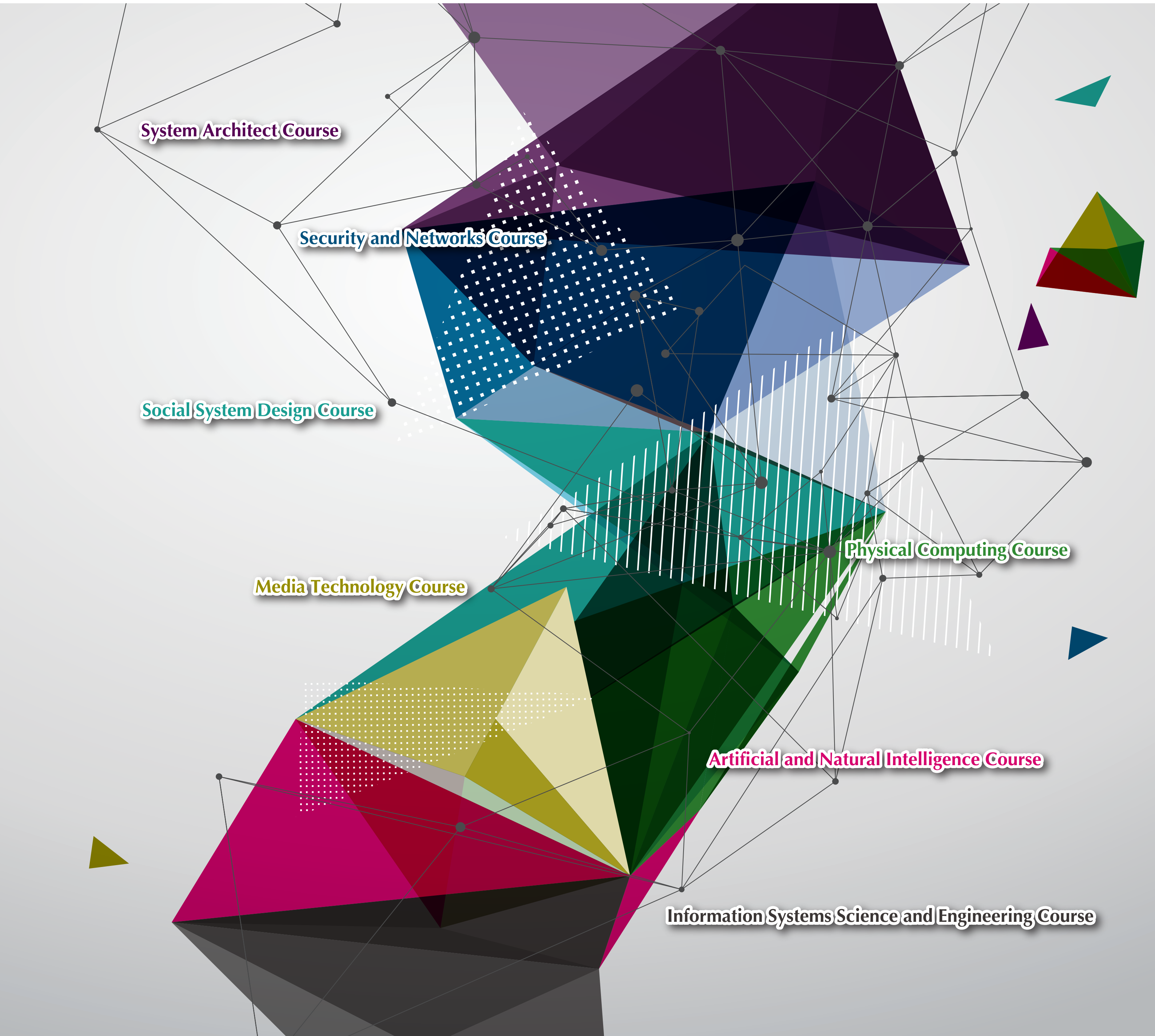
Challenge your mind
Change our future

College of Information Science and Engineering
Ritsumeikan University

2024


System Architect Course
Security and Networks Course
Social System Design Course
Physical Computing Course
Media Technology Course
Artificial and Natural Intelligence Course
Information Systems Science and Engineering Course

The College of Information Science and Engineering was established in 2004 as one of the largest colleges in Japan for conducting information and communication technology (ICT) related education and research. Since then, top level education and research has been conducted with results being actively shared and made public through international and domestic journals and research conferences.

One of the characteristics of our research is active individual and team collaborations with other researchers, both from inside and outside the university, who are working in various fields such as the humanities, social sciences, medical sciences and disaster mitigation. For example, the Research Center of Advanced ICT for Medical Healthcare carries out research and development on such things as anatomical model based diagnosis and treatment support systems and remote collaborative operation support systems with hospitals and medical schools. The Center for Cognitive Sciences aims to elucidate human cognitive processes and to develop systems to support various kinds of human activities in collaboration with the College of Comprehensive Psychology. In 2020, the Research Center for IoT security was established in order to contribute to the realization of a new smart society.

