



USJI Seminar Sept.12, 2011

# Technology against Disasters

Shuji Hashimoto

VP, Waseda University

Humanoid Robotics Institute,

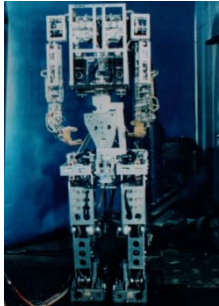
Faculty of Science and Engineering,



# Contents of the Talk

- Self-introduction
  - Robots in Waseda University
- Shock of March 11
- Future of Science and Technology

# Waseda Robots Since 1970



1973 : WABOT-1



1984 : WABOT-2



Mowing Robot  
(Hashimoto)



ROBISUKE(Kobayashi)

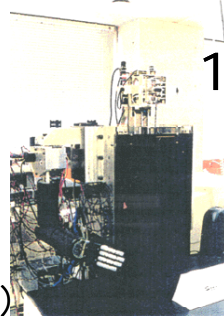


MR assistant robot(Fujie)

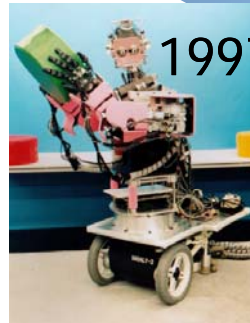
## 1992 : Humanoid Project Started



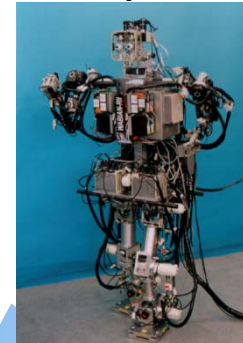
Museum Roboto(Hashimoto)



1995 : Hadaly-1



1997 : Hadaly-2



1997 : WABIAN



TWENDY-ONE  
(Sugano)

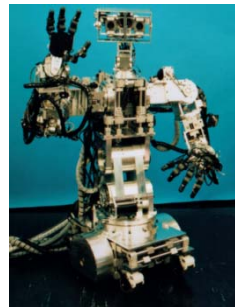
## Humanoid Robotics

### Institute

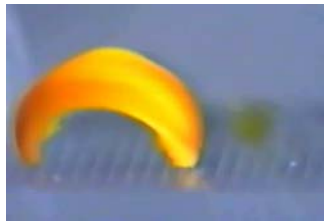
2000



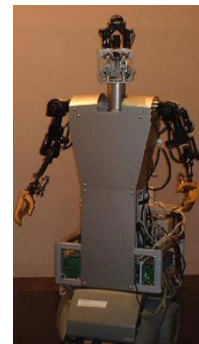
Bugnoid(Hashimoto)



WENDY(Sugano)



Chemica Robot  
(Hashimoto)



iSHA(Hashimoto)



WABIAN II(Takanishi)



WABOT-HOUSE



©WASEDA UNIV.



# About my laboratory

## SHALAB

established in 1991  
at Dept. of Applied Physics



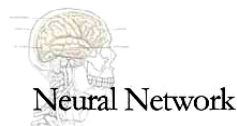
### Vision and Image Processing Group

- Facial Image Processing
- CG and Visual inspection
- Database and Data visualization



### Multimedia Processing Group

- Sound Creation
- Advanced musical instruments
- Sound database



### Meta Algorithm Group

- Neural Network / Genetic Algorithm
- Reinforcement Learning
- Stochastic optimization



### Robotics Group to integrate all

- Humanoid robot / autonomous robot
- Robot vision / map building robot
- Robotic interface



# Robot applications

- Secondary industries : Industrial robot
  - Machine and materials
- Primary industries: Agriculture robot
  - Machine and natural environment
- Tertiary industries: Service robot
  - Machine and human
  - One of forth of the population are aged people

