Faculty and Laboratories of Department of Mechano-Informatics

※: Professors denoted by this symbol do not accept new graduate students for the applicable academic year.
[RCAST] denotes the professors of Research Center for Advanced Science and Technology holding adjunct professorship at School of Information Science and Technology.

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Hirose-Kuzuoka-Narumi Laboratory

Our research laboratory focuses on developing Cybernetic Interfaces, high level user interfaces that unite human and computer seamlessly. On the basis of virtual reality technologies (VR), we explore such interfaces from various aspects.
The research themes of our laboratory include augmented reality (AR), multi-modal/cross-modal interfaces, computer supported cooperative work (CSCW), telepresence, ghost engineering, emotion interfaces, and processing methods for various big data including lifelog data. Our research focus is not only technology developments but also the development of contents that make the most of our technologies. We are also working on social projects such as the Digital Museum project and the Senior Cloud project.

Virtual Reality and Mixed Reality

3D World Reconstruction from 2D Photo Images and Videos
Redirected Walking techniques
Ownership and Agency toward Avatars, and Its Effect on Perception/Cognition
Digital Museum and Virtual Reality-Based Education

3D World Reconstruction from 2D Images

Territorial Virtual Time Machine

Redirected Walking using Visuo-haptic Interaction

Ownership toward Augmented Body

Advanced Human Interface

Multi-modal and Cross-modal Interfaces
Behavior Elicitation & Emotion Evacuation Interfaces
Telepresence Systems for Enhancing Remote Communication
Human-Robot Interaction and Social Robot
Lifelog Visualization and Analysis, and Lifelog-based Future Prediction

