Research topics for graduate students for 2025

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Acceptable course(s)

- Master's Degree
- Doctoral Degree

Research Topics

We are addressing robotics technologies for sophisticated micromanipulation or precise measurement by using micro/nanomechatronics, MEMS, and microfabrication. The scope of the research is fundamental to the innovative functionality and system integration at the micro/nanoscale. The applications are surgical/medical robots, intelligent robots and industrial robots.

1. Quartz Crystal Resonator Force Sensor for High-speed Application

QCR Force Sensor exhibits unique characteristics such as high rigidity, high force sensitivity and high dynamic range. In addition to the potential performance, we have recently challenged the high response bandwidth of the QCR force sensor. The design of the sensor element and mechatronic system for high-speed application is fruitful for industrial application.

2. Multi-axis Quartz Crystal Resonator Force Sensor

Sophisticated robotic manipulation using a multiscale force signal would be achieved by exploring the high dynamic range characteristics of the QCR force sensor. The optimal sensor design and implementation into strain body would exert low interdimensional coupling error, which has never been achieved by the conventional force/torque sensor.

3. Variable Stiffness Shape Memory Polymer Actuator to Exhibit the Functional Reconfigurability.

Thermal control of the shape memory polymer by using CNT-based stretchable heating electrode can configure the variable stiffness structure, which offers the functional reconfigurability of the robot body such as switching of the hinge, the rigid arm, anchor, elastic latch and so on. The challenge is to achieve an excellent adaptability and versatility of the robot.

Articles Related to Research Topics

[1] Yuta Taniguchi et., al, A force measurement platform for a vitreoretinal surgical simulator using an artificial eye module integrated with a quartz crystal resonator, Microsystems & Nanoengineering 8, 74, 2022

[2] Hirotaka Sugiura et., al, Characterization of the variable stiffness actuator fabricated of SMA/SMP and MWCNT/IL:PDMS strain-sensitive heater electrode, IEEE Robotics and Automation Letter, 2022.3194875, 2022

[3] Kazusa Otani et., al, Robotic capillary insertion to the Xenopus oocyte using microscopic image analysis and QCR force sensor, IEEE International Conference on Robotics and Automation (ICRA2024), Yokohama, 2024.

Lab. Web page: https://www.biorobotics.t.u-tokyo.ac.jp/