Lecture Notes in Computational Vision and Biomechanics

Volume 17

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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):

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Jianhua Yao · Tobias Klinder
Shuo Li
Editors

Computational Methods and Clinical Applications for Spine Imaging

Proceedings of the Workshop held at the 16th International Conference on Medical Image Computing and Computer Assisted Intervention, September 22–26, 2013, Nagoya, Japan

Springer

Editors
Jianhua Yao
Center Drive
National Institutes of Health
Bethesda, MA
USA

Shuo Li
GE Healthcare and University of Western Ontario
London, ON
Canada

Tobias Klinder
Innovative Technologies Research Laboratories
Philips Research
Hamburg
Germany

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Preface

The spine represents both a vital central axis for the musculoskeletal system and a flexible protective shell surrounding the most important neural pathway in the body, the spinal cord. Spine-related diseases or conditions are common and cause a huge burden of morbidity and cost to society. Examples include degenerative disk disease, spinal stenosis, scoliosis, osteoporosis, herniated disks, fracture/ligamentous injury, infection, tumor, and spondyloarthropathy. Treatment varies with the disease entity and the clinical scenario can be nonspecific. As a result, imaging is often required to help make the diagnosis. Frequently obtained studies include plain radiographs, DXA, bone scans, CT, MR, ultrasound, and nuclear medicine. Computational methods play a steadily increasing role in improving speed, confidence, and accuracy in reaching a final diagnosis. Although there has been great progress in the development of computational methods for spine imaging over the recent years, there are a number of significant challenges in both methodology and clinical applications.

The goal of this workshop on "Computational Methods and Clinical Applications for Spine Imaging" was to bring together clinicians, computer scientists, and industrial vendors in the field of spine imaging, for reviewing the state-of-art techniques, sharing the novel and emerging analysis and visualization techniques, and discussing the clinical challenges and open problems in this rapidly growing field. We invited papers on all major aspects of problems related to spine imaging, including clinical applications of spine imaging, computer-aided diagnosis of spine conditions, computer Aided Detection of spine-related diseases, emerging computational imaging techniques for spinal diseases, fast 3D reconstruction of spine, feature extraction, multiscale analysis, pattern recognition, image enhancement of spine imaging, image-guided spine intervention and treatment, multimodal image registration and fusion for spine imaging, novel visualization techniques, segmentation techniques for spine imaging, statistical and geometric modeling for spine and vertebra, spine and vertebra localization.

Although being the first MICCAI workshop on this particular topic, we received many high quality submissions addressing many of the above-mentioned issues. All papers underwent a thorough double-blinded review with each paper being reviewed by three members of the program committee including workshop chairs. The program committee consisted of researchers who had actively contributed to the field of spine imaging in the past. From all submissions, we finally

accepted 19 papers as oral presentations. The papers are organized into five parts according to the topics. The parts are Segmentation I (CT), Computer Aided Detection and Diagnosis, Quantitative Imaging, Segmentation II (MR) and Registration/Labeling.

In order to give deeper insights into the field and stimulate further ideas, we had invited lectures held during the workshop. We are very thankful to Tokumi Kanamura, Gabor Fichtinger, and Vipin Chaudhary for agreeing to give invited talks on the topic of clinical indications, image guided intervention, and commercialization.

We hope that with this workshop we have increased the attention toward this important and interesting field of computational spine imaging and would like to finally thank all contributors for their efforts in making this workshop possible. We especially thank the following institutes for their sponsorship: Journal of Computerized Medical Imaging and Graphics, GE Healthcare, Digital Imaging group of London, Philips Research, and National Institutes of Health.

Jianhua Yao
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