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.

[AI center]

denotes the professors of AI Center (*1) holding adjunct professorship at School of Information Science and Technology.

*1 Next Generation Artificial Intelligence Research Division, Center for Education and Research in Information Science and Technology (CERIST), and Next Generation Artificial Intelligence Research Center, The University of Tokyo.

[VR center]

denotes the professors of VR Center (*2) holding adjunct professorship at School of Information Science and Technology.

*2 Virtual Reality Educational Research Division, Center for Education and Research in Information Science and Technology (CERIST), and Virtual Reality Educational Research Center, The University of Tokyo.

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) Dynamics whole body control humanoid : integrating high-torque, high-speed motor drive circuit, high-speed 3D recognition system, dynamics whole-body.
(4) Transform robotics devices: embedded CPU for transform robots, integrated intelligent, IMU sensors, onbody communication LAN system, power system. etc.
(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.

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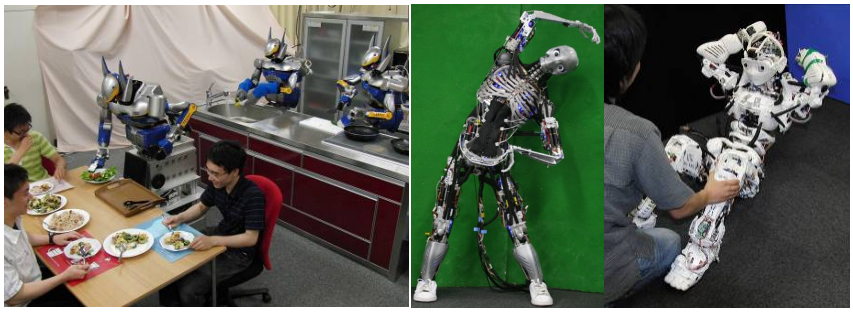


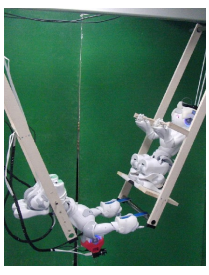
Daily Assisteive HRP2-JSK humanoids

Musculoskeletal humanoids

Flying Transform Robots

IRT Robots

Robot-social interaction



Dynamic whole-body control humanoid

Open software robot : PR2

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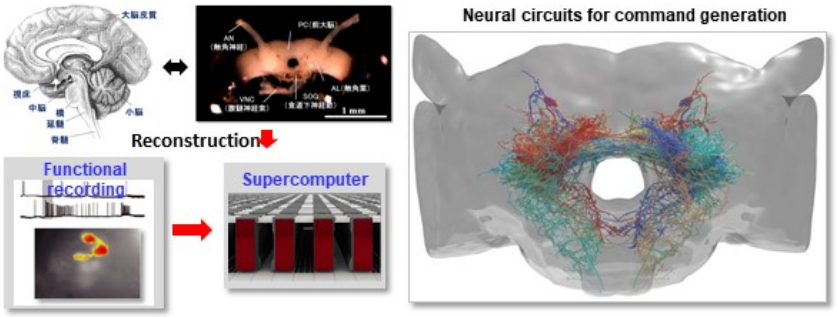
Kanzaki & Takahashi Lab

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.

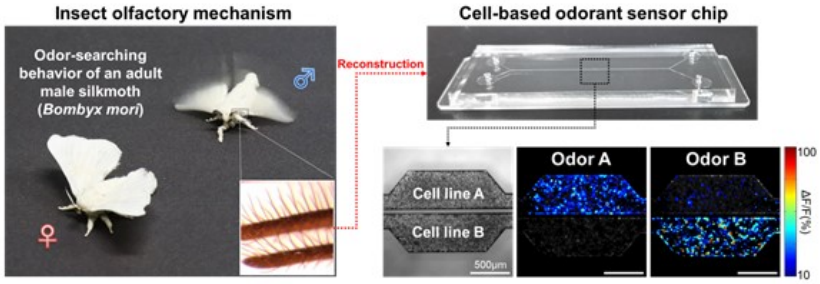
Kanzaki Group (RCAST, Komaba Research Campus)

