From mini-invasive surgery to endocavitary / endoluminal interventions – Part II: Next generation of surgical robots and devices

Description

Goals: Robotics should enable surgery and diagnostic to be less and less invasive. Many prototypes have been developed and validated these last years: robots to manipulate instruments within the abdomen or thorax through small incisions; image-guided percutaneous devices for therapy, biopsy, etc.; mini-robots dedicated to exploration, diagnostic, and therapy through endocavitary or endoluminal access. The objective of the tutorial is to present the key theoretical issues and practical research topics that are, or need to be, investigated.

Due to the large area covered, the tutorial is organized in 2 sessions of 3 hours. This second session will be more application-oriented and will present advanced works and trends for the design of the next generation of surgical robots and devices, while the first session will cover rather theoretical aspects on sensory-based robot control for minimally invasive surgery (MIS).

Provisional schedule

- **Research issues in image-guided mini-invasive procedures**, Gabor Fichtinger (JHU)
- **Research issues in mini-robotics for diagnostic and therapy**, Cesare Stefanini (SSSA, Pise)

Responsible organiser

Etienne Dombre, `dombre@lirmm.fr`

Detailed schedule

- **Research issues in image-guided mini-invasive procedures**, Gabor Fichtinger (JHU)

  Image-guided robot-assisted interventions represent a potentially significant segment of the health-care system in developed countries and numerous aspects of these systems are also expected migrate into technologically less developed regions as well. Increasing the accuracy and safety of interventions, while also reducing their invasiveness and discomfort to patients is a logical imperative. Image guided robotics may play an important role in this process, as they can provide swift, minimally invasive, accurate, and consistent execution of medical interventions. If properly engineered, they can reduce human limitations in hand-eye coordination, dexterity, and stability, while still leaving clinical decisions and high-level control to the medical doctor. In this tutorial, we will survey the land of interventional robotics from multiple perspectives, such application areas, image guidance modalities, hardware design, control scheme, registration, and calibration. We will review the pros and cons of major trends through exciting examples.

  Gabor Fichtinger received BS and MS in Electrical Engineering, and PhD Computer Science from the Technical University of Budapest, Hungary, in 1986, 1988, and 1990, respectively. He has been in the U.S. since 1990. During the first few years of his career, Dr. Fichtinger was involved in computer graphics and biomedical visualization. Later his work progressed to architecting

stereotactic radiosurgery and computer-assisted neurosurgical planning systems for actual clinical use, in both academic and industry settings. For the last couple of years, his focus has been the research of computer-integrated surgery that includes the problems of surgical visualization, modeling, planning, execution, monitoring, and system-level integration of all those. His specialty is robot-assisted image-guided needle-placement procedures, primarily for cancer therapy. Since 1999, Dr. Fichtinger has been at the Johns Hopkins University, as Director of Engineering of the Center for Computer-Integrated Surgery and Associate Research Professor of Computer Science and Radiology.

http://cisstweb.cs.jhu.edu/people/gabor/

- **Research issues in mini-robotics for diagnostic and therapy**, Cesare Stefanini (SSSA, Pise)

Cesare Stefanini received his Laurea Degree in Mechanical Engineering (with hono rs) from the University of Pisa in 1997, as a student of the Scuola Superiore Sa nt'Anna, where he also obtained his Ph.D. in microengineering with a thesis titl ed: "Microengineering Principles and Examples in the Design of Actuators and Mec hanisms for Minimally Invasive Surgery". In 2003 he obtained a position of Assis tant Professor in Biomedical Engineering at the Center of Research in Microengin eering of the Scuola Superiore Sant'Anna, after a visiting research period at th e University of Stanford. His research activity is in the field of microactuator s, micromechatronics and tools for minimally invasive surgery and endoscopy. His interests are also in microrobotics: with a microrobot equipped with an innovat ive micromotor he took part in four editions of the International Micro Robot Ma ze Contest in Nagoya, Japan, receiving three first prizes and one second prize. Stefanini is the author or co-author of five articles on refereed international journals, of nineteen papers published in international conferences proceedings and of one international patent.