# Bio-Robotics & Human-Mechatronics Laboratory

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*Keywords:* Robotics & Mechatronics, System Integration (SI), Mobile vehicle, Human-symbiotic/Human-synergetic, User-friendly, Human-Machine physical/informative interaction, Ambient-Ubiquitous-Ordinary (AUO) Engineering

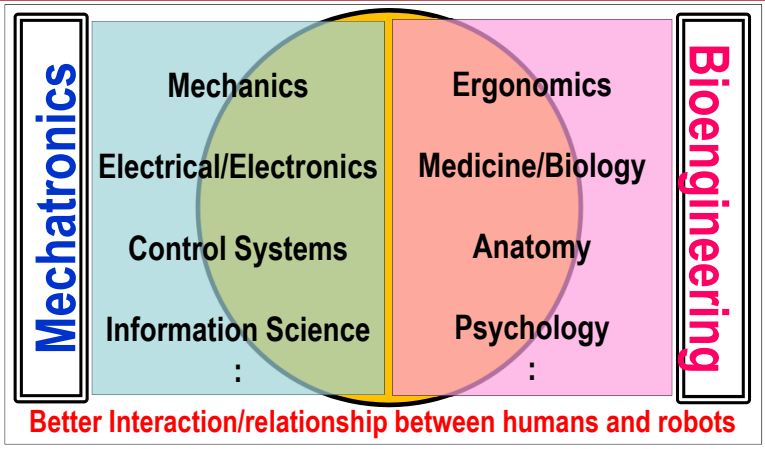


## Goal/Purpose

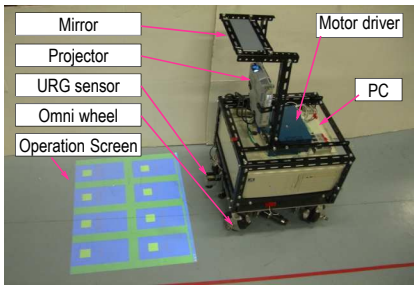
Tackling a broad range of issues related to human-robot symbiosis/synergism by means of mechatronics technology in simulation and physical implementation

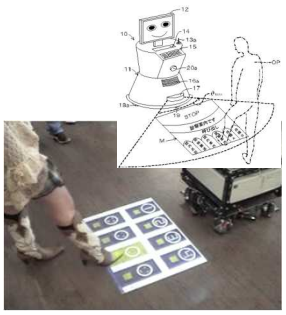
## Approach

- Proposing and developing new features/architecture, with demonstration in simulated and real world environments
- Building systems while integrating broader knowledge and relevant technology
- Emphasis on collaborative work and team communication

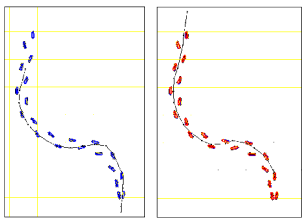



## Step-on Interface (SOI)

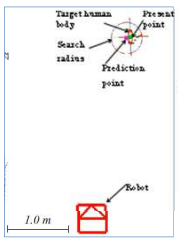


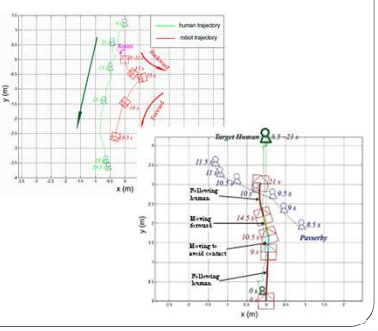



## Walking Training mobile robot (Customizable trajectory)




## Human detection/following robot (considering mobility)

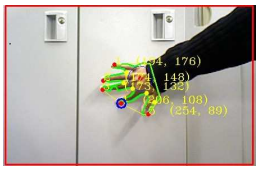


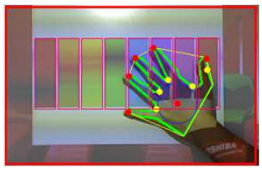
Laser range scanner

Ellipse fitting

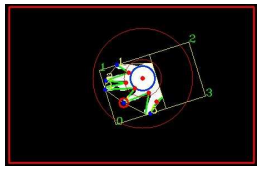
## Hand/finger recognition & Touch detection (Virtual musical instrument)