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

(1) Understanding elementary intelligence of insect brains



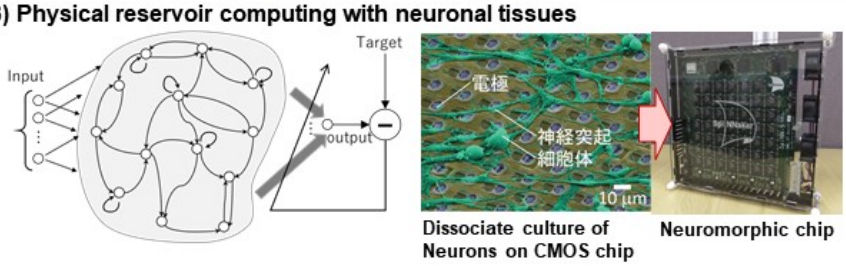
(2) Odorant sensors based on insect odorant receptors



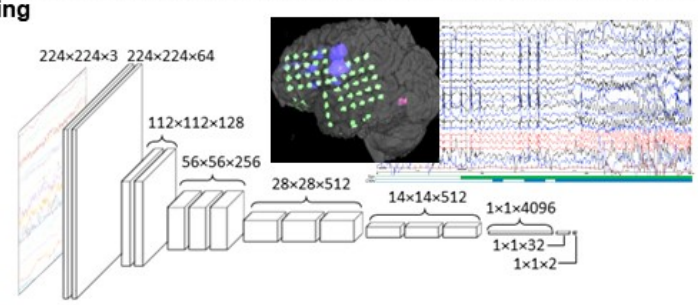
Takahashi Group (Hongo Camupus)

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



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Laboratory for Intelligent Systems and Informatics (ISI)

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

Breakthroughs Towards Truly Intelligent Systems in the Real World:

Towards truly intelligent behavior in the complex and uncertain real world, we reveal the principles of human intelligence and develop next generation AI, with applications to real world tasks.

1. Next Generation AI & Robotics Intelligence

Deep reinforcement imitation learning, multi-agent collaborative learning, dynamical systems/chaos/reservoir computing, spiking neural networks, free energy principle/predictive coding, dual-arm robotic manipulation, behvior emergence/immediate adaptation, autonomus systems, intention understanding, AI ethics

2. Elucidating/Modeling Human Intelligence, Origin of Intelligence

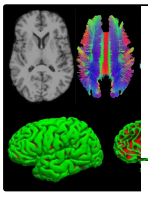
Whole brain simulation, Embodied cognition/behavior, Emotion/Feeling Model , Fetus/neonate embodied brain development simulation, Acquisition of concepts/language, Self-other/social cognition, Emergence of consciousness, Brain science and modeling of moral/value/intention/motivation/creativity

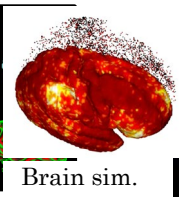
3. Bio-inspired Robots & Adaptive/Learning Control

Muculo-skeletal robots, Soft robots, Dynamic motor skills, “Knacks & Focuses”, Thin&flexible tactile sensors, Adaptive/learning control, Physical resevoir computing, Next gen. neuromorphic devices

4. AI Tech for Medical/Welfare/Handicapped & Global Isseus

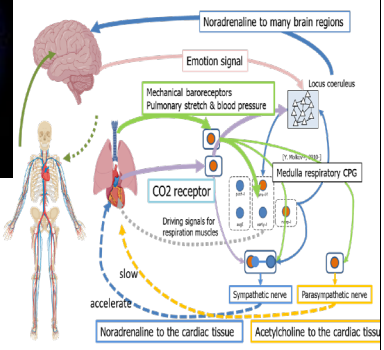
Monitoring & risk prediction of behavior/health, Clinical applications, Interactive elderly care robots, Understanding developmental disorders and alleviative technology for their sufferings, Agile-legal tech.



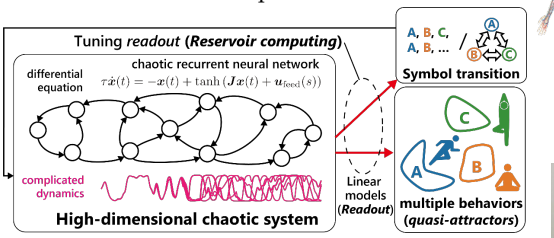


Brain sim.

