Hanoi Institute of Technology
Hanoi, Vietnam, Dec. 20, 2008

Department of Robotics
Ritsumeikan University

Shinichi Hirai
Dept. Robotics
Ritsumeikan Univ.

http://www.ritsumei.ac.jp/se/rm/robo/index-e.htm

Department of Robotics

Established at 1996

Faculty members (2008)

A.Ishii	T.Isaka	
R.Ozawa	S.Kawamura	
N.Tejima	K.Nagai	
M.Nokata	S.Hirai	H.Maeda
M.Makikawa	S.Ma	

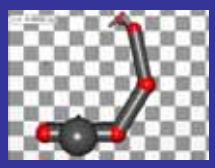
Education & Research on Robotics, Machine Intelligence, and Human Science

Laboratories

Human Robotics	Kawamura Isaka
Biomimetic Robotics	Ma
Intelligent Robot	Maeda
Vision Systems	Ishii
Biophysical Engineering	Makikawa
Machine Intelligence	Hirai
Rehabilitation Engineering	Tejima
Robotics	Nagai
Life-Support Mechatronics	Nokata
Manipulation	Ozawa

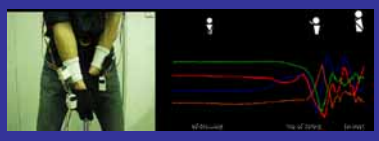
Human Robotics Lab.

Control of Soft-fingered Robot Hand



Control of Redundant Systems – Challenge to Bernstein Problem

Biophysical Engineering Lab.



Human Motion Measurement in Sports

Virtual Walk-through

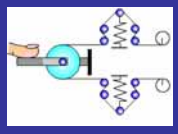
Life-Support Mechatronics Lab.

Magnetic Drive of a Medical Micro Robot

Micro Forceps for Catheter

Micro Pneumatic Hand

Manipulation Lab.



Tendon-driven Mechanism

Blind Grasping and Manipulation

Orthosis using Passive Pneumatic Devices

Related Research Centers

Research Center for Robotics and Flexible Automation

Research Center for Sports and Healthcare Technology

Research Institute for MicroSystem Technology

VLSI Center

SR (Synchrotron Radiation) Center

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Laboratory for Integrated Machine Intelligence

Shinichi Hirai
Dept. Robotics
Ritsumeikan Univ.

http://www.ritsumei.ac.jp/se/~hirai/

Robotics

Intelligent connection from perception to action (Winston, Brady 1980)

Scope of Laboratory

Machine intelligence based on mechanics

Related technology of sensors and actuators

Members

1 Research associate

2 Ph.D candidates

12 Graduate students

10 Undergraduate students

Collaboration with Osaka Univ., Sapporo City Univ., Okayama Pref. Univ., and industries.

2007 activity summary

Journal papers	
ASME J. Dyn., Meas., and Control	1
Int. J. Automation Technology	1
Conference papers	
IEEE ICRA	4
IEEE/ICME Complex Medical Eng.	1
Robotics: Science and Systems	1
IEEE/ASME AIM	4
IEEE Int. Conf. Automation Sci.	1
IEEE/RSJ IROS	2

Workshop organizer

Workshop on Modeling, Identification, and Control of Deformable Soft Objects

2006 activity summary

Journal papers

Int. J. Robotics Research	2
IEEE Trans. Robotics	1
IEEE/ASME Trans. Mechatronics	1
J. Robotics and Mechatronics	1

Conference papers

IEEE ICRA	4
Int. Symp. Experimental Robotics	1
IEEE/RSJ IROS	2
IEEE Sensors	1

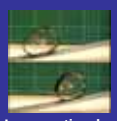
Awards

- 2006 ICRA Best Manipulation Paper Finalist
- 2006 ICRA Best Vision Paper Finalist