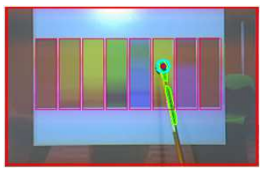
Hand/finger



Key board

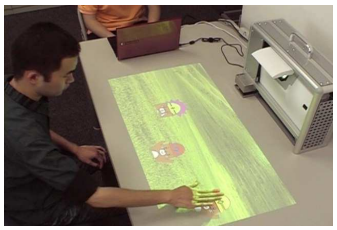


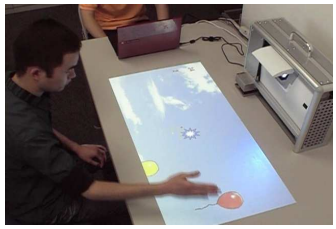
Touch

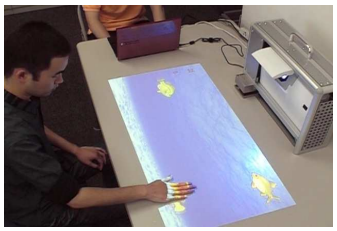


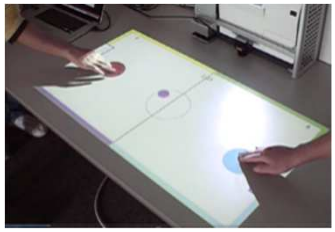
Xylo-phone

## Image-projective Desktop Arm Trainer (IDAT) (Mole/Balloon/Fish/Air Hockey)

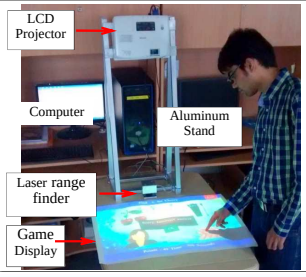


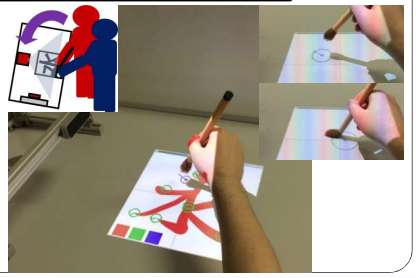






## Education/Learning System (Literacy-alphabet/Calligraphy-brush stroke)



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# バイオ・ロボティクス＆ヒューマン・メカトロニクス研究室

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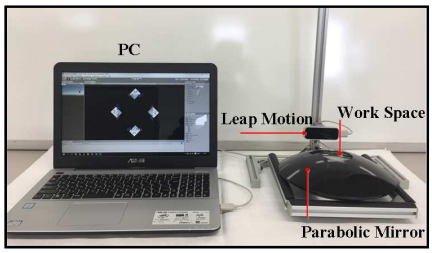
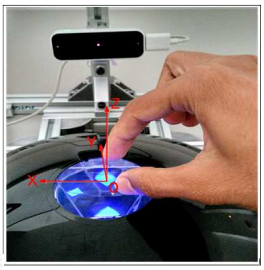
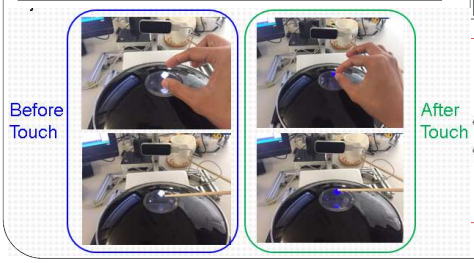
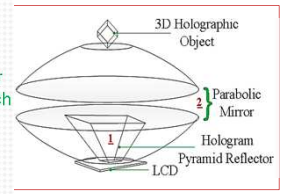
## ◆ 3D Aerial Holographic Image Interface (3DAHII)





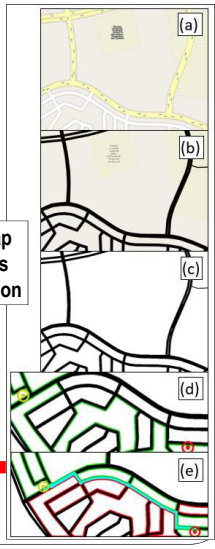

## ◆ Outdoors Path Planning for Mobile Robots

**Navigation of mobile robots in semi-structured outdoor environments**

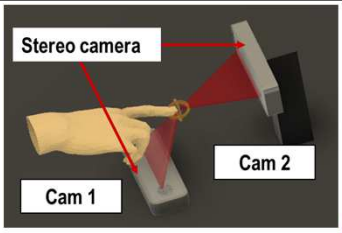
- Without pre-driving recording (i.e. SLAM)
- Using network-provided maps (i.e. OpenStreetMaps)
- Contextual awareness for navigation (vision, location)