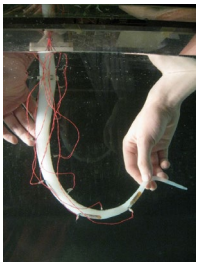
Fetus embodied development simulation



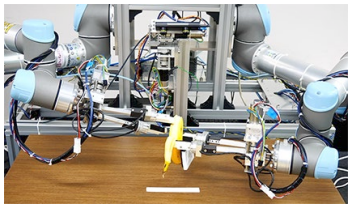
Embodied Emotion-Cognition Model



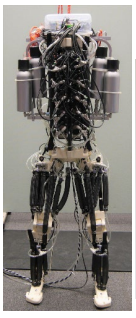
High dim. chaos autonomous learning & control



Octopus robot



Deep learning of human skills



Musculo-skeletal robot

Baby Robot

Kuzuoka-Amemiya-Narumi Laboratory

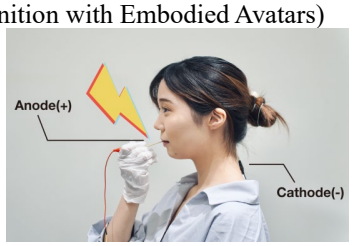
http://www.cyber.t.u-tokyo.ac.jp

Research on Cybernetic Interface aims to study interfaces that unite human and computer seamlessly. Our particular interest is in exploring Cybernetic Interface on the basis of Virtual Reality (VR) and Computer Supported Cooperative Work (CSCW) technologies. We focus not only on system development, but also on exploring innovative contents in application areas, and studying the impact of human-computer interaction on psychological and social science research. Specifically, we are conducting research on multi-modal/cross-modal interfaces including tactile, olfactory, and gustatory senses, human augmentation technologies to enhance human physical and cognitive abilities, social robots, and educational systems using virtual and augmented reality.

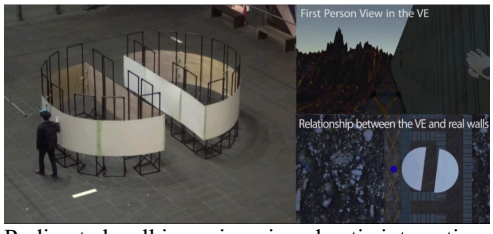
Virtual Reality / Mixed Reality

Multi-modal and Cross-modal Interfaces
Redirected Walking Techniques
Electrical Stimulation for Presenting Sensations
Human Augmentation with Virtual and Augmented Reality
Ghost Engineering (Augmenting Perception/Cognition with Embodied Avatars)

Multi-modal / Cross-modal interfaces



Presenting spiciness through electrical stimulation

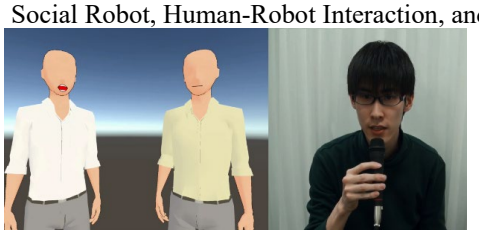


Redirected walking using visuo-haptic interaction

Manipulation of weight perception through body transformation with avatars

Computer Supported Cooperative Work (CSCW) / Human-Computer Interaction

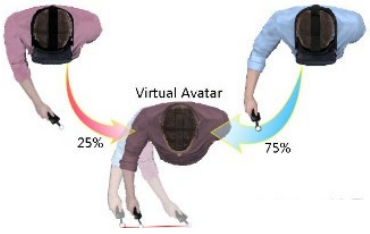
Telepresence Systems for Enhancing Remote Communication
Behavior Elicitation & Emotion Evacuation Interfaces
Virtual Reality-Based Education, Rehabilitation, Consultation
Social Robot, Human-Robot Interaction, and social media