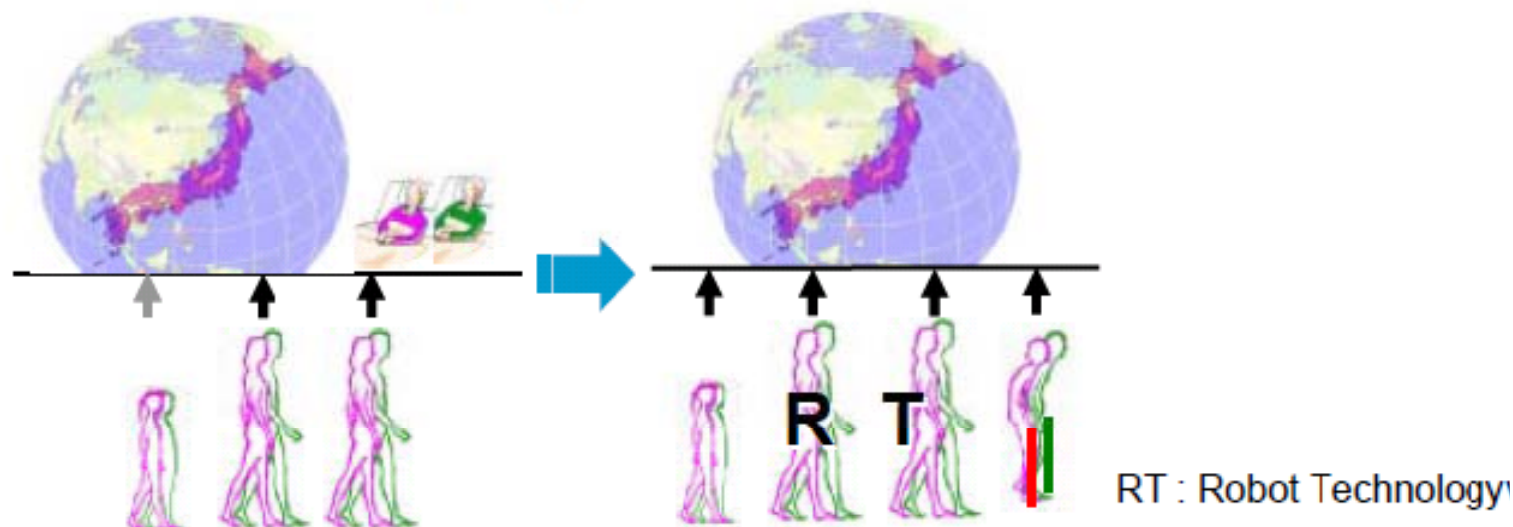


# Directions of robotics

- Beyond production machine
  - Robot in human living environment
- Beyond software simulator
  - Robot as a sensor-actuator complex
- Beyond GUI
  - Robot as an information terminal
- Beyond multimedia
  - Robot as an embodied media

# 21th Century Center of Excellence program 2003-2007 FY

Create new society supported by all generation



## Education

“Creative researchers” who are rich in progressive characteristics  
“Practical advanced engineers”