Mobile Robot Testing Platform

2D Internet Map Edge Analysis & Path Formation



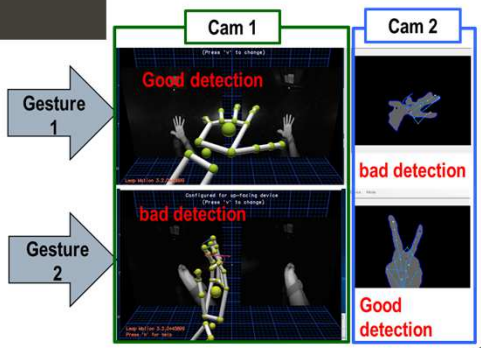

## ◆ Precise Hand Pose/Gesture Capture




**Purpose**

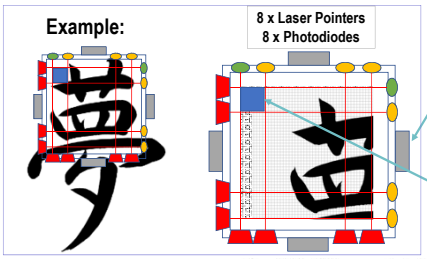
- Usage of a multi-camera setup
- Accurate identification of hand pose
- Overcoming incorrect detections due to poor viewing angles

Example hand gestures




## ◆ Dynamic Precise Localization of Multi-Mobile Robots in 2D Plane

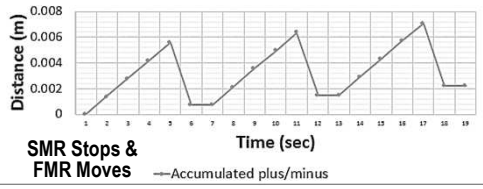
SMR: Small Mobile Robot
FMR: Frame Mobile Robot




Omni-wheel

SMR

Simulated Accumulated Error




## ◆ Robot Arm Manipulation with Machine Learning in Simulation

**Robot Manipulator:**

- 7 DOF Kuka Arm
- Barrett Hand

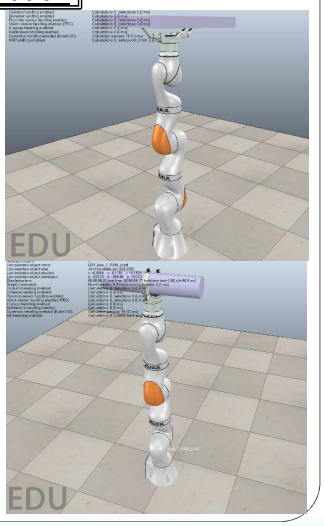
**Study Contents:**

- Arm joints' impact on hand finger joints while operating with objects
- Stable object holding by hand under impacts

**Training Methods:**

- Reinforcement Learning (Q-Learning)
- Neural Networks

v-rep player



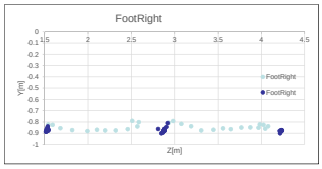

## ◆ Human Gait Characterization

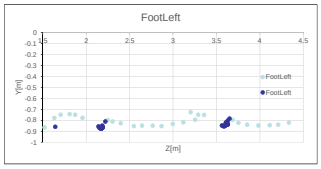
**Problem Definition**

- Dependence on certain devices (e.g. acceleration sensor, pressure plate, laser range scanner etc.)
- High devices cost, detection area limitation

**Purpose**

- Detecting by Kinect (low cost)
- Recording walking activities (stance phase, swing phase, step length, stride length, and stride width etc.)



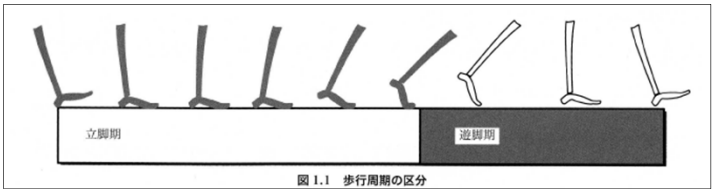




図 1.1　歩行周期の区分