to Philadelphia and hope that you found the meeting an enjoyable and stimulating experience. For readers unable to attend the workshop, we hope that you will find this a valuable record of the scientific program.

June 2003

James C. Gee
J.B. Antoine Maintz
Michael W. Vannier

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