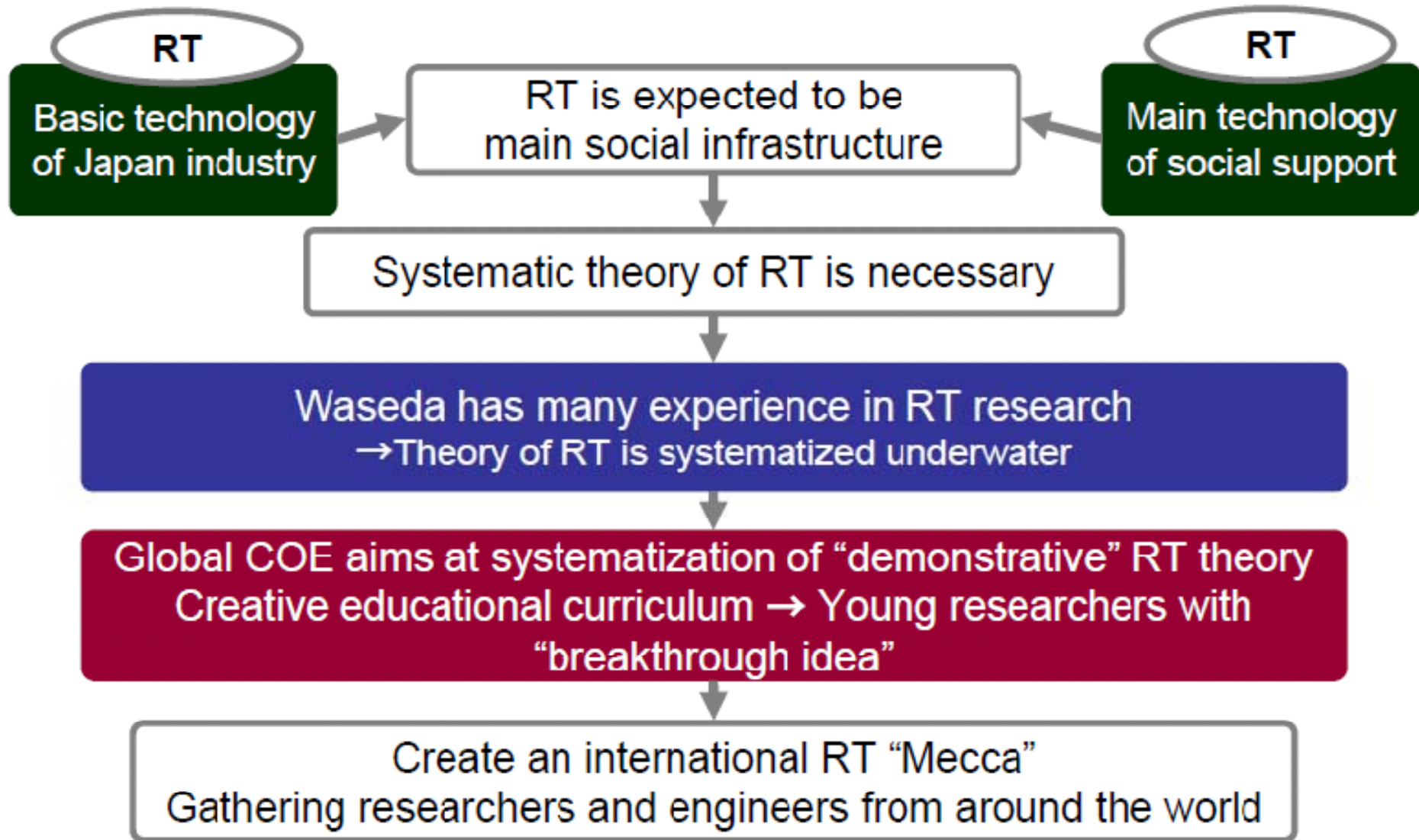
## Research


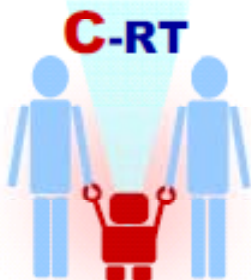

Establish “next-generation robotics”

1. Surgical support robot system
2. New mobility for elderly
3. Life support system for elderly
4. Agriculture support robot system
5. Robotics basic theory and elements