Current Research Issues


CMOS+FPGA vision


Soft-fingered manipulation


Locomotion by deformation


Virtual rheological object


Loosely coupled joint

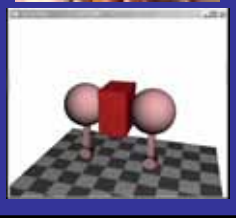

Linear object manipulation


Vibrational pneumatic valve

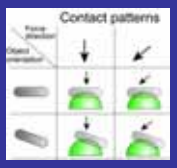

Micro parts feeding

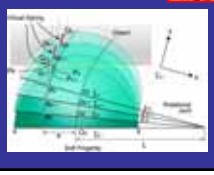
Soft-fingered Manipulation

2002-



Soft-fingertip Model

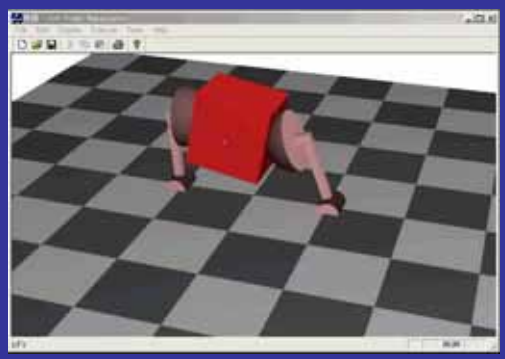




Rigid vs. Soft fingertips

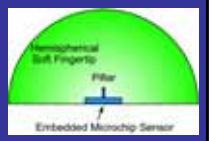
	Hemispherical rigid fingertips	Hemispherical soft fingertips
stable grasping	A pair of 1-DOF fingers (2DOF)	A single 1-DOF (1DOF)
stable grasping & posture control	1 DOF and 2-DOF (3DOF)	A pair of 1-DOF fingers (2DOF)

Simulation

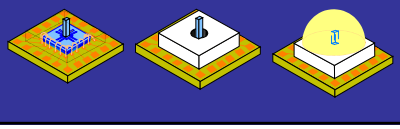


Embedded Force Sensor for Soft-fingered Manipulation

2003-



Micro 6-DOF force/moment sensor



Crawling and Jumping of Deformable Soft Robot

2003-

charge/discharge of potential energy stored in deformable body

Principle

Charge/Discharge of Potential Energy

Stable | Unstable | Stable with high energy

Externally/internally powered

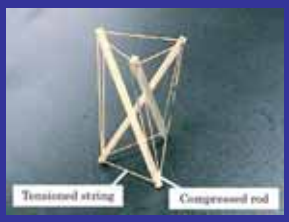
Robot I on flat ground

Robot II on flat ground

Robot I on slope (10 deg)

Robot II on slope (10 deg)

Tensegrity robots



Consists of rigid rods and extensible strings

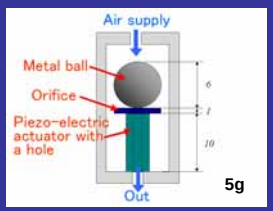
Can select body size and body stiffness independetly

Rolling of tensegrity robot

Can roll by reducing distance between two rods

Vibrational Pneumatic Valve

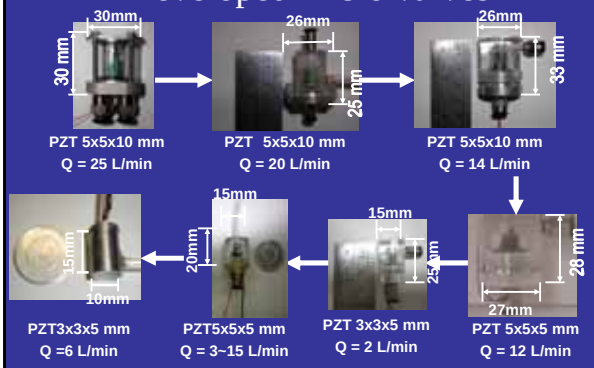
2002-



No structural constraint between a poppet and an hole

Driven by PZT actuator

Developed micro valves



Micro Parts Feeding

2002-

2012 (2.0mm x 1.2mm) through
0402 (0.4mm x 0.2mm) capacitors

Motion driven by symmetric vibration

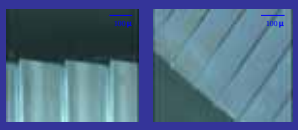
Saw-teeth surface realized unidirectional motion

