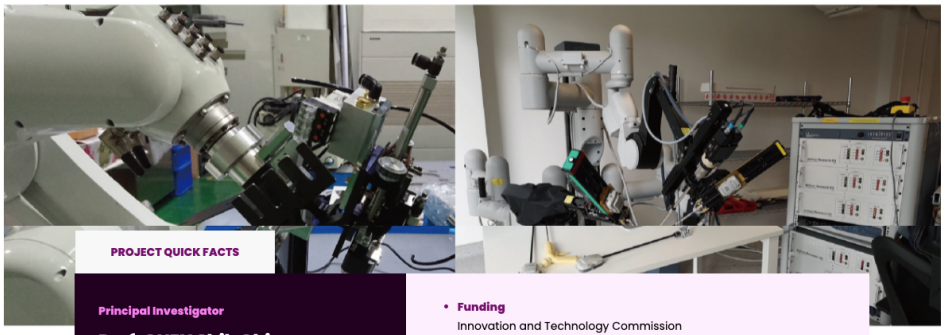
Advanced Vision and Sensing System for Next-Generation Medical Robots

#Treatment #Imaging #Advancedsystems #2019



PROJECT QUICK FACTS

Principal Investigator

Prof. CHEN Shih Chi

DEPARTMENT OF MECHANICAL AND AUTOMATION ENGINEERING

- **Funding**
  Innovation and Technology Commission
- **Collaboration**
  - Department of Surgery of CUHK, - Bluestone Medical Technology Limited, - ITE Engineering Limited, - Massachusetts Institute of Technology, - Semiconductor Equipment Manufacturing, Inc.

With the advancement of technology, medical robots have been widely adopted in many hospitals in Hong Kong and around the world. More and more conventional open surgical processes are replaced by robot-assisted minimally invasive surgeries. However, due to the lack of significant haptic feedback, accidents of robotic surgical systems have been reported occasionally. CUHK research team develops an innovative compact imaging and sensing system that can be integrated to different robotic systems, such as da Vinci Surgical System, to improve accuracy, flexibility and safety. It may reduce these preventable incidents in the future.

- The system includes a miniaturized high-speed optical coherence tomographic robotic vision system (OCTRVS) and disposable high-sensitivity flexible tactile sensor.
- OCTRVS allows real-time visualization of sub-surface 3D blood vessels with depths of 2 – 5 mm.
- Flexible tactile sensing technology provides high-sensitivity, real-time haptic feedback (pressure sensitivity of 2 kPa-1; force measurement range of 0-10 N), emulating a real surgeon's haptic feedback on robot-end effectors.

Uniqueness and Competitive Advantages:

- Fast, real-time, sub-surface 3D robotic vision system
- High sensitivity, true, real-time surgeon's haptic feedback
- Compact and Integrated modules

Applications:

The vision and electronic sensing system will be readily used and implemented on medical robotic platforms to increase precision, flexibility and safety of operation.

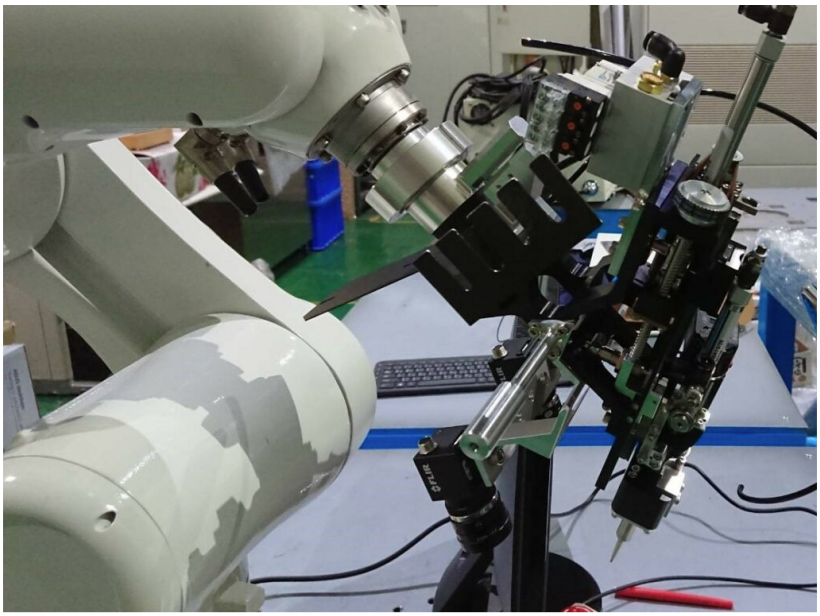
Example – Six-axis Hair Transplant Robot

The six-axis robot arm is selected to demonstrate the general applicability of the OCTRVS and tactile sensing system to any medical robotic systems. Specifically, we will develop a high-precision hair transplant robot based on the six-axis robot arm integrated with the OCTRVS vison system.