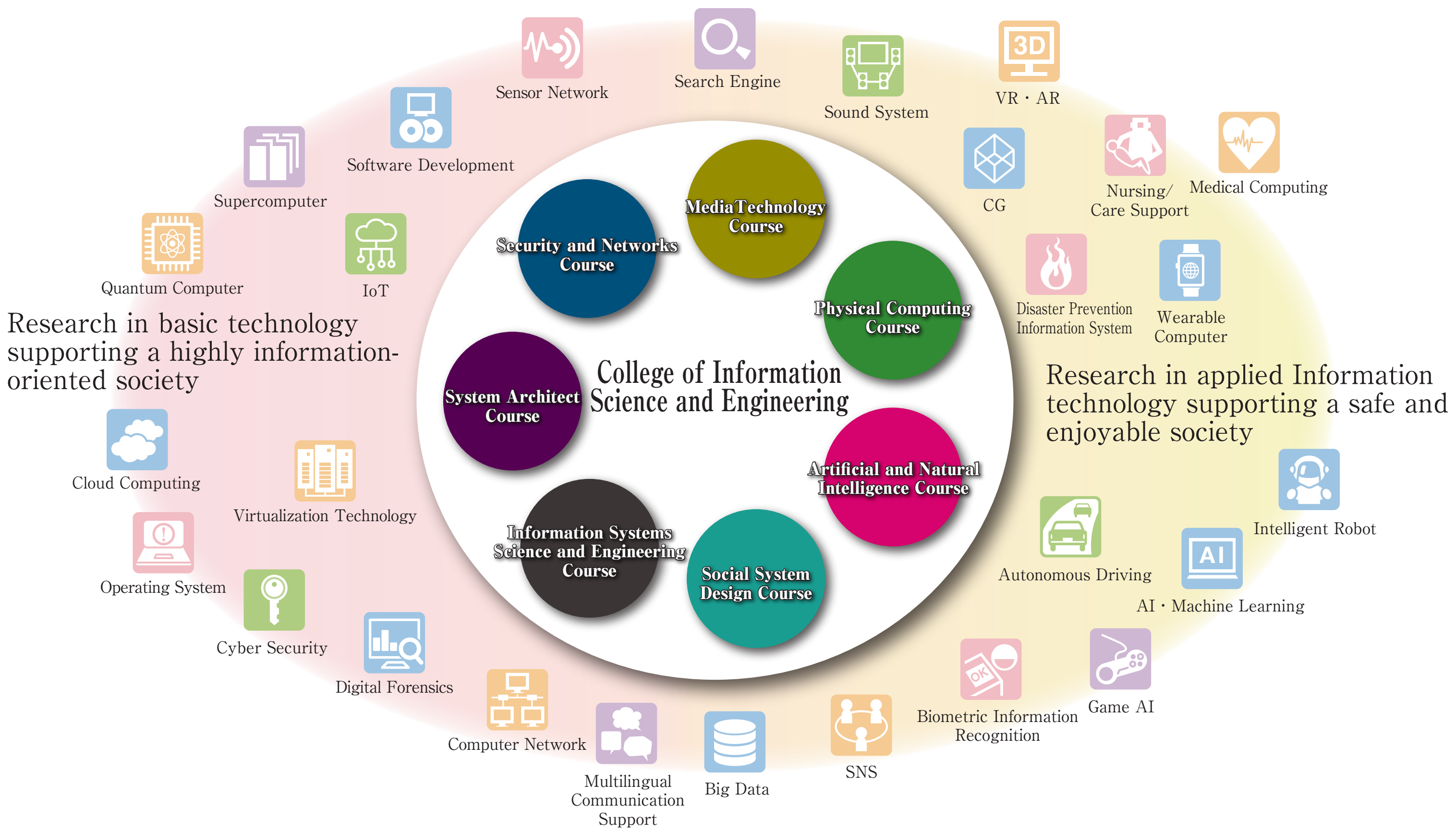
Another characteristic of our research is active collaboration with companies. Some professors do this by collaborating within their own laboratory while others collaborate by forming teams with professors from other laboratories. This is evidenced by the fact that the amount of funds received from joint and funded research in the College of Information Science and Engineering accounts for about 25% to 30% of the total research funds. In addition, the university-company cross-appointment system has enabled us to engage in research activities that fuse the cutting-edge technologies of our faculty with the data and expertise of companies in the field. This has also facilitated the business development of research results through the university's leave system dedicated to entrepreneurial activities. Collaborations with companies are beneficial for both developing fundamental technologies and improving marketing and business compatibility of fully developed technologies.

The College of Information Science and Engineering has reorganized its previous four departments into one department with seven courses, and established an English-based standard course called the Information Systems Science and Engineering Course (ISSE), in April 2017. The new structural plan allows for a curriculum that makes it easier for students to take various classes that go beyond their own specialties and enforces collaboration among professors in an effort to keep pace with the rapid changes occurring within the field of ICT. In April 2024, we have moved to the Osaka-Ibaraki campus, taking on the challenge of creating a new educational and research environment. We greatly appreciate your continued support and cooperation as we engage in our pursuit of developing skilled professionals and enhancing ICT research.

Seven courses to develop high expertise and a diverse perspective

Taking from seven different academic approaches, students can study beyond borders.

How our research areas relate to society


Sensor Network
Search Engine
Sound System
VR・AR
Software Development
Supercomputer
CG
Nursing/
Care Support
Medical Computing
Quantum Computer
IoT
Disaster Prevention
Information System
Wearable
Computer
Research in basic technology
supporting a highly information-
oriented society
Media Technology
Course
Security and Networks
Course
Physical Computing
Course
System Architect
Course
College of Information
Science and Engineering
Artificial and Natural
Intelligence Course
Information Systems
Science and Engineering
Course
Social System
Design Course
Research in applied Information
technology supporting a safe and
enjoyable society
Cloud Computing
Virtualization Technology
Operating System
Cyber Security
Digital Forensics
Intelligent Robot
Autonomous Driving
AI・Machine Learning
Game AI
Biometric Information
Recognition
Computer Network
Multilingual
Communication
Support
Big Data
SNS

Ubiquitous Computing and Networking Laboratory

Research/Development Areas

Smart space systems linking the real/ edge and virtual/cloud.

Head researcher: NISHIO Nobuhiko

Research and development to provide a system that connect the real world at any scale (personal, indoor, urban) with the virtual world by countless computers and sensors connected to ubiquitous networks.

[IoT]
We are developing technologies to recognize the user's situation and surrounding environment status using sensors in mobile devices, wearable devices and robots/ AGVs. We recognize and predict the environment status and human behavior, and aim to realize a variety of services that intelligently adapt to the current environment. Until now, we have been researching and developing energy harvesting for indoor positioning, Wi-Fi packet human flow analysis, disaster prevention systems and smart building infrastructure system.