Social robots in museum

Gustatory / Olfactory displays

"Cloning" technique for mediated group work

Emotion evocation via pseudo-bodily reactions

※ Yoshihiko Nakamura
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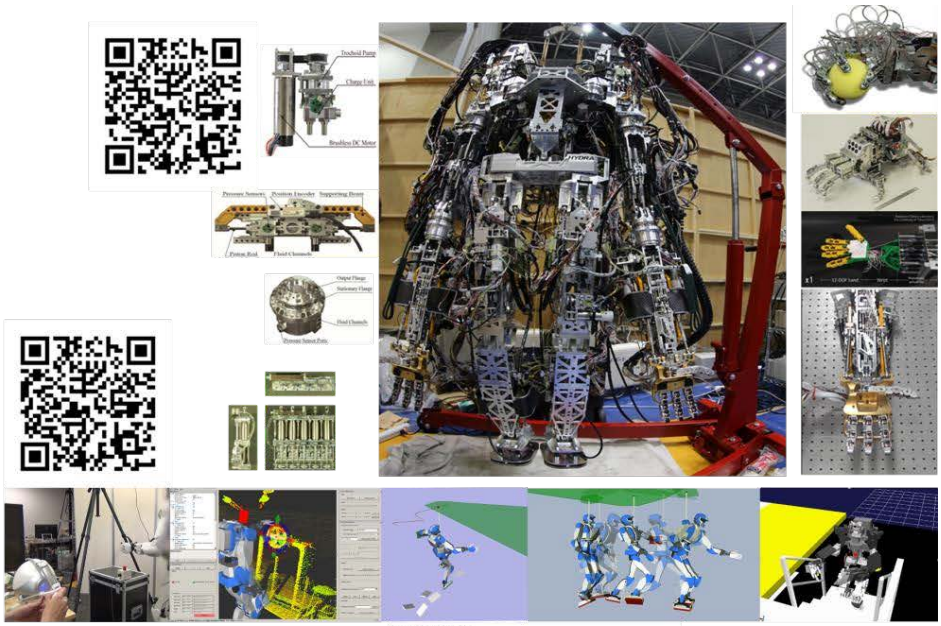
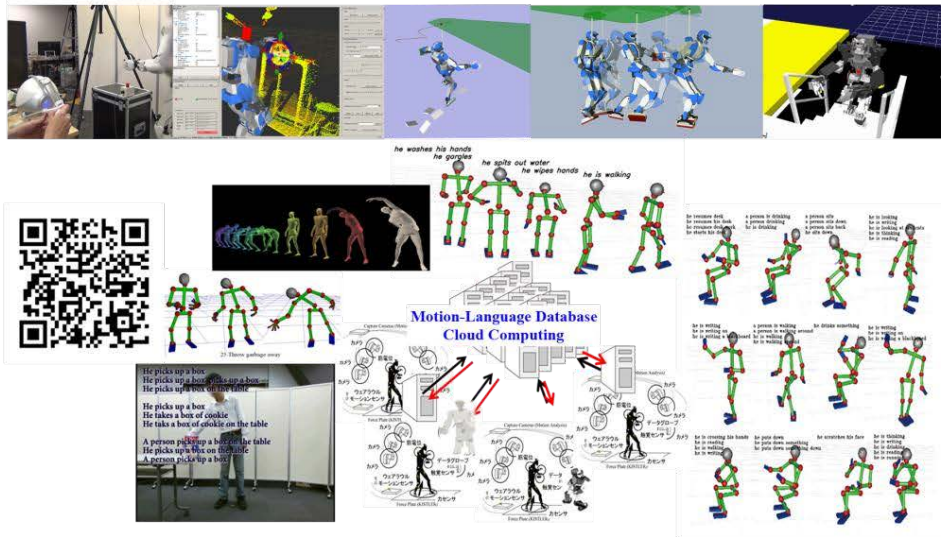
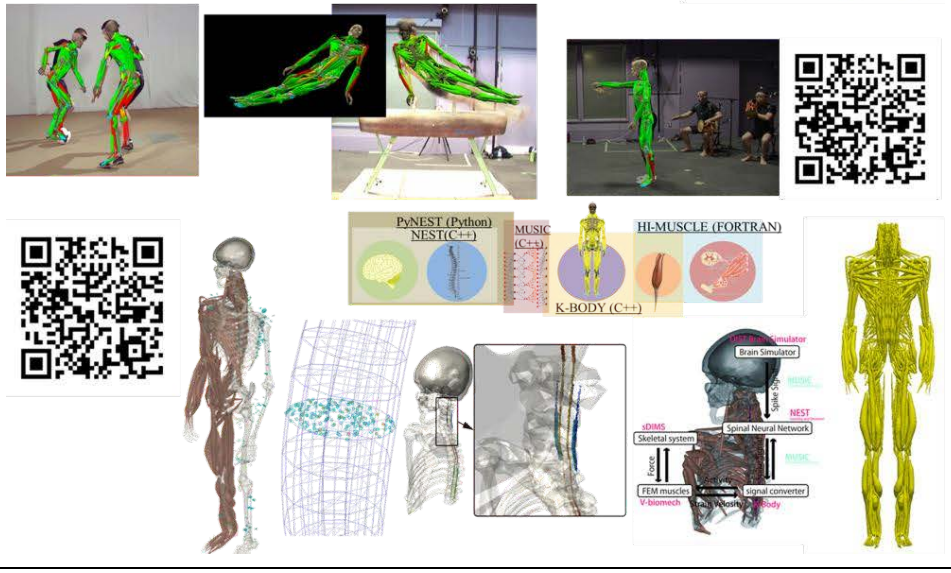
Robotics, Dynamics and Control Laboratory http://www.ynl.t.u-tokyo.ac.jp/

(1) Small Hydraulic Actuators: Force Control, High Pressure and Mechatronics
(2) Humanoid Robotics: Whole-body Compliant Control and Soft Robotics
(3) Motion Control Theory: Biped Locomotion and Nonlinear Optimization
(4) Human Computation: Whole-body Motion Control by Mouse Brain Model
(5) Human Understanding: Video MoCap, Embodiment, Symbols and Language
(6) Sports Performance Analysis and Training: Biomechanics, Individual and Team Analysis, Intervenient Training by Sound Information