Feeding of chip condensers

Selective feeding

Unidirectional feeding

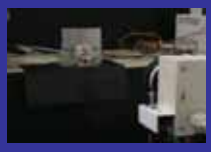
Asymmetric surface



Symmetric vibration
sinusoidal or square

CMOS+FPGA Vision

2004-



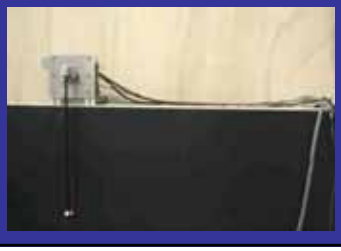
x (1/30)

Visual feedback at 1,000fps
from 1024x512 pixel images

1,000 fps visual feedback

Without visual feedback

With visual feedback



Light-weighted,
thin robots

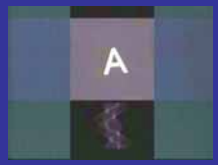
FPGA-based Vision

2001-

Time Consuming Algorithms
- Matched Filtering
- Phase-Only Correlation
- Hough-Fourier Transform Method
- Generalized Hough Transform
- Argument Voting Method

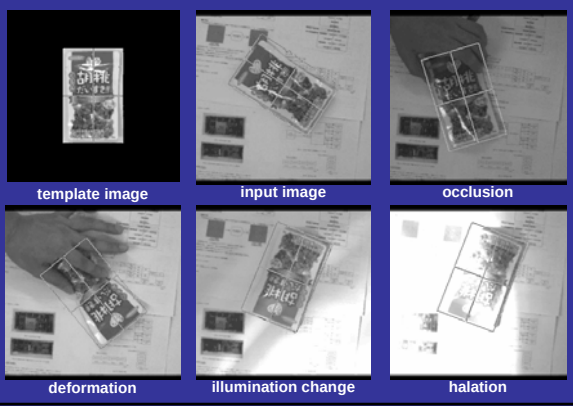
Implementation on FPGA to reduce computation time in good cost performance

matched filtering



Radon transform

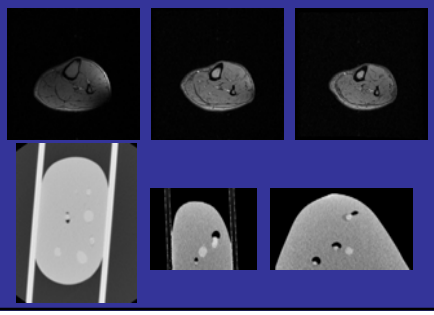
Robust Image Registration



Modeling of Biological Objects

2004-

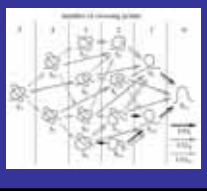
Building deformation model of biological tissues through MRI or CT imaging



Linear Object Manipulation

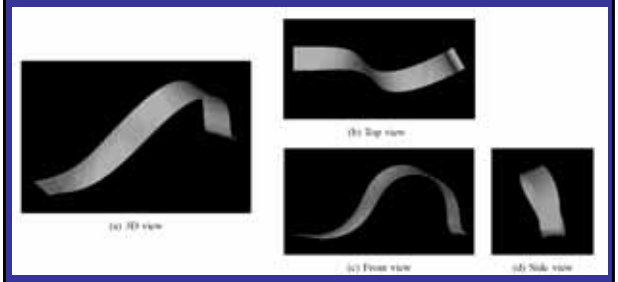
2000-

Differential geometry coordinates

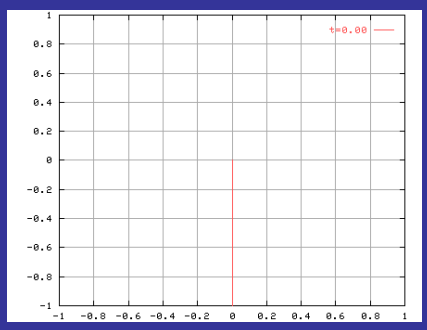


Knotting/Unknotting of DLO

Modeling of Band Object Deformation



Dynamic modeling of DLO



Thank you for your interests

See
http://www.ritsumei.ac.jp/se/~hirai/
for details