i-Snake surgical robot for minimally invasive surgery

Steve Taranovich - January 08, 2013

Minimally Invasive (or so called “Keyhole”) surgery was one of the great medical advances of the twentieth century, allowing sophisticated surgical operations to be carried out with little trauma. However, there are limits to the types of procedures that can be carried out this way. The new ‘i-Snake’ (which stands for imaging-sensing-navigated, kinematically enhanced), aims to provide a platform to extend the use of this surgical technique, breaking new ground across the fields of surgery and engineering.

The ‘i-Snake’ will incorporate state of the art imaging and intuitive manipulation technologies, allowing surgeons to carry out more complex and demanding procedures within the body, previously only possible using more invasive surgical approaches. The ‘i-Snake’ robot will use fully articulated joints powered by special motors, with multiple sensing mechanisms and imaging tools at its ‘head’, to extend the vision and dexterity of the surgeon, allowing them to navigate difficult and restrictive regions of the body.

Among the many possible applications of i-Snake are the clinical investigation of the alimentary tract, or complex, multi-vessel coronary bypass surgery. The cost benefits that the ‘i-Snake’ will introduce include earlier, cheaper and less invasive treatment, faster recovery and procedure times and intangible benefits through an increase in patient care and quality of life.

The project represents a unique cross-disciplinary collaboration within Imperial in imaging, sensing and robotics involving Department of Computing, Department of Surgery, and the new Institute of Biomedical Engineering. It also highlights the increasingly important role of medical image computing in reshaping the future of medical technology.

The paper, entitled 'An articulated universal joint based flexible access robot for minimally invasive surgery', introduced the key design features of the joint mechanism used by i-Snake. It incorporates a unique hybrid tendon-micromotor arrangement that enables fully controllable articulation of the robot while maintaining large inner channels for imaging probes and surgical instruments.

Dr Jian-Zhong Shang, who presented the paper at the conference, described the detailed
mechatronic design of the system, as well as results from animal experiments using the robot to perform surgical sterilization procedures. The IEEE International Conference on Robotics and Automation (ICRA) Best Medical Robotics Paper Award is sponsored by Intuitive Surgical to recognize outstanding work in the area of medical robotics and computer-assisted interventional devices and systems, with specific emphases on technological innovation and clinical efficacy.

Congratulating the team on the award, Professor Guang-Zhong Yang, Director of the Hamlyn Centre, said: "This is a great recognition to our multidisciplinary team who have been working hard to bring a bold engineering concept to reality. There are still significant hurdles ahead of us in translating our research results into routine clinical practice, but I am confident that this will happen in the near future."

The main focus of the Welcome Trust-supported i-Snake® research program is developing a fully articulated snake robot that integrates imaging and sensing to address key limitations of the current rigid instrument and laparoscope design of minimally invasive surgery. A range of challenging research issues are being addressed by the Hamlyn team, including joint articulation, integrated sensing, navigation and control, imaging inside live subjects, tissue characterization, motion tracking, and surgical navigation under active constraints.

By integrating imaging and sensing, the i-Snake® robot will potentially enable an expansion of applications for robotic-assisted minimally invasive surgery, for performing gastrointestinal, gynecological and, eventually, cardiothoracic surgery. The i-Snake® robot is expected to make significant advances in robotic surgery and ensure greater success in the development of future clinical robotic systems.

Phys.org has a good educational video on this topic also.