[Real world oriented computing]
We aim to build an intelligent environment system that collects and recognizes information linked to real world objects and things with sensors, has a server system that manages and analyzes the obtained information, and provides a new UI / UX. Until now, we have been researching and developing barrier-free navigation, an unmanned panoramic viewer, and a landmark visibility confirmation dialogue navigation system in the underground shopping mall around Osaka Station and Umeda Station.

[Edge computing]
The "edge" is used in contrast with "cloud", the "site" where the system interacts with the real world. Here, sensors recognize changes in the real world and the environment without human intervention. Such embedded systems will play an active role in home appliances, automobiles and industrial machinery, and in future urban infrastructure. Until now, we have been conducting research and development on an open source project (Autoware) for an autonomous car driving software using a robot OS and dynamic map generation and distribution based on a cooperative distributed platform of embedded system with GPGPU.

Distributed and Collaborative Systems Laboratory

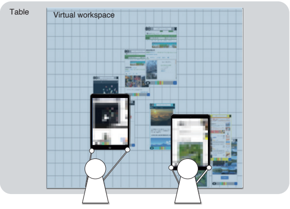
Research/Development Areas

Creating Distributed Computing Environments to Support Collaborative Activities

Head researcher: TAKADA Hideyuki

In the Distributed and Collaborative Systems Laboratory, we are working on distributed computing environments that support collaborative human activities in learning places, offices, and urban areas. One of the examples of research achievements is a collaborative programming environment that allows a group of children to work on a project together. This environment has been evaluated in an actual programming workshop with elementary school children participated. Another example is a collaborative Web search support tool that enables a group of users to search Web sites of their interest and make a decision in a collaborative task such as travel planning. In addition, we are conducting research on various kinds of applications to make smartphones more useful, and methods to predict the degree of people gathering using Wifi signals emitted from smartphones. Through these research activities, we are trying to contribute to making people's daily activities smoother, more enjoyable and more creative.

Collaborative programming environment for children



Collaborative Web search on the Virtual Tabletop Environment

New Generation Computing Laboratory

Research/Development Areas

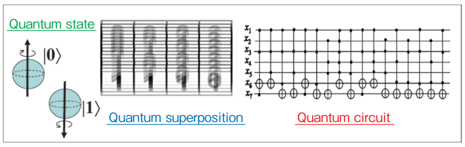
New Computing Paradigm and It's Design Methodology

Head researcher: YAMASHITA Shigeru

The New Generation Computing Laboratory works on methods of designing next-generation computers to meet the demands of high failure resistance and low power consumption; this contrasts with most computers to date, which tend to consider only the need to meet conventional demand for performance. The Lab is also researching theoretical analysis of operating principles and ways of designing radically different computing methods from today's methods-technologies such as quantum computers and biocomputers. Related to the above-mentioned researches, the Lab is also researching theoretical aspects of algorithms and data structures, and parallel high-performance computing with GPUs, etc. Some of the Lab's current research areas are:

Highly dependable computers
-Research on ways of designing computers that can avoid failures
Increasing LSI miniaturization has made the problem of hardware failures during manufacture and operation. This research is addressing ways of dealing with such hardware failures.

Quantum computers
-Creating methods and tools for efficient design of quantum circuits
By controlling microscopic physical states such as electron spin, we can perform a type of parallel computation known as "quantum parallel computation." This approach results in computers that are significantly faster than current supercomputers for solving particular types of problems. This Lab is researching theoretical analysis of quantum computation as well as developing design methods and tools for quantum circuits, which are components of quantum computers.

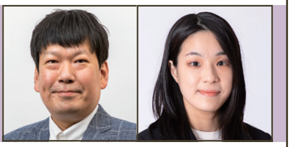


Quantum superposition and a quantum circuit.

Automated Software Engineering Laboratory

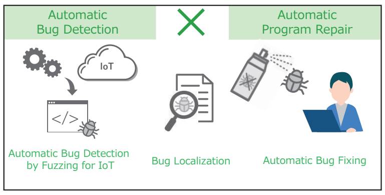
Research/Development Areas

Automated support for software development and programming education



Head researchers: YOSHIDA Norihiro, MAKIHARA Erina

Building Automated Testing and Bug Repair Infrastructure for IoT



IoT devices connected to the Internet, such as smart home appliances, are becoming increasingly popular. Practitioners that develop IoT devices have to release them only after thorough verification to ensure that bugs do not exist. However, detecting and fixing bugs is not easy because IoT devices have complex user- and device-specific behaviors, identifying multiple users and other devices. For secure IoT devices, it would be helpful if computers could automatically find bugs and automatically fix them. In our laboratory, we are conducting research toward realizing such automated bug detection and repair techniques.

Automated Programming Education for Adaptive Learning

Adaptive learning is an educational style that can provide personalizing efficient educational contents to a learner based on her/his skill and comprehension. In our laboratory, we are researching technologies to automated creating problem, hint, feedback, debugging, detecting of difficulty points, scoring and creating self-study environment for adaptive programming education. As well, we are analyzing programming communities such as online judge system and Scratch.

Integrated Systems Laboratory

Research/Development Areas

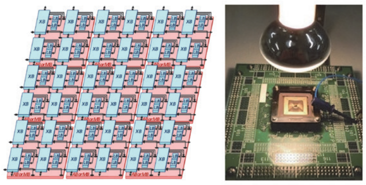
VLSI System Design and its Design Methodology

Head researcher: OCHI Hiroyuki

To improve the performance, power consumption, cost, and size of computers and other information devices/systems, we research integrated circuits as well as systems built on them.

Reconfigurable Hardware
Unlike ordinary integrated circuits whose functionality cannot be changed after fabrication, reconfigurable devices provide programmability to cover various applications flexibly. They are getting critical, especially in the field of artificial intelligence, such as image recognition. We are researching the architecture, design tools, applications, etc., of reconfigurable devices.

