

# Introduction of Laboratory

## FUJIMOTO Lab

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### 1. Preface

Fujimoto Lab takes charge in Robotics & Automation Lab of the electronic mechanical field in the mechanical program of the Department of Mechanical Engineering. Mainly graduate students of computer science and engineering and engineering physics, electronics and mechanics and undergraduates of mechanical engineering belong to this lab and carry out the research. Moreover, this lab works in cooperation with 2 contribution laboratories included in the department of Mechanical Engineering and the total number of the staff and students are more than 90.

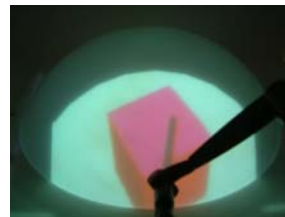
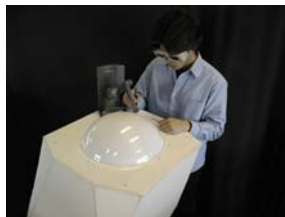
In this paper, Human-Centered Robotics, Medical Engineering Research Project, Initiation of Craft Skills of Ceramics, and Eco-Robot Project among the research themes of Fujimoto Lab are described.

### 2. Human-Centered Robotics

Research on sensor, display, tele-operation system, and robot such as those display something to human, operated by human, and imitate human taking account of human.

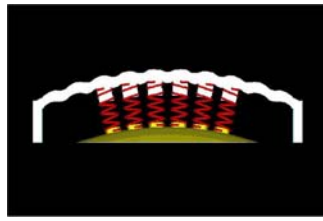
#### Micro-Dome Display

A dome-shaped backward projection display was developed. Stereoscopic vision can be realized by using crystal liquid shutter goggles together with head tracker. An object in the dome can be manipulated instinctively by using virtual tool.



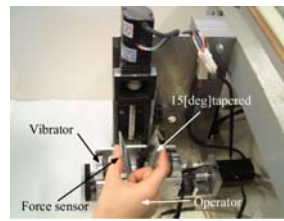
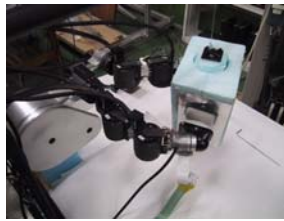
#### Soft-Finger Tactile Sensor

A soft-finger tactile sensor that can detect sense of slipperiness was developed by modeling human fingers. A soft sensor can be realized by combining spring, silicon gel, and silicon rubber.



### **Multi-Fingered Robot Hand for Teleoperation**

Using robot hand equipped with soft-finger-sensor and master robot with ultrasonic display of slipperiness, a master-slave system that can transmit slipperiness and touch senses was developed.

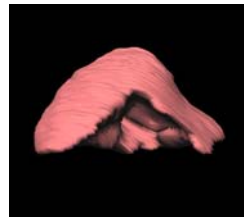
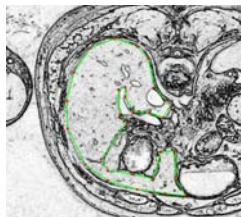


### **3. Medical Engineering Project**

Recently, various medical engineering research projects such as developments of medical education training system or support system for surgical operation have been carried out in cooperation with the medical school in this region. Also Medical Engineering Lab was established in NIT aiming to raise fund for projects, create a new industry, and set up a global base with cooperation of enterprises.

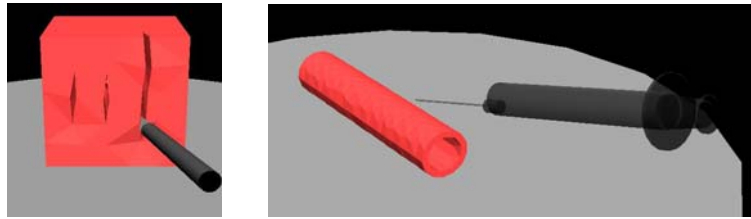
### **Modeling of Organs and Force Simulation of Deformation**

Shape modeling of living soft bodies such as internal organs and muscles based on CT data, and real-time simulation of force and deformation in cutting and insertion using finite element model are carried out.



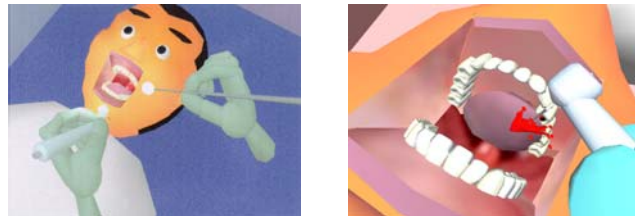
### **Virtual Surgical Operation Simulator**

Using deformation force simulation with finite element model, virtual surgical operation simulator is constructed. By manipulating interactively the soft object that is displayed stereographically with feeling reaction force, training for basic skills of surgical operation and image training for doctors before operation can be realized.



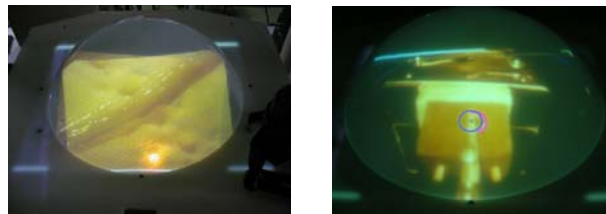
### **Training Simulator for Dental Treatment Education**

A simulator for training to use a dental instrument for drilling teeth was developed. Since to obtain delicate force sense called *feather-touch* that is essential to drill teeth requires repeated practice, feedback and visibility of force is possible with this simulation. Moreover, by reflecting unexpected motion of a patient and bloodshed in case of cutting tongue, higher presence compared with conventional manikin is realized.



### **Assist for Suture with Force Feedback**

A surgical operation assist system using force-display master device, and slave robot for surgical operation was developed. Support for suture is realized by magnifying capillary vessels, displaying an invisible edge of a needle and suturing spot by computer graphics (Mixed Reality), and displaying guide force.



## **4. Tradition of Potter's Skill of Ceramics**

By developing 3D movies in a way of measuring the movements for ceramics that requires high degree of craft skills and developing teleoperation system for ceramics using master-slave robot, development of system for preservation, tradition, and experience of potter's skills, and suggestion of a new force art have been made.



## 5. Eco-Robot Project

Development of multifunctional fish-type eco-robot that purifies the environment of the river which runs through the city is carried out in cooperation with other departments such as chemistry or environment and local community aiming to develop robots that carry out water-measuring and water-improvement.



## 6. Conclusion

Wide range of research and development on medical engineering, force tactile, tradition of craft skills, etc based on robot engineering and VR technology are carried out.

Please refer to web site of the lab for further information.

URL: [http://www.mech.nitech.ac.jp/~fujimoto/fujimoto\\_lab.html](http://www.mech.nitech.ac.jp/~fujimoto/fujimoto_lab.html)

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