"Cloning" technique for mediated group work

Emotion evocation via pseudo-bodily reactions

Social robots in museum



Co-embodiment for skill transfer

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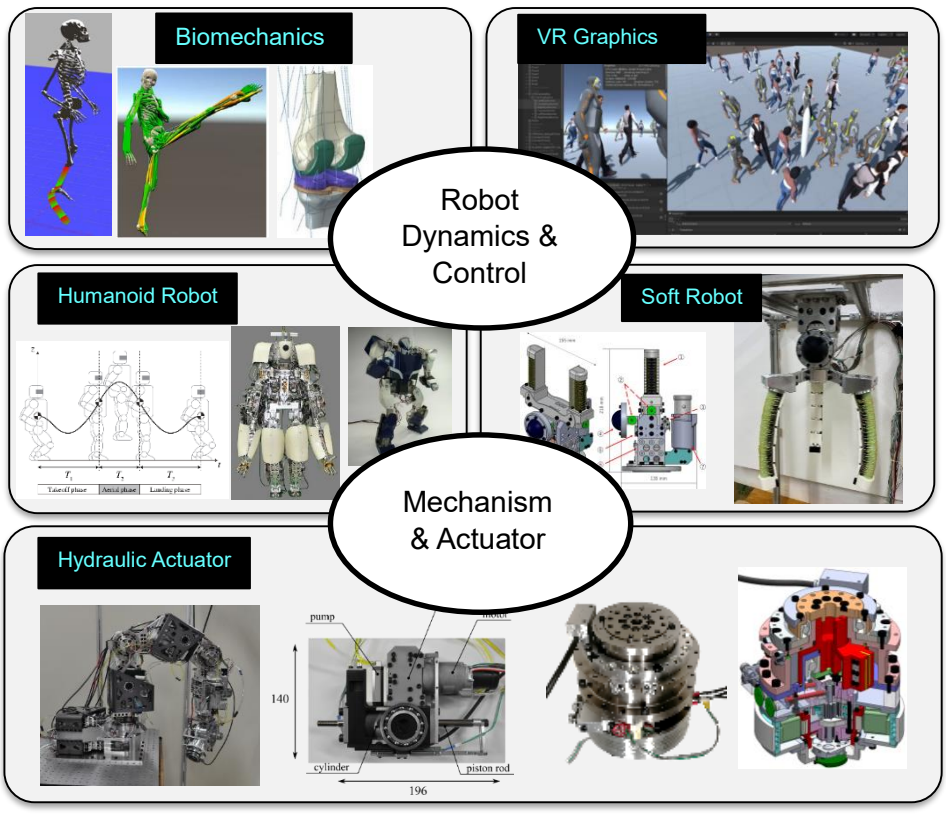
Dynamics and Control Systems Laboratory

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

(1) Highly Robust Autonomous Driving Systems of Cars and Trucks
(2) AI-based Autonomous Harvest/Transport Systems for Vegetables and Fruits
(3) Human Sports Motion Biomechanics
(4) Robot Control & Actuators for Dynamic, Flexible and Skillful Human Motion
(5) Advanced Optical Sensing and Image Understanding



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Machine Intelligence Laboratory

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Advanced Intelligent System for
Recognition in Real-world, Contents Generation and Knowledge Discovery

Our goal is to invent advanced intelligent systems for real-world recognition, contents generation and knowledge discovery by combining useful but infinite information in the physical space with a massive amount of data and powerful computational resources in cyberspace. To tackle this challenging problem, we utilize all resources in the area of computer science, including the mathematical basis and robotics.

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

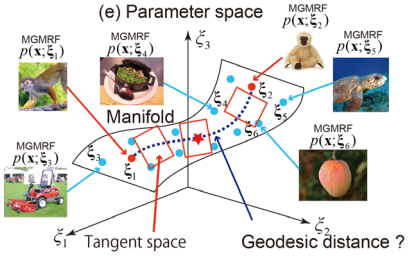


Image feature extraction based on information theory and machine learning

Causal analysis for meteorological data

A silver car parked in a residential street.

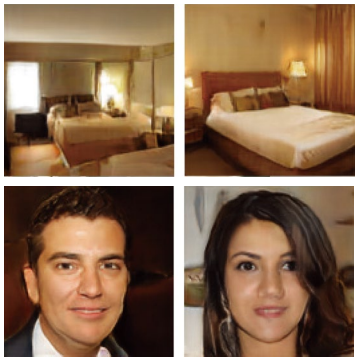
A brown horse standing in a lush green field.

Automatic sentence generation system

Integration of computer vision, computer graphics, and machine learning

oboe Siamese cat diaper

Large-scale image recognition system



Automatic realistic image generation of unseen object

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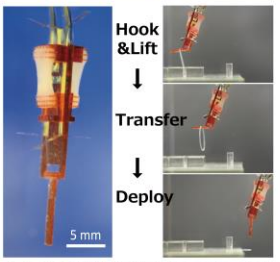
Biohybrid System Lab.