Ultra-low-power System
Mobile information devices such as cell phones, PDAs, and portable game consoles work with battery power, and thus reduction of power consumption is desired to achieve longer operation. Extremely low-power design is essential in devices supplied by solar cells such as sensor nodes. We are developing low-power architectures and circuits for systems that operate with energy harvested by solar cells.

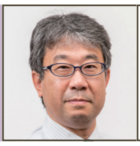


Left: Developed Reconfigurable Device Architecture
Right: Measurement Setup of Integrated Circuit with On-chip Solar Cells

Software Science and Technology Laboratory

Research/Development Areas

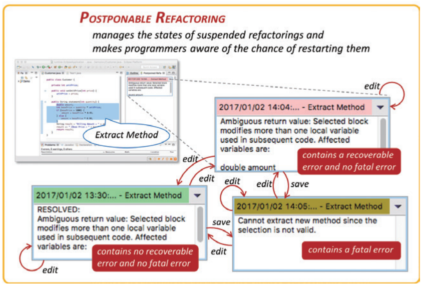
Next-generation Software Development Environments



Head researchers: MARUYAMA Katsuhisa, Xiqin LU

Our research group are exploring principles and methods that can make software construction and evolution easier and faster. The group also tackle research work on design and implementation of next-generation software development environments embracing those principles and methods.

Latest research topics include: (1) Tool platforms that facilitate the construction of software-development support tools, (2) Mechanisms that can keep track of the evolution of a software application by analyzing its development history and visualizing its structure and behavior, (3) Automated tools of refactoring that improves internal structure of existing software without changing its external behavior to make the software easier to understand or cheaper to modify, and (4) Automatic evolution of software, such as an extension of functionality and bug repair based on development histories.



Postponable Refactoring

manages the states of suspended refactorings and makes programmers aware of the chance of restarting them

2017/01/02 14:04:... - Extract Method
Ambiguous return value: Selected block modifies more than one local variable used in subsequent code. Affected variables are:
double amount

2017/01/02 13:30:... - Extract Method
RESOLVED:
Ambiguous return value: Selected block modifies more than one local variable used in subsequent code. Affected variables are:

2017/01/02 14:05:... - Extract Method
Cannot extract new method since the selection is not valid.

Extract Method
edit
save
contains a recoverable error and no fatal error
contains no recoverable error and no fatal error
contains a fatal error

A prototype tool that makes it more user-friendly by postponing the execution of refactoring.

Intelligent Interactive System Laboratory

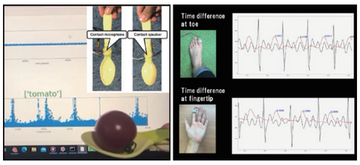
Research/Development Areas

Sensor data processing and human computer interfaces for mobile/ubiquitous/wearable computing

Head researchers: MURAO Kazuya, FUTAMI Kyosuke

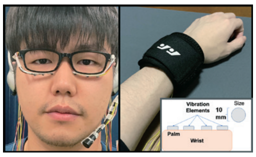
With the advent of mobile, wearable, and ubiquitous devices, data on human activities, situations, and physical conditions can be collected. Systems and services that utilize the results of analyzing such data provide advanced functions that have been difficult to achieve so far and support tasks performed by manual work, human intuition, and human wave tactics. These technologies also improve human capability, i.e., human augmentation, and contribute to the construction of new social structures, such as health care, medical support, business support, sports, entertainment, interface, and authentication.

In our laboratory, we develop technologies that enable computers to understand humans, transfer information appropriately to people, and efficiently manipulate computers by sensor information processing, machine learning, cognitive science, usability, system design, and so on.



Cutlery that recognizes foodstuffs with active acoustic sensing (left).

Method for estimating load position of sensors from time difference of ECG and PPG (right).



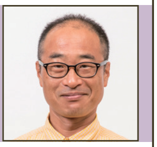
Eyewear to recognize silent speech movements for input manipulation (left).

Wristband to make illusion for manipulating subjective elapsed time sense (right).

Data Engineering Laboratory

Research/Development Areas

Lifestyle/Community Services Created by Analyzing Lifelogs



Head researcher: SHIMAKAWA Hiromitsu

Advances in sensor technology and computer technology make it possible to gather many kinds of data from subjects going about their routine activities. These technologies make it possible to record the types of school texts subjects have read, the websites they have searched for, and even the types of objects they have come in contact with that day. These records are known as lifelogs. Analyzing them lets researchers infer information on subject likes and dislikes. The Data Engineering Laboratory's research and development work is designed to use these inferences to create computer systems that provide users with the services they want, when they want them, before even being asked. If successful, such systems will be able to provide services perfectly in tune with user needs. The Lab's goal is to create an environment that will let even first-time computer users master the use of such services. Applications could span a wide range of fields, including assistance for the elderly, task management, education, disaster readiness, and inferring user interests.

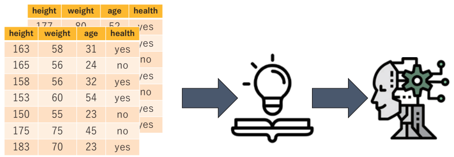
Applied Cryptography Laboratory

Research/Development Areas

Privacy preserving technology using cryptography

Head researcher: NOJIMA Ryo

Cryptography has now become a technology that supports the society. Among cryptographic research, we focus on (1) security evaluation and designing of cryptographic primitives such as post-quantum cryptography and SSL/TLS, and (2) privacy preserving technologies. In (2), we have three sub-themes. (2-1) We evaluate what kind of privacy information leaks from a model that have been machine learned using data that contains privacy information. (2-2) Conversely, we aim to build a machine learning method that does not leak information of the data used for learning. (2-3) In order to improve the performance of machine learning, it is necessary to collect a large amount of data which may contain privacy information. To collect data that contain privacy information from multiple organization, a machine learning method while hiding information from each other is needed. We develop such a privacy-preserving machine learning method using the cryptographic technologies such as homomorphic encryption and differential privacy.

