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Computational Methods and Clinical Applications in Musculoskeletal Imaging

5th International Workshop, MSKI 2017
Held in Conjunction with MICCAI 2017
Quebec City, QC, Canada, September 10, 2017
Revised Selected Papers

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Preface

The musculoskeletal system consists of the skeleton, muscles, cartilage, ligaments, joints, and other connective tissue that supports and binds tissues and organs together, and provides form, support, protection, stability, and movement to the body. Specific subsystems like the spine provide 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. The musculoskeletal system is involved in various disease processes associated with aging and degeneration of bones and joints, such as osteoporosis and osteoarthritis. Osteoporosis is a condition where bones become brittle and fragile from loss of tissue due to hormonal changes, or deficiency in calcium or vitamin D. Osteoporosis leads to an increased bone fracture risk, which is further exacerbated in the elderly due to the loss of muscular strength and frailty. Osteoarthritis, or degenerative arthritis, is caused by inflammation and the eventual loss of cartilage in the joints, which wears down with time. These are just a few relevant examples of the conditions associated to the musculoskeletal system, not to mention therapeutic procedures in orthopedic surgery, and the related medical implants and devices where imaging plays a crucial role in the planning, guidance, and monitoring phases. As a specialty of diagnostic radiology, musculoskeletal imaging involves the acquisition, analysis, and interpretation of medical images of bones, joints, and associated soft tissues for injury and disease diagnosis and treatment. Given the increasing volume of multimodal imaging examinations associated with musculoskeletal diseases and the complexity of their assessment, there is a pressing need for advanced computational methods that support the diagnosis, therapy planning, and interventional guidance, with several related challenges in both methodology and clinical applications.

The goal of the workshop series on Computational Methods and Clinical Applications in Musculoskeletal Imaging is to bring together clinicians, researchers, and industrial vendors in musculoskeletal imaging for reviewing the state-of-the-art techniques, sharing the novel and emerging analysis and visualization techniques, and discussing the clinical challenges and open problems in this field. Topics of interest include all major aspects of musculoskeletal imaging, for example: clinical applications of musculoskeletal computational imaging; computer-aided detection and diagnosis of conditions of the bones, muscles, and joints; image-guided musculoskeletal surgery and interventions; image-based assessment and monitoring of surgical and pharmacological treatment; segmentation, registration, detection, localization, and visualization of the musculoskeletal anatomy; statistical and geometrical modeling of the musculoskeletal shape and appearance; image-based microstructural characterization of musculoskeletal tissue; novel techniques for musculoskeletal imaging.

The 5th Workshop on Computational Methods and Clinical Applications in Musculoskeletal Imaging, MICCAI-MSKI2017[1], was a full-day satellite event of the 20th International Conference on Medical Image Computing and Computer-Assisted Intervention, MICCAI 2017[2], held during September 10–14, 2017, in Québec City, Canada. The workshop was a continuation of the former Workshop on Computational Methods and Clinical Applications for Spine Imaging, CSI, which was after four successful consecutive editions at MICCAI 2013, 2014, 2015, and 2016 opened up to a wider community by broadening the scope from spine to musculoskeletal imaging, therefore recognizing the progress made in spine imaging and the emerging needs in imaging of other bones, joints, and muscles of the musculoskeletal system. We received several high-quality submissions addressing many of the above-mentioned issues. All papers underwent a double-blind review, with each paper being reviewed by three members of the review committee. We finally accepted 13 papers collected into soft-copy electronic proceedings distributed at the workshop and during the conference.

MICCAI-MSKI2017 was held on September 10, 2017, with the program consisting of four oral sessions: Spine Imaging, Musculoskeletal Imaging, Anatomy Localization and Rendering, and Bone Density Estimation. To gain deeper insight into the field of musculoskeletal imaging and stimulating further ideas, two invited talks were held during the workshop. In his morning talk entitled "Musculoskeletal Imaging: An Overview," Dr. Cristian Lorenz from Philips Research Hamburg, Germany, overviewed musculoskeletal imaging by covering the most important areas from fetal and postnatal screening to poly-trauma, cancer, and interventional imaging, while providing discussion over the corresponding clinical context and imaging modalities. In the afternoon, Dr. Punam K. Saha from the University of Iowa, USA, gave a talk entitled "Topologic and Geometric Approaches for In Vivo Quantitative Assessment of Trabecular Bone Micro-Architecture," in which he focused on osteoporosis and related imaging, and presented the results of several human studies on this topic. The members of the Organizing Committee selected one outstanding contribution for the MICCAI-MSKI2017 Best Paper Award, which was given to the paper entitled "Reconstruction of 3D Muscle Fiber Structure Using High Resolution Cryosectioned Volume" by Otake et al. After the workshop, the authors were invited to revise and resubmit their papers by considering the comments of the reviewers and the eventual feedback from the workshop itself, to be considered for the publication in Springer's *Lecture Notes in Computer Science* (LNCS) series. All authors responded to the call, and after reviewing the resubmitted papers, the members of the Organizing Committee agreed that the revisions were of adequate quality, thus the papers now appear, in the chronological order of the initial submission, in these LNCS proceedings.

Finally, we would like to thank everyone who contributed to this workshop: the authors for their contributions, the members of the Program and Review Committee for their review work, promotion of the workshop, and general support, the invited

[1] http://mski2017.wordpress.com.

[2] http://www.miccai2017.org.

speakers for sharing their expertise and knowledge, and the MICCAI Society for the opportunity to exchange research ideas and build the community during the premier conference in medical imaging.

December 2017

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