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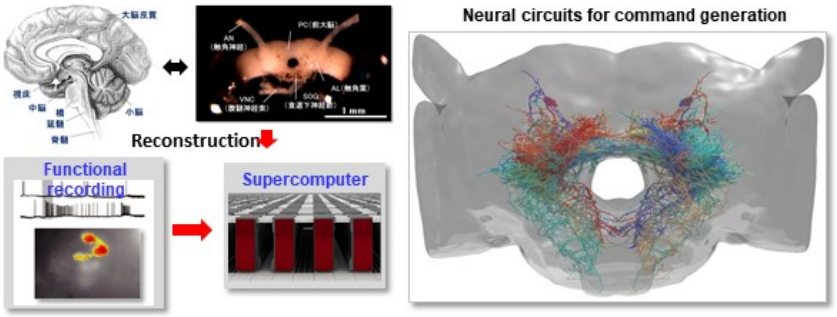
Kanzaki & Takahashi Lab

Research field: The aim of our research is to clarify the basic neural mechanisms for generating adaptive behaviors (or intelligence) using interdisciplinary approaches combining informatics, engineering and biology. As model systems, we use cultured neurons, insect brains and rat brains. Our research deals with investigating bio-machine hybrid systems, and also establishes basic technologies for controlling behavior by external commands to brain functions.

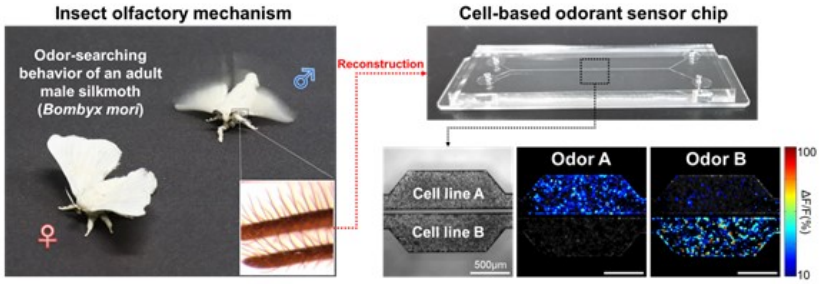
Kanzaki Group (RCAST, Komaba Research Campus)

http://www.brain.rcast.u-tokyo.ac.jp/

(1) Understanding elementary intelligence of insect brains



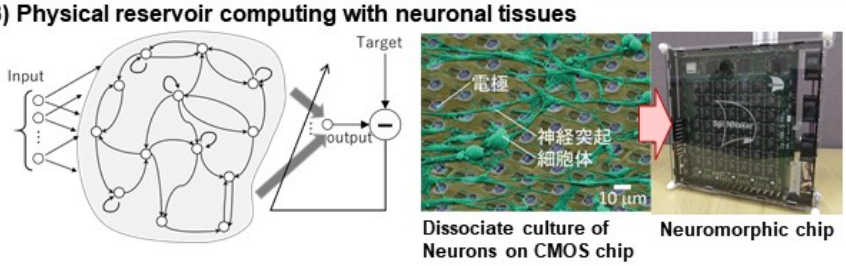
(2) Odorant sensors based on insect odorant receptors



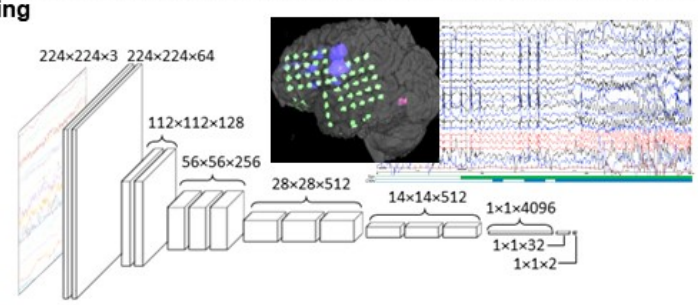
Takahashi Group (Hongo Camupus)

http://www.ne.t.u-tokyo.ac.jp/

(3) Physical reservoir computing with neuronal tissues



(4) Neural consciousness of consciousness and learning based on functional imaging



JSK Robotics Laboratory
(Jouhou System Kougaku Laboratory)

URL: http://www.jsk.t.u-tokyo.ac.jp/

Research in this laboratory is focusing on the fundamental functions and systems necessary for future intelligent robots that will live and work in the daily life field and human society. The members are challenging something new through their own integrated robot systems and learning how to build sustainable systems for the future with each other.

