1 Half-day workshop on "Cutaneous Feedback for Teleoperation in Medical Robotics"

Workshops and Tutorials will take place on Monday, June 22, 2015 during the IEEE World Conference 2015 in Chicago, USA.

General Information:
A web page is available at http://sirslab.diism.unisi.it/whc15-cutaneous-in-medicine.

2 ABSTRACT

Telerobotic surgical systems involve a slave robot, which interacts with the patient, and a master console, operated by the human surgeon. The slave robot reproduces the hand movements of the surgeon, who in turn needs to observe the operative environment with which the robot is interacting. The latter can be achieved by a combination of visual and haptic cues that flow from the operating table to the surgeon. Visual feedback is already available in commercial robotic surgery systems (e.g., the Intuitive Surgical da Vinci Si), but current surgical robots have very limited haptic feedback. This omission is due to multiple reasons, from the negative effect that haptic feedback has on the stability of the system to the difficulty of including accurate sensors in the robotic instruments due to sterilization and cost requirements. However, haptic force feedback is still widely considered a valuable addition to teleoperated surgical systems. It has been shown to improve performance in fine microneedle positioning (Salcudean et al., 1997), telerobotic catheter insertion (Kazi et al., 2001), suturing simulation (Moody et al., 2002), cardiothoracic procedures (Kennedy et al., 2002), and cell injection systems (Pillarisetti et al., 2007). Moreover, it can enhance surgeons' performance in terms of completion time (Massimino et al., 1994; Pacchierotti et al., 2012), accuracy (Prattichizzo et al., 2010), peak and mean force applied to the remote environment (Wagner et al., 2002; Meli et al., 2014).

For this reason, it is paramount to study and develop new systems to provide surgeons with haptic feedback from the operating tools, while guaranteeing the safety of the patient. In this sense, cutaneous feedback has recently received great attention from researchers; delivering ungrounded haptic cues to the surgeon's skin conveys rich information and does not affect the stability and the safety of the teleoperation system.

The aim of this workshop is to bring together researchers from haptics and surgical robotics to discuss current research and future directions, to bring haptics in the operating room and improve the performance of current surgical robotic systems.

3 AUDIENCE

Topics include, but are not limited to, cutaneous haptic sensing and rendering systems, robotic teleoperation, safety and ethical issues in robot-assisted surgery and related medical scenarios. The workshop is open to any student, researcher as well as developer and end user interested in the design, development, and use of cutaneous feedback for teleoperated medical procedures.
We also intend to provide ample opportunity for round-table discussions where invited speakers and workshop participants will be encouraged to propose questions and ponder the next greatest challenges for cutaneous feedback in medical robotics.

4 Tentative program

9.00 – 9.05 Welcome by the organizers
9.05 – 9.25 Dr. Antonio Gangemi (Univ. of Illinois Medical Center), "Robotic Training for General Surgery Residents at UIC"
9.25 – 9.45 Dr. Lawton Verner (Intuitive Surgical, Inc.), "Challenges to Adding Haptic Feedback to Surgical Robots"
9.45 – 10.05 Prof. Cagatay Basdogan (Koc Univ.), "Challenges in Characterization of Soft Tissue Material Properties"
10.05 – 10.15 Panel discussion
10.15 – 10.30 Coffee Break
10.30 – 10.50 Dr. Claudio Pacchierotti (Italian Institute of Technology) and Prof. Domenico Prattichizzo (Univ. of Siena and Italian Institute of Technology), "Cutaneous Feedback of Fingertip Deformation and Vibration for Palpation in Robotic Surgery"
10.50 – 11.10 Prof. Allison M. Okamura (Stanford Univ.), "Tactile Skin Deformation Feedback for Conveying Environment Forces in Teleoperation"
11.10 – 11.30 Prof. Dong-Soo Kwon (KAIST), "A Novel Surgical Pen-type Master Device using Vibrotactile Feedback"
11.30 – 11.50 Prof. Katherine J. Kuchenbecker (Univ. of Pennsylvania), "Tactile Feedback of Tool Vibrations in Robotic Surgery"
11.50 – 12.00 Panel discussion

5 ORGANIZERS

Dr. Claudio Pacchierotti, Italian Institute of Technology

Claudio received the B.S. and M.S. degrees cum laude in computer engineering from the University of Siena (Italy) in 2009 and 2011, respectively. He was a visiting student at the Karlstad University (Sweden) in 2010, at the University of Padua (Italy) in 2013, at the University of Twente (The Netherlands) in 2014, and at the University of Pennsylvania (USA) in 2014. He received the Ph.D. degree in Robotics and Automation from the University of Siena

and the Italian Institute of Technology in 2014. His research deals with robotics and haptics, focusing on cutaneous force feedback techniques, wearable devices, and haptics for robotic surgery. Email: claudio.pacchierotti@iit.it.

Prof. Domenico Prattichizzo, University of Siena and Italian Institute of Technology

Domenico received the M.S. degree in Electronics Engineering and the Ph.D. degree in Robotics and Automation from the University of Pisa in 1991 and 1995, respectively. He has been Associate Professor of Robotics at the University of Siena since 2002 and Scientific Consultant at Istituto Italiano di Tecnologia, Genova, Italy since 2009. In 1994, he was Visiting Scientist at the MIT AI Lab. He co-authored the Grasping chapter of Handbook of Robotics Springer, 2008, which was awarded two PROSE Awards by the American Association of Publishers. From 2003 to 2014, he has been Associate Editor in Chief of the IEEE Transactions on Haptics. From 2003 to 2007, he was Associate Editor of the IEEE Trans. on Robotics and IEEE Trans. on Control Systems Technologies. He was vice-chair for Special Issues of the IEEE Technical Committee on Haptics (2006-2010); chair of the Italian Chapter of the IEEE RAS (2006-2010), awarded with the IEEE 2009 Chapter of the Year Award; and co-editor of two books by STAR, Springer Tracks in Advanced Robotics, Springer (2003, 2005). His research interests are in haptics, grasping, visual servoing, mobile robotics and geometric control. He has authored more than 200 papers in these fields. Email: prattichizzo@diism.unisi.it.

Prof. Katherine J. Kuchenbecker, University of Pennsylvania

Katherine received the B.S., M.S., and Ph.D. degrees in mechanical engineering from Stanford University, Stanford, CA, in 2000, 2002, and 2006, respectively. She completed a Postdoctoral Research Fellowship at the Johns Hopkins University, Baltimore, MD, in 2006–2007. She is currently an Associate Professor in Mechanical Engineering and Applied Mechanics at the University of Pennsylvania, Philadelphia. Her research centers on the design and control of haptic interfaces and robotic systems, and she directs the Penn Haptics Group, which is part of the General Robotics, Automation, Sensing, and Perception (GRASP) Laboratory. Prof. Kuchenbecker was the recipient of the 2009 National Science Foundation CAREER Award, the 2008 and 2011 Citations for Meritorious Service as a Reviewer for the IEEE Transactions on Haptics, and the 2012 IEEE Robotics and Automation Society Academic Early Career Award. She is co-chairing the IEEE Haptics

Symposium in 2016 and 2018, and she is presently a co-chair of the IEEE RAS Technical Committee on Haptics. Email: kuchenbe@seas.upenn.edu.