MCEN GRADUATE SEMINAR

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Capsule Robots for Endoscopy and Surgery
A paradigm for Bio-Mechatronic design towards the next generation of Surgical Robots

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Abstract

The talk will move from capsule robot for wireless capsule endoscopy toward a new generation of surgical robots, having a relevant reduction in invasiveness as the main driver for innovation. The primary goal of robotic wireless endoscopy is to make gastrointestinal endoscopy a painless screening procedure and to allow wireless therapeutic intervention by means of untethered miniaturized robots. This talk will outline the technical challenges to be faced, mainly related to meso-scale mechatronic design and miniaturization of mechanisms and components, and it will show possible solutions already implemented until the proof-of-concept stage. In particular, some of the most promising approaches developed so far concern magnetic locomotion by external robotic control, a 12-leg capsule able to crawl autonomously inside the colon, a hybrid capsule capable of both magnetic and legged locomotion, and a 4-propeller "submarine" for the exploration of the gastric cavity upon ingestion of water. Other enabling features for robotic capsule endoscopy, such as wireless powering, telemetry, control, real-time vision system and tissue interaction, will be also briefly addressed. The second part of the talk will give an overview about the development of novel robotic solutions for single incision robotic surgery. In particular, a novel surgical robotic platform based on trans-abdominal magnetic links will be presented as a possible approach to further minimize access trauma.

Bio:

Pietro Valdastri received the Master's degree in Electronic Engineering from University of Pisa, Italy, in 2002, and the Ph.D. in Biomedical Engineering from Scuola Superiore Sant'Anna, Pisa, in 2006. After spending three years as Assistant Professor of Biomedical Robotics at Scuola Superiore Sant'Anna, in August 2011 he moved his research to Vanderbilt University, where he is now Assistant Professor of Mechanical Engineering and Director of the STORM Lab (*research.vuse.vanderbilt.edu/storm*). His research is focused on the design and creation of mechatronic and self-contained devices to be used inside specific districts of the human body to detect and cure diseases in a non-invasive way. He had extensively used magnetic fields to manipulate and control wireless and soft-tethered meso-scale robots inside body cavities, such as the gastrointestinal tract and the abdomen. His research has been published in more than 45 peer-reviewed journal papers, and has recently received the "Best Technology Award" at the 19th International Congress of the European Association of Endoscopic Surgery and the "Best Oral Presentation Award" at the 2011 Hamlyn Symposium of Medical Robotics.