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Image-Guided Procedures, Robotic Interventions, and Modeling

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Ziv R. Yaniv
Editors

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Sensing Challenges and Prospects in Miniaturizing Surgical Robots and Tools
Jessica Burgner-Kahrs, Leibniz Universität Hannover (Germany)

Interventional Procedures: Emerging Technologies and Clinical Applications
Ziv R. Yaniv, U.S. National Library of Medicine (United States)

Introduction

Welcome to the 2016 edition of the SPIE Image-Guided Procedures, Robotic Interventions, and Modeling conference proceedings. This year we received 113 abstract submissions and accepted 101 as full manuscripts which were presented at the conference during the oral and poster sessions.

The keynote presentation by Kenneth Goldberg from the University of California Berkeley was outstanding. The title of the talk was **Robot-Assisted Tumor Resection: Palpation, Incision, Debridement and Adhesive Closure**. Prof. Goldberg presented a fascinating view on the future of automation in robotic surgery. He described new tooling and learning algorithms to facilitate supervised automation of surgical subtasks. In particular, he described new approaches to palpation, dissection, retraction, debridement, and adhesive closure.

This year we held two parallel workshops; **Sensing Challenges and Prospects in Miniaturizing Surgical Robots and Tools**, and a joint workshop with the physics conference **Interventional Procedures: Emerging Technologies and Clinical Applications**.

Jessica Burgner-Kahrs organized the Sensing Challenges and Prospects in Miniaturizing Surgical Robots and Tools workshop. It featured three presentations on cutting edge research in robotics and sensing technologies. First, Jenny Dankelman from TU Delft in the Netherlands spoke about numerous medical devices being developed at Delft, including steerable needles, robotic catheters, and hand-held laparoscopic instruments. Next, Dan Popa of the University of Louisville spoke about sensors and the micro-manufacturing technologies used to create them. Lastly, Robert Webster of Vanderbilt University spoke about the need to consider sensing, design, and motion planning simultaneously in order to create optimal flexible robots, such as concentric tube robots. A major theme that emerged from the workshop was the need to integrate sensing systems into the material of the robot. Another was the need for many different kinds of sensors, including those measuring position, orientation, force, strain, contact, temperature for various surgical applications.

The joint workshop with the Conference 9790 was well attended and included talks from leading researchers in the field. Terry Peters from Robarts Research Institute described Imaging Systems for Minimally-Invasive Surgery. Jeffrey Siewerdsen from Johns Hopkins University talked about Interventional Imaging Technologies for Therapy Guidance. Kullervo Hynynen from Sunnybrook Health Sciences Center described Applications of Non-Invasive Surgery and Targeted Therapeutics, and Puneet Sharma from Siemens Healthcare talked about Technology Transfer of Interventional Imaging Technologies to the Clinic.

This year's Young Scientist Award went to Sureerat Reaungamornrat from Johns Hopkins University (United States) for her paper titled **MIND Demons for MR-to-CT deformable image registration in image-guided spine surgery**. She also received the Robert F. Wagner All-Conference Best Student Paper Award for this work. This year we had two co-runners up for the Young Scientist Award, Clément Baumgarten from the University of Rennes I (France) for his paper titled **Image-guided preoperative prediction of pyramidal tract side effect in deep brain stimulation** and Neal Dillon form Vanderbilt University (United States) for his paper titled **Increasing safety of a robotic system for inner ear surgery using probabilistic error modeling near vital anatomy**. The winner of Best Poster Award this year was Xiaofeng Yang from Emory University (United States) and the two honorable mention awardees were Maggie Hess from Queen's University (Canada) and Burton Ma from York University (Canada). We would like to thank Siemens Healthcare for sponsoring the Young Scientist Award prizes and Northern Digital Inc. for sponsoring the prizes for our Best Poster Awards.

We are grateful to all of our committee members for their help in reviewing abstracts, evaluating student papers, and judging posters. Their commitment enables us to maintain the high scientific standards of our conference. We also recognize the outstanding service of Ziv Yaniv from the National Institutes of Health as chair of the conference; he has completed his term and is resuming his role as a committee member. Baowei Fai from Emory University is our new co-chair, and will begin his four year term next year.