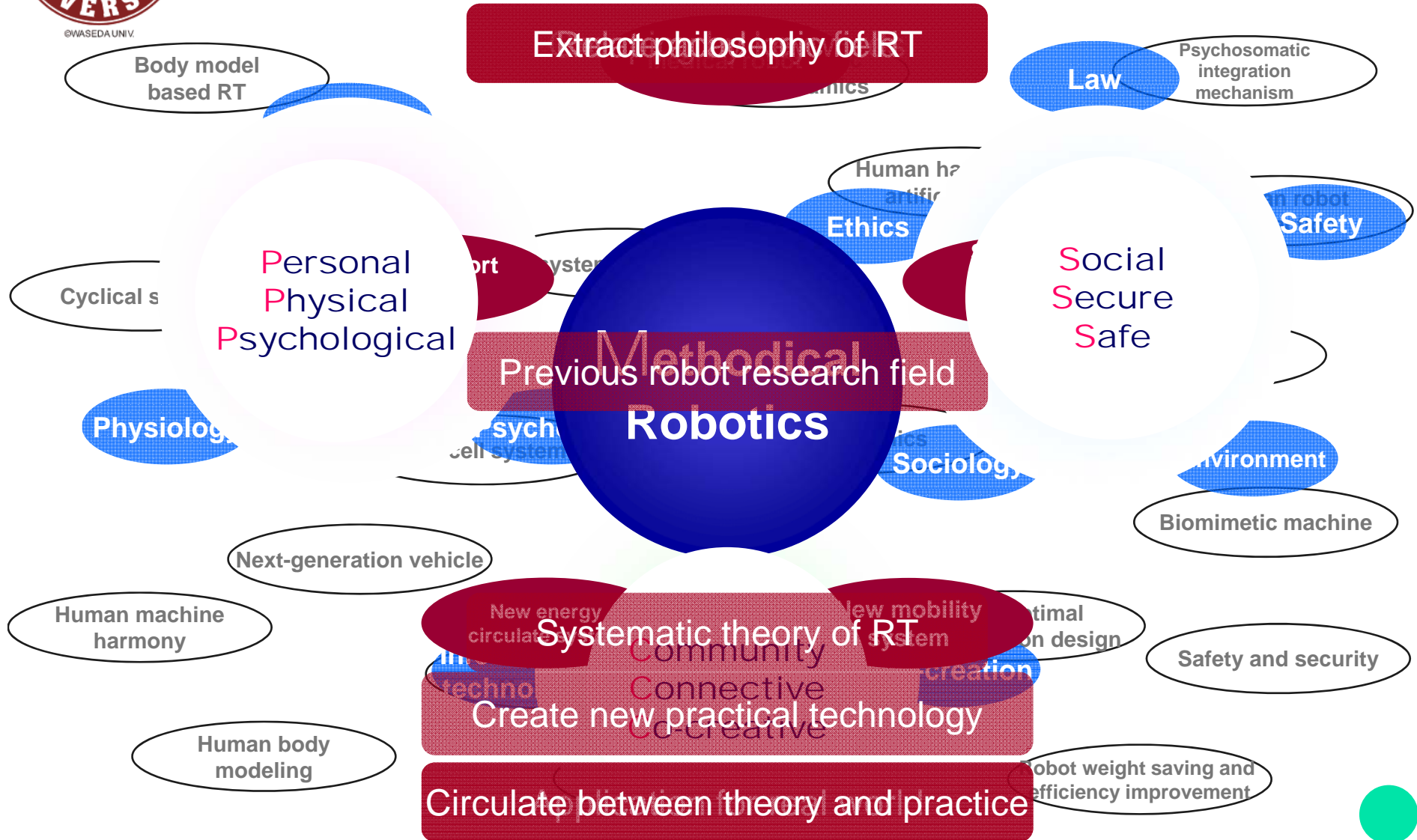


# Objective of Global COE



<b>P-RT</b> Group	<b>C-RT</b> Group	<b>S-RT</b> Group
<b>Personal</b> <b>Physical</b> <b>Psychological</b>	<b>Community</b> <b>Connective</b> <b>Co-creative</b>	<b>Social</b> <b>Secure</b> <b>Safe</b>
for individual	for plural	for numerous people
		
Fusion of engineering field and medical, biology, psychology and brain/neuroscience field	Based on informatics and emergence engineering	Collaborate with social & environment science, ethics, safety engineering
Basic technology : mechanical, material, electrical, electric and control engineering + informatics		

# Systematic theory (Methodical Robotics)

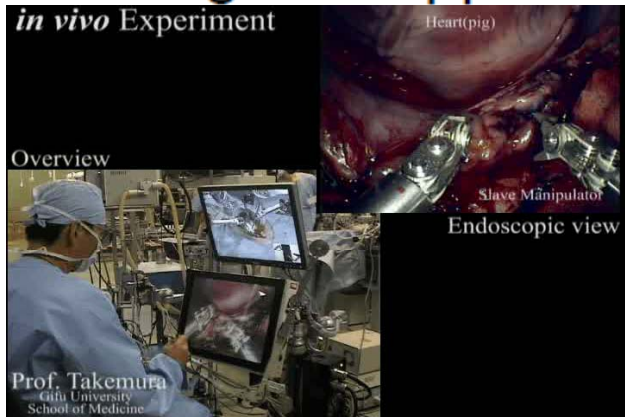




# COE research activities



## Surgical support robot system

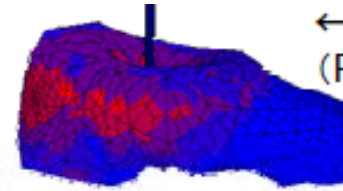


Heart surgery robot (Fujie)

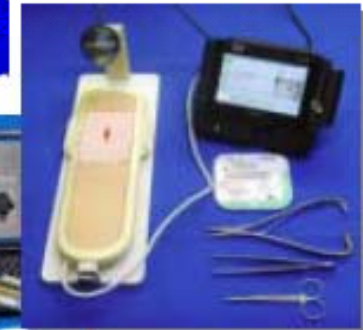


MR guidance surgery robot (Fujie)

"The robot awards" 2007



←Dynamic liver model (Fujie, Yamakawa)



Tracheal intubation & suture evaluation system (Takanishi)

## New mobility for elderly



Tread Walk (Fujie)

2008/9/1



Fuel-cell wheel chair (Nagata, Katsuta)

Special zone in Fukuo (Fujie, etc..)