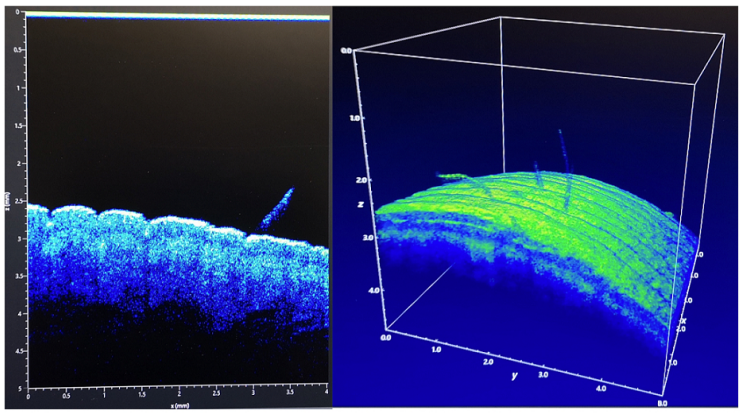
The OCTRVS system can perform real-time sub-surface imaging for a depth of 2 – 5 mm, it can directly locate the hair follicle in the scalp instead of prediction. With our new system, the six-axis robot arm can carry the OCTRVS system to scan the scalp contour and provide a 3-D hair follicle map.

Target Users:

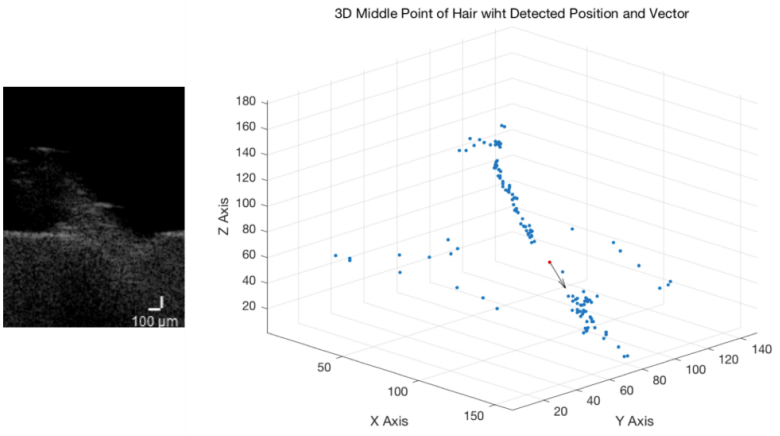
01 Local hospitals 02 Clinics and cosmetic institute 03 Cosmetic and surgical robot producers



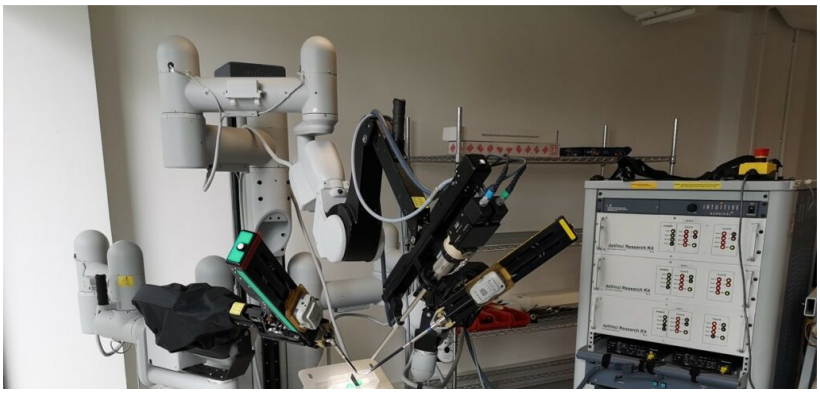
Hair transplant robot with OCTRVS integration



Images of OCTRVS for human body skin surfaces and sub-surface. The hairs and follicles have been identified



2D Images of OCTRVS for human hair in skin surfaces and sub-surface (left one). The hair's position and vector have been identified by our algorithm shown in right image.



Further OCTRVS integration with Da Vinci surgical robot

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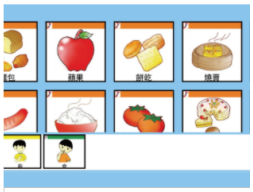

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