Finally, we would like to thank all the attendees who gave talks, presented posters, and actively participated in the meeting. The success of the conference is in no small part due to you. Next year, the conference will take place in Orlando, Florida. We look forward to seeing you there for another great conference!

Robert J. Webster III
Ziv Yaniv

2016 Medical Imaging Award Recipients

Robert F. Wagner Best Student Paper Award

Robert F. Wagner was an active scientist in the SPIE Medical Imaging meeting, starting with the first meeting in 1972 and continuing throughout his career. He ensured that the BRH, and subsequently the CDRH, was a sponsor for the early and subsequent Medical Imaging meetings, helping to launch and ensure the historical success of the meeting. The Robert F. Wagner All-Conference Best Student Paper Award (established 2014) is acknowledgment of his many important contributions to the Medical Imaging meeting and his many important advances to the field of medical imaging.

This award is cosponsored by:

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2016 Recipients:

First Place: **MIND Demons for MR-to-CT deformable image registration in image-guided spine surgery** (9786-16)
S. Reaungamornrat, T. De Silva, A. Uneri, Johns Hopkins Univ. (United States), J.-P. Wolinsky, Johns Hopkins Hospital (United States), A. J. Khanna, Johns Hopkins Health Care & Surgery Ctr. (United States), G. Kleinszig, S. Vogt, Siemens Healthcare (Germany), J. L. Prince, J. H. Siewerdsen, Johns Hopkins Univ. (United States)

Second Place: **Design, fabrication, and implementation of voxel-based 3D printed textured phantoms for task-based image quality assessment in CT** (9783-76)
Justin Solomon, Duke Univ. School of Medicine (United States), Alexandre Ba, Institut Univ. de Radiophysique Appliquée (Switzerland), Andrew Diao, Duke Univ. (United States), Joseph Lo, Elianna Bier, Duke Univ. School of Medicine (United States), François Bochud, Institut Univ. de Radiophysique Appliquée (Switzerland), Michael Gehm, Duke Univ. (United States), Ehsan Samei, Duke Univ. School of Medicine (United States)

Conference 9786 Awards

Young Scientist Awards sponsored by Siemens

First Place: **MIND Demons for MR-to-CT deformable image registration in image-guided spine surgery** (9786-16)
S. Reaungamornrat, T. De Silva, A. Uneri, Johns Hopkins Univ. (United States), J.-P. Wolinsky, Johns Hopkins Hospital (United States), A. J. Khanna, Johns Hopkins Health Care & Surgery Ctr. (United States), G. Kleinszig, S. Vogt, Siemens Healthcare (Germany), J. L. Prince, J. H. Siewerdsen, Johns Hopkins Univ. (United States)

Runner Up: **Image-guided preoperative prediction of pyramidal tract side effect in deep brain stimulation** (9786-29)
C. Baumgarten, Y. Zhao, INSERM (France), LTSI, Univ. de Rennes 1 (France); P. Sauleau, C. Malrain, Ctr. Hospitalier Univ. de Rennes (France); P. Jannin, INSERM (France), LTSI, Univ. de Rennes 1 (France); C. Haegelen, INSERM (France), LTSI (France), Ctr. Hospitalier de Rennes (France)

Runner Up: **Increasing safety of a robotic system for inner ear surgery using probabilistic error modeling near vital anatomy** (9786-51)
Neal P. Dillon, Michael A. Siebold, Jason E. Mitchell, Vanderbilt Univ. (United States), Gregoire S. Blachon, Ramya Balachandran, Vanderbilt Univ. Medical Ctr. (United States), J. Michael Fitzpatrick, Vanderbilt Univ. (United States), Robert J. Webster III, Vanderbilt Univ. Medical Ctr. (United States)

Cum Laude Poster Award

First Place: **Patch-based label fusion for automatic multi-atlas-based prostate segmentation in MR images** (9786-72)
Xiaofeng Yang, Ashesh B. Jani, Peter J. Rossi, Hui Mao, Walter J. Curran, Tian Liu, Winship Cancer Institute, Emory Univ. (United States)