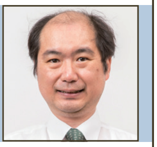


Applied cryptography for:
- Learning while preserving private information secret
- Technology that does not leak private information from the trained model

Global Information Networks Laboratory

Research/Development Areas

Developing Cooperative Distributed Systems on Large-Scale Networks



Head researcher: NISHIMURA Toshikazu

Global Information Networks

On global information networks, all network entities such as data centers, fixed terminals, mobile computers and sensors, can be connected to interact with each other without a centralized mechanism. Our aim is to establish the next generation protocols for autonomous distributed cooperative communication to implement network applications and systems.

Next Generation protocols

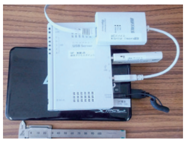
In wireless communications such as mobile networks and Wi-Fi, quality degradation due to radio waves is inevitable. We are focusing on protocols that realize high-quality computer network by retransmission of missing data or by using multiple communication paths for single connection for example.

Overlay Networks

An overlay network is a computer network built on top of another network. Our Japanese patent No. 433200 employs overlay network technology to the mechannism for Wi-Fi Hotzone that covers a city with a wireless local area network.

Mobile Networks and Internet Protocol

A virtual single cell is our solution that supports high-speed roaming and mobility by unifying neighboring micro-cells. We can realize broadband mobile networks by combining this idea with Internet Protocol over Wi-Fi Hotzone.

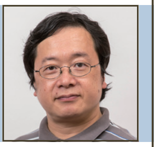


A router for satellite link (in the center of the photo) and its driving battery (a black equipment in the back of the router).

Cyber Security Laboratory

Research/Development Areas

System Security and Digital Forensics

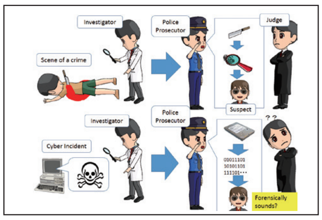


Head researcher: UEHARA Tetsutaro

ICT has become crucial in our society. The social impact of failures that occur in critical information systems is quite serious. In particular, cyber crime has become a major obstacle threatening the safety and security of our society We are doing the research and development of technologies that will contribute to achieve stability of secure information systems as well as to fight against cyber crime.

[Digital Forensics]

Today, many pieces of evidence of frauds and crimes remain on various digital equipment in the form of digital data. However, this digital evidence is quite fragile and can be easily erased or tampered with. It is also quite difficult to understand and investigate for anyone other than professional engineers. Digital forensics is a set of related technologies to acquire and investigate digital evidence related to cybercrimes, frauds, system incidents, and failures. It is a new field of research, and we are developing a variety of techniques as pioneers in digital forensics.

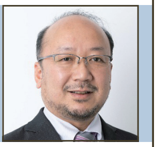


In regular crimes, judges normally understand the evidence of the crimes. However, digital evidence is difficult to evaluate.

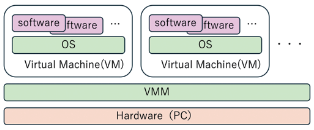
System Software Laboratory

Research/Development Areas

Aiming for a Software Revolution Using Cutting-Edge System Software



Head researcher: MOURI Koichi



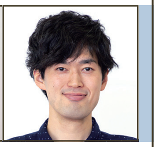
We research system software such as operating systems (OSs) and virtual machine monitors (VMMs). Although OSs are software, they have a unique role in managing computer hardware. Furthermore, OSs are necessary for those who create the software, those who operate the computer, and for the software to be executed. They are required for the computer to be "usable" as a computer. VMMs can create multiple virtual PCs (virtual machines) within a single physical PC, and each virtual computer can run the operating system independently. In addition, a virtual machine on one PC can be moved to another over a network. This technology is indispensable in today's cloud computing environment. In addition to the searching, shopping, and social networking services you use, self-driving cars will be built on top of the technology.

But how many people understand what they are? In our laboratory, we deepen the basic knowledge of system software learned in class and develop human resources who can acquire and utilize cutting-edge expertise and technology to solve real-world problems. Become super strong in software. Why don't you challenge yourself in this exciting field?

Information Networking Laboratory

Research/Development Areas

Research and Development of Innovative Network Systems utilizing Internet-based Technology



Head researchers: YAMAMOTO Hiroshi, MIYAJI Hideaki

An IoT (Internet of Things) is the network system consisting of not only computers/smartphones but also various physical objects (or things) that have connectivity to the Internet. These things can be embedded with various devices and electronics (e.g., sensors, robots, cars) in the real world, hence the IoT is attracting attention in research/business fields for creating new network services. In our laboratory, we are focusing on greater value that can be achieved by interconnecting things through the Internet, so researching and developing enabling technologies for achieving the innovative network system which can improve quality of life in the real world.

【Topic 1: Social life support system using embedded system】
The embedded system is a small-sized, low-power, low-cost computer which can include various sensing capability and network interfaces. By utilizing the embedded system, we are researching and developing various social life support systems (Figure 1: snowplow support system for an area of heavy snowfall, Figure 2: victim detection system for a mountainous area).

【Topic 2: Highly reliable data management system utilizing "Blockchain"】
Behavior of the social life system is decided based on the "data" that are collected from the real world, so the system may cause critical issues if the data is tempered by attackers. Therefore, in order to guarantee reliability of the real-world data, we are researching a data management system utilizing "Blockchain" that is originally proposed for cryptocurrency such as Bitcoin, and designing/developing applications utilizing the system.