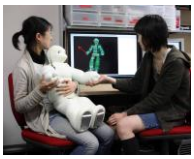
(1) Daily life support humanoid platform : recognition of situations in human life environments, using tools, dishes, tablewares, and appliances, learning from humans, conversation with humans, etc.
(2) Musculoskeletal tendon-driven humanoid : humanlike musculoskeletal body with very many joints and numerous redundant sensors aiming at powerful and supple motions like human, design principle of humanoid body structure, autonomous development of complex sensory-motor system, etc.
(3) Embedded robotics devices: soft flesh or deformable tactile sensor devices, integrated IMU sensors, perception devices, embedded CPU for flying robots, onbody communication LAN system, power system for intelligent robots. etc.
(4) Dynamics whole body control humanoid : integrating high-torque, high-speed motor drive circuit, high-speed 3D recognition system, dynamics whole-body.
(5) IRT (Information and Robot Technology) to support human and aging society: through fusing IT and RT systems, personal mobility robots, affectionate watching appliance are conducted for supporting the future life society
(6) Robot Open Software System : design and development of open-source type intelligent robot for mobile manipulation robot.

Daily Assisteive HRP2-JSK humanoids

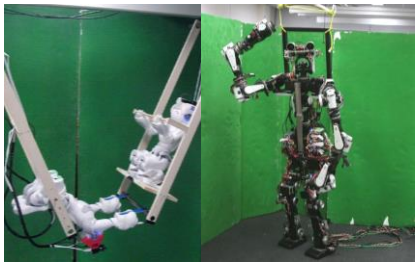
Musculoskeletal humanoids

Flying Robots

IRT Robots



Soft exterior and interaction



Dynamic whole-body control humanoid

Open software robot : PR2

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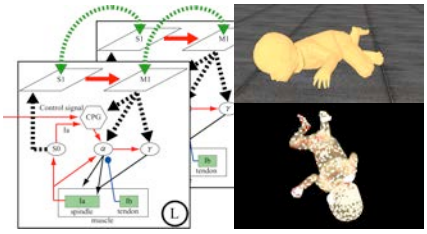
Intelligent Systems and Informatics Lab

http://www.isi.imi.i.u-tokyo.ac.jp/

Breakthrough Toward Intelligent Systems in the Real World

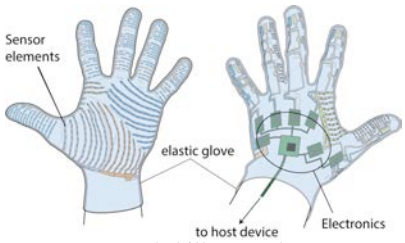
Our goal is to achieve intelligent systems that can behave appropriately in the uncertain and complex real world. In order to have a true understanding of the principles of such intelligence, we focus on the physical embodiment, emergent behaviors, developmental processes, and sociality. We carry out investigations into theories, applications, software and hardware to solve those problems.

1. **Origin of Intelligence: Fetus and Infant Developmental Scenario**
   Human fetus simulation (with cortex model, spiking neuron, sensory-motor feedback, tactile sensation, and uterus model), Self-organization of neural network, Baby robot, Cognitive development, Emotion.
2. **Embodied Cognitive Science: Emergence of Behaviors and Cognition**
   Coupled chaos network, Adaptive body image, Tool use, Affordance, Analyzing the "knacks" of human skills, motor learning, motor skills in sports, humanoid robot.
3. **Understanding Human Brain**
   Time series analysis brain activity, Neural network, Multimodal recognition and learning, Body scheme, Estimation of emotion and intention, Developmental disabilities, Neuro-rehabilitation.
4. **Bio-Inspired Robot and Soft Robotics**
   Bio-inspired mechanism, Biomimetics, Biomechanics, Soft actuator, Printable Robot, Artificial musculo-skeletal system, Human-robot interaction (HRI), Soft UI, shape-changing computer interface, wearable device.
5. **Social ICT**
   Understanding, designing and realization of social systems and services as information systems. Innovation of mental health by combining advanced ICT technologies and clinical psychology.