Biped robot chair (Takanishi)→

Electric community bus (Daisho)





# COE research activities



## - Life support systems

### WABOT-HOUSE

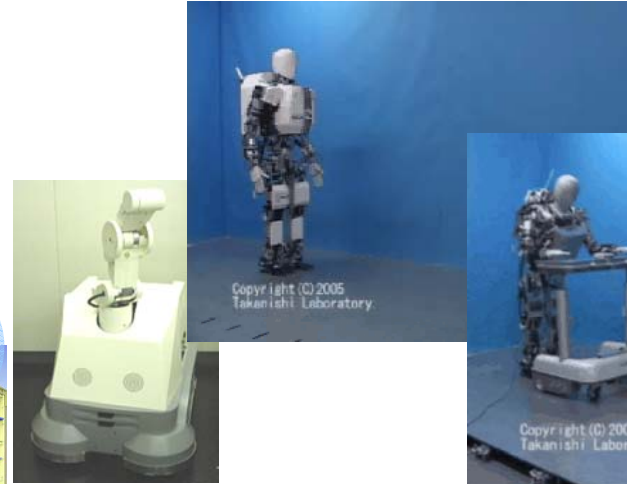
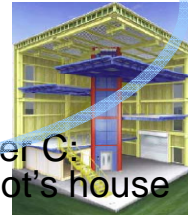
Tower B:  
Human-robot  
co-existence house



Tower A: Human's  
house



Tower C:  
Robot's house



RFID guidance robot  
(Sugano, Hashimoto)



Simulate elderly walking  
(Takanishi) **Aichi Expo'05**



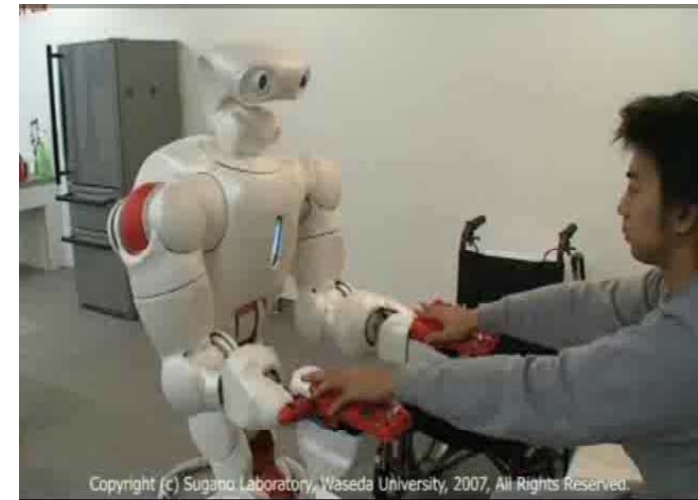
Mobile agriculture  
support robot  
(Hashimoto)



Tree climbing and  
pruning robot  
(Sugano, Miwa)  
**Aichi Expo'05**



Rope guidance  
mobile robot (Miwa)

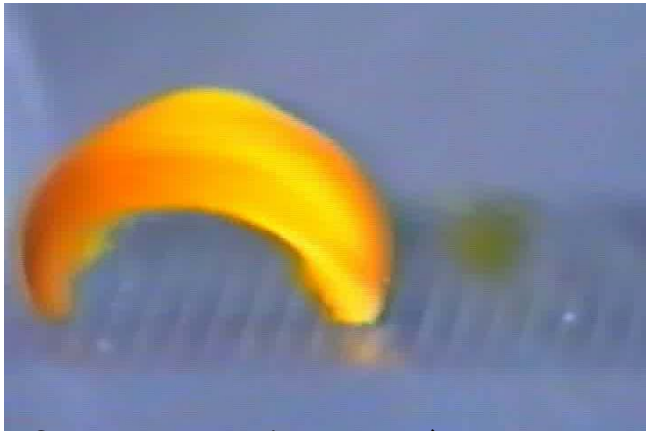


TWENDY-ONE  
(Sugano)