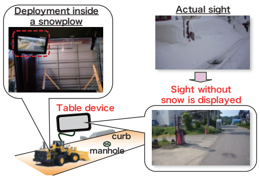


Figure 1: Snowplow support system using a table device

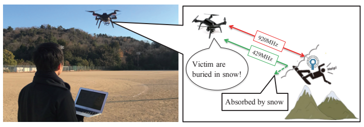


Figure 2: Victim detection system using a drone

Advanced Systems Laboratory

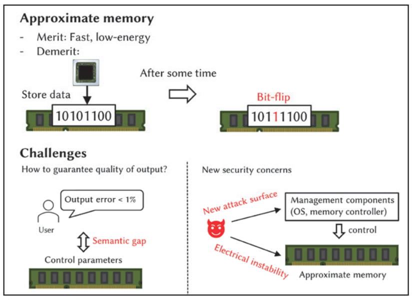
Research/Development Areas

Computing Systems for Sustainable Improvement of Software Performance

Head researcher: AKIYAMA Soramichi

Performance improvement of computer hardware has slowed down due to the slowdown of silicon manufacturing processes' refinement and the limited heat dissipation capabilities at runtime. This is leading us to an end of the good old age where the speed of underlying computers "automatically improve" from the software point of view. However, software domains such as AI, large-scale simulation, and big-data analytics keep requiring faster and faster computers.

To keep improving software performance, we focus on techniques that reside on the boarder of hardware and software. For example, a technique called Approximate Computing achieves time- and energy-efficient calculation by slightly sacrificing its integrity. However, gaining real benefit from this technique leaves us many challenges including which part of target software can be approximated (How do we know this? How do we control this?) and security issues that might stem from unconsciously modified data. We tackle these challenges with system software and computer architecture principles.



Overview of approximate memory and related research topics

Advanced Network Laboratory

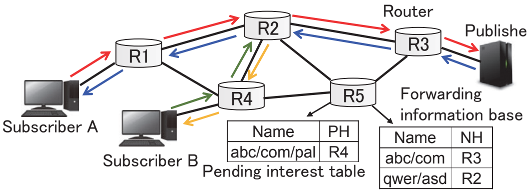
Research/Development Areas

Advanced Networks and Network Security

Head researcher: KAMIYAMA Noriaki

With the increasing definition of YouTube videos and the enrichment of web pages, the size of digital contents such as videos and images has increased, and the amount of data transmitted on the networks has continued to increase explosively. Furthermore, the patterns of data generation and consumption have diversified with the spread of IoT, which makes lives of people comfortable by analyzing the measurement data of sensors and smartphones installed in various places. Information-centric networking (ICN) is attracting attention as a new-generation network that replaces the current Internet in order to efficiently distribute large-capacity and diversified data. In our laboratory, we are engaged in research on various technologies of content delivery, e.g., router technology to realize a world-scale ICN and reliability technology to continue stable services even in the event of a disaster.

In addition, the Internet has become widespread as a social infrastructure that is indispensable for daily life of people. However, since the Internet is accessible to everyone, cyberattacks such as information leaks and denial of service (DoS) attacks that render Web servers inoperable occur on a daily basis. In our laboratory, we are also engaged in various research on network securities, e.g., defense technologies of various cyberattacks such as DoS attacks targeting network links, attacks targeting caches used to efficiently distribute content, and data management systems using blockchains.



Name	PH
abc/com/pal	R4

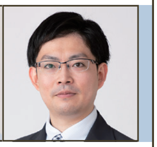
Name	NH
abc/com	R3
qwer/asd	R2

Motion principle of ICN

Network Systems Laboratory

Research/Development Areas

Research for Advanced Network Technologies integrating Mobile Wireless Devices into the Internet



Head researchers: NOGUCHI Taku, YOSHIDA Masami

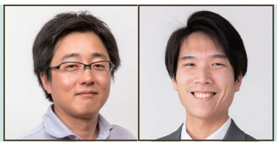
We are researching how to improve networks by integrating wireless technologies into the Internet. Our research interests include mobile ad-hoc networks (MANET) consist of mobile devices, e.g. smartphones, tablets and in-vehicle units, connected by wireless link, wireless sensor networks, which monitor the environment for any activities, and network coding theory, which is one of the most important breakthroughs in network communications. Through these researches, we would like to develop new generation network technologies to achieve a secure and reliable IT-based environment.
The photo shows concept of MANET, which is a self-configuring, infrastructure-less network of mobile devices connected by wireless links. MANETs are expected as an essential technology for an alternative communication networks after any large-scale disaster and vehicular communication networks connect vehicles because MANETs do not need any infrastructure support.

Concept of Mobile Ad-hoc Networks

Collaboration Design Laboratory

Research/Development Areas

Designing Human Society based on Multi-Agent Systems

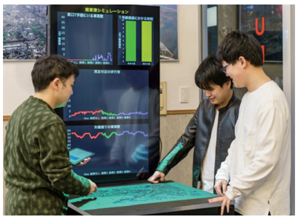


Head researchers: HATTORI Hiromitsu, YOSHIZOE Mamoru

As human society is getting highly-developed and complicated, it becomes hard to design suitable social systems for the society. Social simulation has been regarded as a promising method to understand complicated human society and predict probable social problems. The research objective in this laboratory is to explore technologies to design systems, mechanisms, services for human society in the future. The core technology is Multiagent-based simulation (MASim) which has been focused as a promising form of micro-simulation because it is suitable to reproduce complex phenomena in human societies.

We have conducted MASim in various domain such as traffic, energy, disasters, and internet communities. Especially, in the traffic domain, we have developed massively multi-agent simulator on which each agent can make its own decision every few seconds. Then, we successfully reproduced traffic flows under conditions applied for social experiment held in Kyoto City in 2007.

Simulation is not a technology to accurately predict the future, but a tool to find or point out possible form of the future. We will try to develop MASim-based technologies which can promote collaborations among humans and machines/softwares to solve diverse issues in human societies through interactions among them.



User Experiment with Urban Design Simulator

Natural Language Processing Laboratory

Research/Development Areas

Human-Computer Interaction, Entertainment Computing, Affective Computing

Head researcher: FUKUMOTO Junichi

We are conducting research on human-computer interaction, entertainment computing and affective computing, based on Natural Language Processing (NLP) which aims to handle human language on a computer. We also interested in affection and emotion processing relate to NLP.