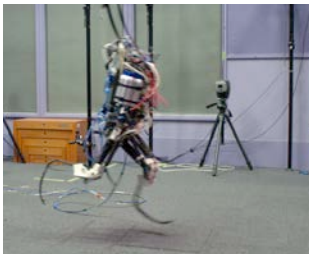
Self-organization of neural system and behavior of fetus and newborn

Baby robot

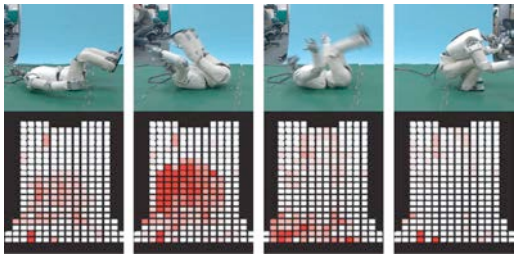


Hand skill copy glove

Human skill copy suit

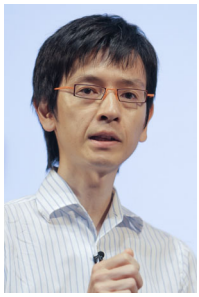


Running Athlete Robot



Roll and rise motion using whole body distributed tactile sensor

Tatsuya HARADA
Professor



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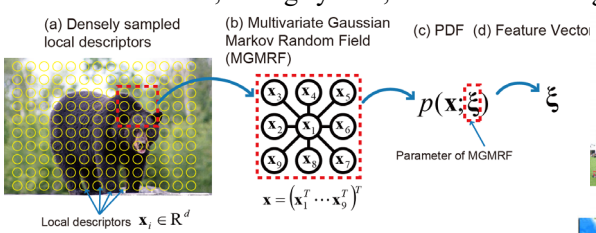
Machine Intelligence

Advanced Intelligence for Machine

Our goal is to invent advanced intelligent systems by combining useful but infinite information in the physical space with huge amount of data and powerful computational resources in the cyber space. To tackle this challenging problem, we utilize all resources in the area of computer science including mathematical basis and robotics.

1. **Mathematical Basis**
   Information theory, machine learning, data mining, pattern recognition, stochastic/statistical theory, time series analysis, causality analysis, learning theory, feature extraction
2. **Recognition, Understanding and Thinking**
   Deep learning, big data, computer vision, image recognition and retrieval, 3D vision, image segmentation, behavior recognition, multimodal recognition, detection of interesting and newsy events, dialog understanding, emotion understanding, natural language processing, speech and music information processing
3. **Contents Creation**
   Sentence generation and summarization of image and video, image generation from sentences, dialog system, automatic article generation system



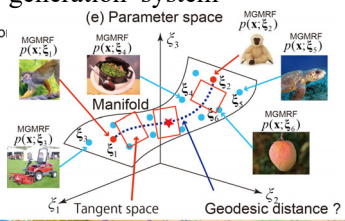
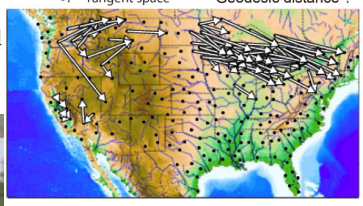


Image feature extraction based on information theory and machine learning

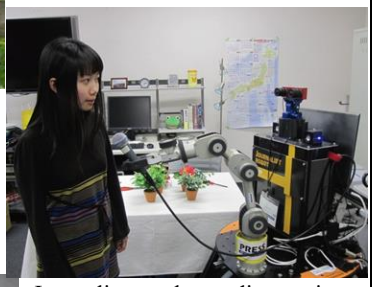
A silver car parked in a residential street.

A brown horse standing in a lush green field.

Automatic sentence generation system



Causal analysis for meteorological data



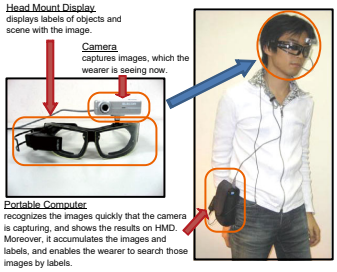
Journalist robot discovering newsy events in the real world

1. oboe
2. flute
3. ice lolly

1. Siamese cat
2. Egyptian cat
3. Ibizan hound

1. diaper
2. swimming trunks
3. bikini

Large-scale image recognition system



Artificial intelligent goggles recording everything you see and enabling you to find missing belongings