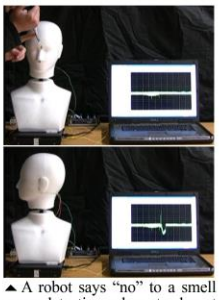
http://www.hybrid.t.u-tokyo.ac.jp/

Our group focuses on creating bio-hybrid systems that combine bio-functional materials with micro/nano devices. As one example, biohybrid robots powered with skeletal muscle tissues allow to engineer dynamic systems of living organisms. As another example, biohybrid sensors with recombinant cells can detect target materials with high sensitivity and selectivity. 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.

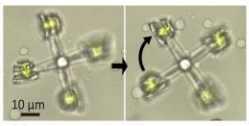
Cyborg technology *Enhance robots with living tissue, or upgrade living body by implanting artificial materials.*



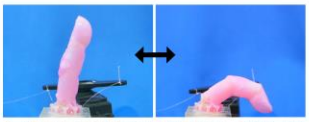
▲ A biohybrid robot with an antagonistic pair of skeletal muscle tissues reconstructed in-vitro. Contractions of the skeletal muscle tissues can be controlled via electrical stimulation.



▲ A robot says "no" to a smell upon detecting relevant odorant molecules using a cell-based sensor chip.

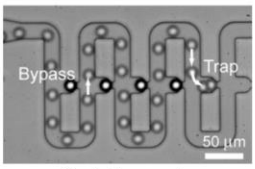


▲ Gears spun by the movement of Chlamydomonas, a moving green alga.

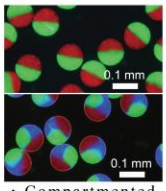


▲ Robot covered by skin tissue, which can heal its damage like what the living systems do.

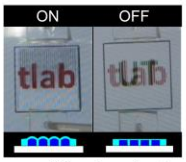
MEMS *Fabricate microdevices with refined structures and unique functions using microfabrication techniques.*



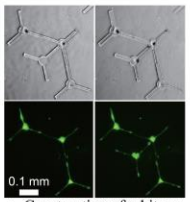
▲ Manipulate and arrange biomolecules or cells effectively using microfluidics, and achieve biological assays with unprecedented accuracy.



▲ Compartmented, uniform-sized hydrogel beads can be fabricated en masse using microfluidics.

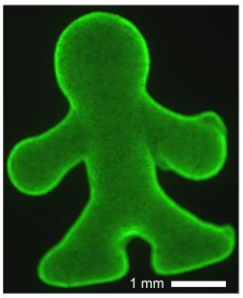


▲ Micro lens for the dynamic ON/OFF control of 3D displays. The lens consists of deformable microchannels actuated by hydraulic pressures.

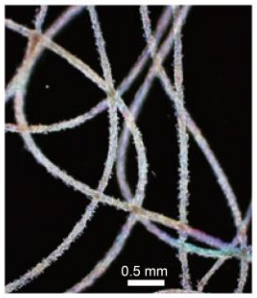


▲ Construction of arbitrary neuron networks by arranging cell-laden micro-plates.

Biofabrication *Fabricate biological "gears" and "wheels" using molecules or cells, assemble three-dimensional "machines", i.e. tissues/organs, for regenerative medicine or drug-testing models.*



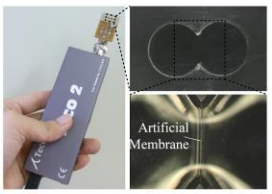
▲ Process living cells into micro beads, accumulate the beads to fabricate millimeter scale 3D tissues.



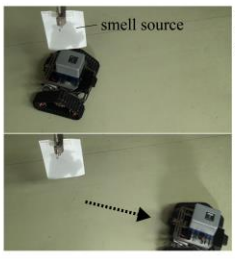
▲ Cell fiber: a thin, long, fibrous tissue fabricated using microfluidic techniques.

▲ A mini beef steak fabricated using cells isolated from bovine muscles.

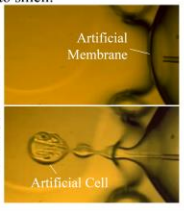
Artificial cell membranes *Manufacture cell membranes and eventually cells from scratch for biosensing.*



▲ Portable senor powered by an artificial cell membrane. The membrane consists of proteins derived from olfactory cells to detect smells.



◀ A robot mounted with an artificial cell membrane based odorant sensor, which can move in response to smell.



▶ Inspired by the principle of bubble guns, artificial cells can be fabricated by jetting a flow onto an artificial cell membrane.