[Human-Computer Interaction]

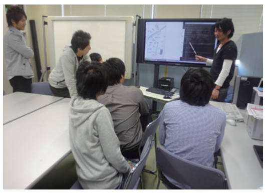
Question Answering (QA) is one of the interaction support technologies which extracts answer strings from a large amount of document data on the Internet. We are expanding this QA technology to handle metaphorical expression and system interaction in an ambiguous situation. We are also doing research on multimodal interaction such as gesture to realize more human-like communication in robots.

[Entertainment Computing]

We are conducting tourism information processing for sightseeing assistance by extracting appropriate information from a variety of blogs and reconstructing the extracted information for personal travel assistance. There are positive and negative reputations in blogs, and we aim to present information such as what is attracting points and caution points from the cause.

[Affective Computing]

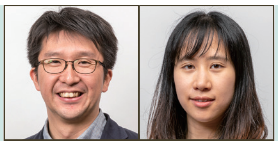
We are conducting research to understand metaphorical expressions of taste information. We try to understand semantics of taste expression to compute taste expression similarity and generate appropriate taste expressions.



Social Intelligence Laboratory

Research/Development Areas

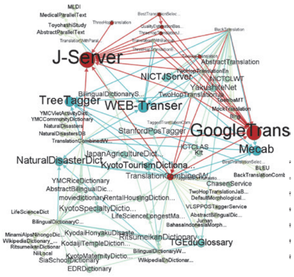
Developing a Service-Oriented Platform for Social Intelligence



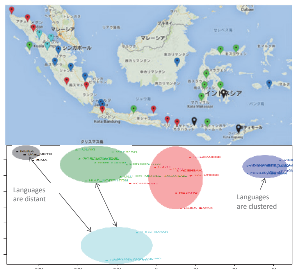
Head researchers: MURAKAMI Yohei, Mondheera PITUXCOOSUVARN

Social problems increasingly become too complex to be solved within one discipline. To address such problems, it is necessary to collect intelligence from a whole society. Our laboratory aims at forming social intelligence based on services computing technologies. Especially, by interconnecting web services of human/machine intelligence, we are developing a service-oriented platform that accelerates the construction of social intelligence.

For example, to overcome language barriers caused by globalization, we are operating the Language Grid, a platform to customize a multilingual service according to a community's context by combining various language resources. Also, to save endangered languages, we are driving Indonesia Language Sphere project that comprehensively creates bilingual dictionaries of low-resourced languages by combination of automatic generation and multiethnic crowdsourcing.



Language service network on the Language Grid

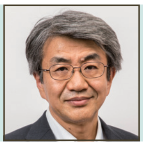


Clustering Indonesian ethnic languages and their distribution

Semantic Communication Laboratory

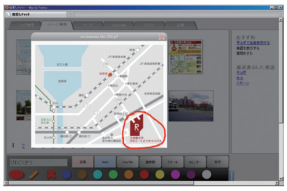
Research/Development Areas

Research on Web Collaboration

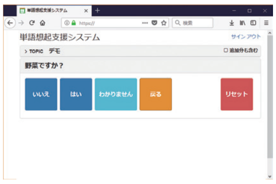


Head researcher: KUWABARA Kazuhiro

The Web is fast becoming a collaborative platform for the creation of new information and knowledge. In our lab, we are involved in achieving Web collaboration to support people's activities and communications on the network. In particular, we are developing specific applications by applying the Semantic Web technology and multi-agent technology. For example, we developed Yubisashi-chat ("Finger-Pointing Chat") to support communication with people with a cognitive handicap such as aphasia or dementia. To support word finding difficulty of people with aphasia, we also developed a word retrieval assistant prototype as a Web application, which controls the order of multiple choice type questions to ask and guesses the word an aphasia sufferer wants to say based on the answers given. Additionally, toward making use of knowledge of many people (collective intelligence), we are conducting research on gamified crowdsourcing for knowledge base acquisition and refinement.



Screenshot of "Yubisashi-chat (Finger-Pointing Chat)" software prototype



単語想起支援システム

> TOPIC デモ

□ 追加分も含む

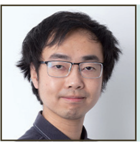
野菜ですか？

Screenshot of "Word Retrieval Assistant"

Communication and Interaction Design Laboratory

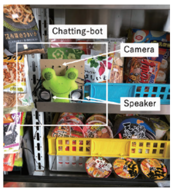
Research/Development Areas

Communication Support via Information Extraction and Visualization

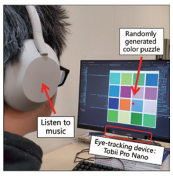


Head researchers: NISHIHARA Yoko, Junjie SHAN

The objective of the research is to support human communication. The laboratory is researching methods of information extraction and visualization.

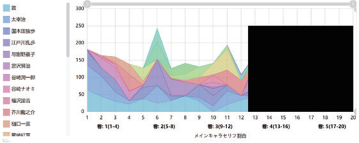


[Communication Chatting Bot]
We are developing chatting bots that enhance communication among people and provide communication topics. The chatting bots increases the number of physical communications among people. The increase of the physical communications reduces loneliness and prevents isolation.


Randomly generated color puzzle
Listen to music
Eye-tracking device: Tobii Pro Nano

[Nonverbal Information in Communication]
We are developing a system that estimates the colors that users imagine and feel by the eye-tracking device.

[Comic and Anime]
We are developing an information retrieval system on comic contents. Users do not need to use language query, so they rarely encounter comic's spoilers. We are also developing a listening practice support system using anime dialogues with estimated levels and features.