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BIOHYBRID SYSTEMS

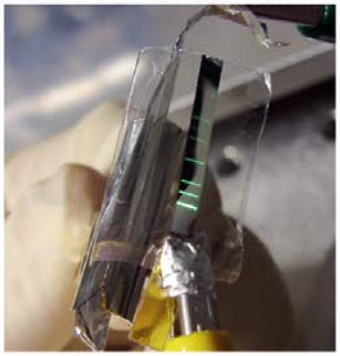
- SHOJI TAKEUCHI RESEARCH GROUP -

Our group focuses on creating bio-hybrid systems that combine bio-functional materials with micro/nano devices. As one example, bio-molecular motors, such as kinesin-microtubule, are on the order of a few nanometers; such dimensions make them suitable as actuating elements in small devices. As another example, micro neural electrodes can serve as interfaces between the living organs and artificial equipments. We aim to realize such hybrid systems by combining various disciplines, such as mechanics, informatics, biophysics, cell biology, and material sciences. Personnel interested in multidisciplinary research, with any of these abovementioned backgrounds, are warmly welcomed to join us.

【RESEARCH PROJECTS】

IT devices

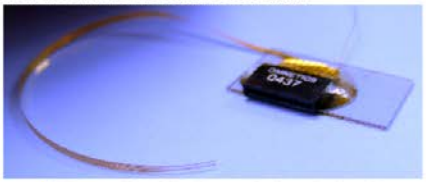
We study on flexible, low-cost displays using organic light emitting diodes.



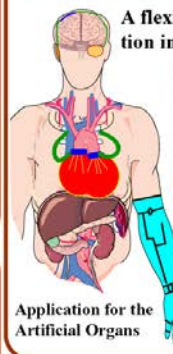
World thinnest OLED display; the thickness is around 6 micrometers.

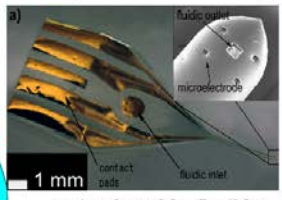
Brain-Machine Interfaces

We apply flexible microelectrodes for neural stimulation and recording.



A flexible electrode for the implantation into the spinal cord of a monkey.



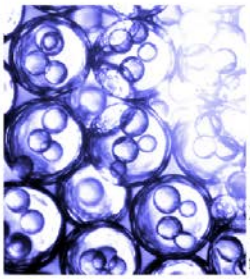


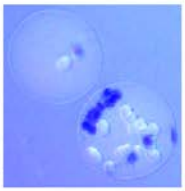
Application for the Artificial Organs

An implantable, flexible microelectrode with microfluidic channels for chemical injection.

NanoBiotechnology

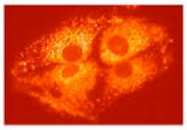
We try to understand mechanism of biomolecules or cells by using microfluidic devices.





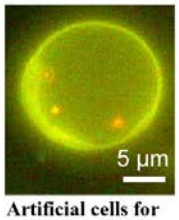
Micro hydrogel beads encapsulating cells for transplantation

Synthesis of cells for understanding "what is the life?", and for medical and pharmaceutical purposes



Single cell assembly for the advanced tissue engineering

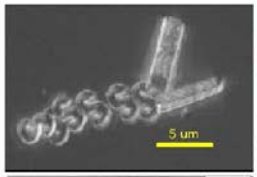
Controlling the shape of cells with microfluidic technologies: bacterial springs



Artificial cells for medical uses

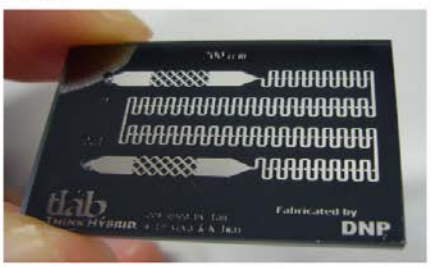
Micromachine

We study on the design and fabrication of micromechanism and structures.



micro humanoid fabricated by micro stereolithography

micro/nano structures driven by biomolecular motors



Lab-on-a-chip systems for the high throughput screening.