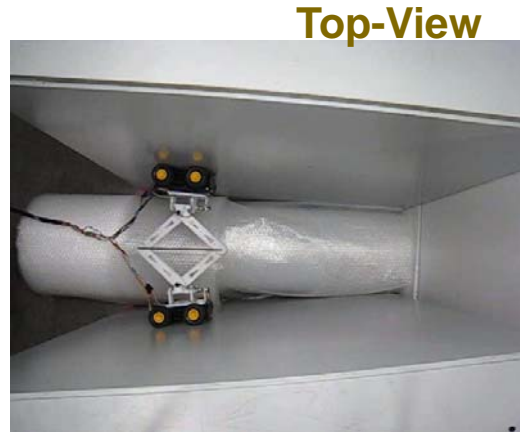


# COE research activities

## - Basic Technologies



Chemical Robot (Hashimoto)  
 ISSP Gel Sympo Poster Award, 2007  
 IEEE IROS Hewlett-Packard Most Innovative Paper Award, 2007

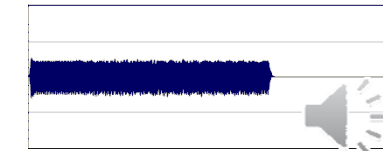
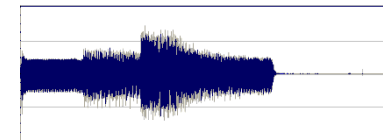


Top-View

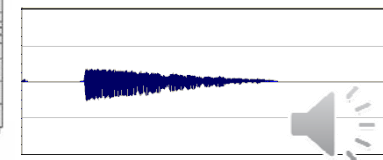
Vertical Narrow Space Robot (Hashimoto) 2010



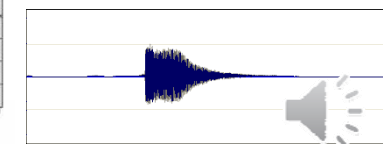
Mixed input



Separated 1

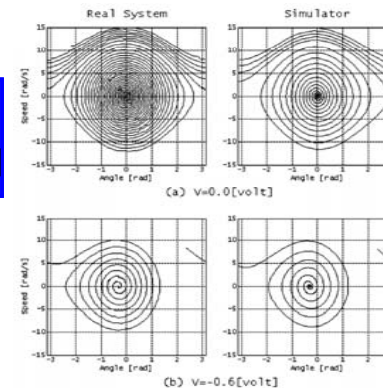
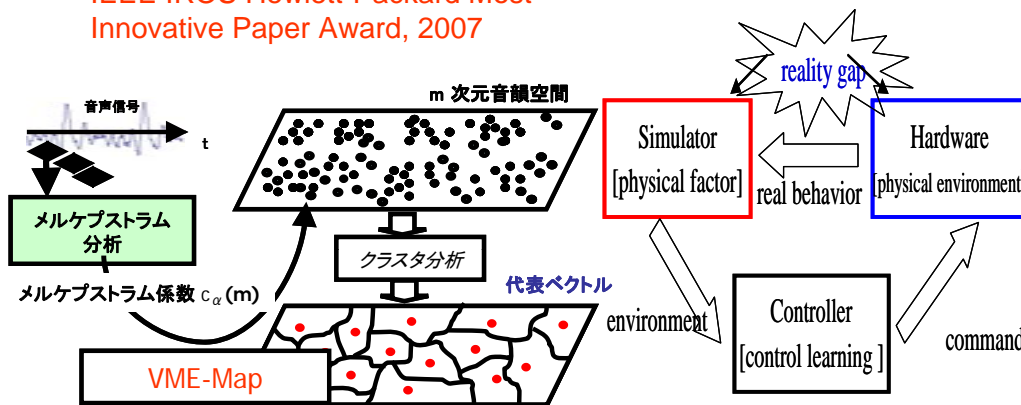


Separated 2



Separated 3

Monaural Sound Separation (Hashimoto 2008)



Language Acquisition Learning (Hashimoto)  
 Awarded at IISJP Conf. 2006

Physics Based Hybrid Machine Learning (Hashimoto)  
 ISIS & SCIS Session  
 Best Presentation Award, 2006



# Robotics Research for Future

- Show-time is ending
  - Safety, Secure, Low-energy consumption
- 24hours nonstop operation
  - All-weather
- No license required
  - For anyone, anytime, anywhere
- Extended RT
  - Environment, Tool, Furniture
- Fusion with IT
  - RFID、GPS, Internet



# March 11, 2011

- Shock of March 11
  - What happened ?
  - What are happening ?
  - What will happen ?



# Sumatra

2004, M9.1, Killed 220,000



[http://ja.wikipedia.org/A\\_village\\_near\\_the\\_coast\\_of\\_Sumatra\\_lays\\_in\\_ruin\\_after\\_the\\_Tsunami\\_that\\_struck\\_South\\_East\\_Asia.jpg](http://ja.wikipedia.org/A_village_near_the_coast_of_Sumatra_lays_in_ruin_after_the_Tsunami_that_struck_South_East_Asia.jpg)



# Haiti

2010, M7, Killed 220,000

WASEDA UNIV.  
HRI



<http://www.aichi.jrc.or.jp/news/entry-369.html>

(C) Matthew Marek/American Red Cross



# Hanshin-Awaji

1995, M7.3, Killed 6,600



[http://www.kkr.mlit.go.jp/hanshin/mati/photo/photo\\_01.html](http://www.kkr.mlit.go.jp/hanshin/mati/photo/photo_01.html)



# East Japan 3.11

2011, M9, Killed >20,000



<http://www.yukawanet.com/archives/3602393.html>



<http://blog.goo.ne.jp/zen-en/e/3046632663a5365163a4baaf6aca15c8>



# Earthquake disasters

- Sumatora: 2004, M9.1, Killed 220,000
- Haichi: 2010, M7, Killed 220,000
- Hanshin-Awaji: 1995, M7.3, Killed 6,600
- East Japan: 2011, M9, Killed >20,000

**What dose “advanced country” mean ?**



# For the future of humankind

System as a surrogate of human

System to extend human ability

System to enhance humanity

Human with artificial systems:

What will be realized ?

Where human will go ?



# Different phases to Science and Technology against Disasters

- Before the disasters
  - foresight, prediction, forecasting, foretell
    - signal processing, measurement, knowledge eng.
- In the middle of the disasters
  - fail-safe, steps to minimize, emergency functions
    - maintenance, management, operation eng.
- After the disasters
  - restoration, revival, preparation for future
    - planning, learning, understanding, philosophy



# Science and Technology for “Never Again”

- Robust society
  - Natural science
    - Observation, analysis, understanding
  - Engineering
    - Infrastructure, physical effect, IT+RT
  - Cultural science
    - Individuals, mind and body
  - Social science
    - Policy, social system
- Civilization, Industrialization, Culture
  - Sustainable happiness
  - Security control technology and strategy



## Center for Research on Reconstruction from the Great East Japan Earthquake, Waseda University

- **Director : Prof. Yoshiaki Fukazawa,  
Waseda University Executive Director**
- **Recovery from large-scale disaster and  
construction of a new social system**



# Research Projects

## 1. Medicine and Health Care:

- Research on the needs for scientific/social support and administration toward the prevention of health damage caused by earthquakes.

## 2. Infrastructure Restoration and Disaster Management Systems:

- Disaster analysis and proposal for rehabilitation process for the Tohoku earthquake and tsunami
- Environmental diagnosis and proposal of countermeasure technology for restoration and reconstruction from the Great East Japan Earthquake
- Research related to causes, effects, measures and restoration for complex mega disasters; Nuclear disaster and risk governance

## 3. Urban Planning and Social Design:

- General study on housing and urban planning for reconstruction incorporating harmony with and respect for nature
- Waseda University Legal Aid Project for Eastern Japan Earthquake
- Rebuilding a new global social system resilient to large-scale disasters



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# Technology against Disasters

- Shuji Hashimoto (Waseda Univ.)
- Dr. Martin Buehler (iRobot)
- Mr. Roy Rondoe (iRobot)
- Dr. Steven L. McCabe (NIST)