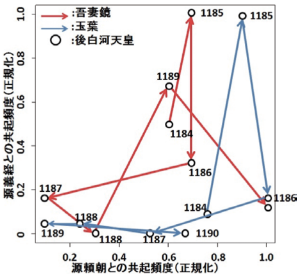
Digital Library Laboratory

Research/Development Areas

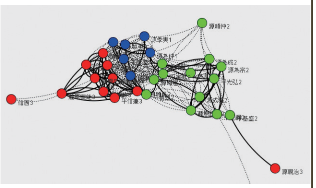
Information Access Technology for Digital Libraries

Head researcher: MAEDA Akira

We are doing research mainly on information access technologies to facilitate the organization and use of a vast amount of text media information. In recent years, an increasing amount of information has become available online, but it is becoming difficult to find the desired information from it. In order to support users in accessing information that matches his/her needs, we research techniques for information retrieval, which is the basis of information access technologies, as well as data mining techniques to discover useful knowledge hidden in a vast amount of information, information recommendation techniques that recommends useful information according to the user's interests, search and mining techniques for valuable historical materials that have been increasingly digitized, and multilingual information retrieval which enables access to information written in various languages in the world.



Transition of personal relationships estimated by analyzing historical documents



Interpersonal relationship diagram obtained by analyzing a historical document

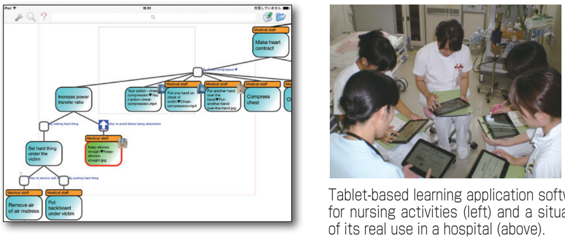
Knowledge Computing Laboratory

Research/Development Areas

Semantics-based Knowledge Support Systems

Head researcher: KITAMURA Yoshinobu

In recent information society, it is necessary to use diverse knowledge and information in different areas, organizations, and disciplines. Our research aims to facilitate access to knowledge-supported by computers-and its semantic-based use of knowledge computing. The key technologies cover "ontology engineering," i.e., semantically defined concepts, and "semantic technology," i.e., interlinking heterogeneous resources on the web. In previous research, one of the implemented systems included ontology-based procedural activities to describe nurses' expertise, developing a tablet-computer application for education and training of novice nurses. This system has successfully been used in real-world applications. In other research effort, for the manufacturing industry, design-support systems based on the models of artifacts, material and faults have been developed and deployed. This laboratory conducts fundamental research, development of application systems, and research applied in the real-world containing a variety of disciplines and domains.



Tablet-based learning application software for nursing activities (left) and a situation of its real use in a hospital (above).

Cognitive Engineering Laboratory

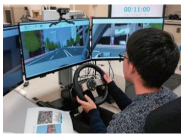
Research/Development Areas

Interaction design between human and human, objects based on cognitive engineering

Head researchers: IZUMI Tomoko, OTSU Kouyou

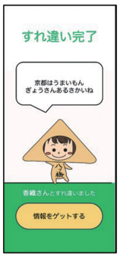
Cognitive engineering is a research filed that attempts to design objects with a consideration of human psychological and behavioral characteristics based on knowledge of cognitive science and psychology. We consider interaction between human and human, human and objects, human and computers in order to propose a mechanism that supports human behavior or that gives human a feeling such as happy or fun. Our major fields are as follows:

1. Sightseeing Support: We study on a sightseeing support system that encourages spontaneous sightseeing behavior and exploratory behavior to make sightseeing fun.
2. Disaster Mitigation: We study on support for disaster prevention and evacuation behaviors assuming various users.
3. Driving Assistance: We study on information provision by which it is easy for a driver to recognize, and a mechanism to encourage safe driving.
4. Fond Memory Engineering: We focus on fond memory which is essential element for human, and study on methodology for promoting recollection of memories and interaction between people.



Verification of a driving support system using the drive simulator

Interaction support via playing catch with a robot



すれ違い完了

京都はうまいもん
ぎょうさんあるさかいね

香織さんとすれ違いました

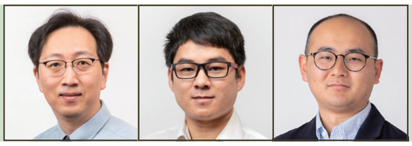
Tourist information app that gives a sense of being told by locals

Physical Computing Course

Advanced Intelligent System Laboratory

Research/Development Areas

Solving various problems with Intelligent Systems - Intelligent Space, Intelligent Robots, Artificial Intelligence

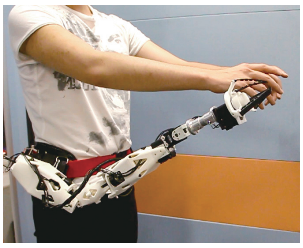


Head researchers: Jooho LEE, Dinh Tuan TRAN, FUJII Yasuyuki

We are conducting research to solve various problems by integrating various IT and related technologies mainly robots to take action, computer vision to see events, artificial intelligence to judge the situation and instruct actions doing. For example, in Intelligent Space research, data obtained from sensors distributed in space are processed to retrieve useful information then the space will provide comprehensive support; physical support by robot and informative support by image and voice for people in space.

In addition to this, a wide range of researches in various fields such as a wearable robot arm that supports human work, an elderly care assistance robot, a on water environment monitoring system, and a medical behavior recognition technology are performed widely in this laboratory.

A nursing care support robot that quantitatively measures nursing care movement and teaches the correct nursing care movement

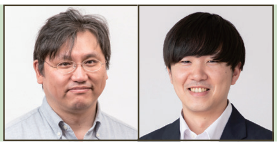


Assistance Oriented Arm (Wearable Robot Arm)

Interaction Laboratory

Research/Development Areas

Developing Interfaces and Robots Supporting Human Life by Interactive Intelligence



Head researchers: SHIMADA Nobutaka, MORI Yoshiki

Computer Vision for Service Robot

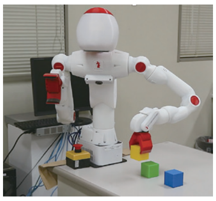
Service robot has ability to move around autonomously, identify human faces/gestures, and engage in verbal conversations. It behaves as a physical agent mediating between a user and the indoor surveillance system. It also automatically learns and recognizes the usage of new tools by observing daily human activities. Our vision-based intelligent interfaces including real-time object detection and gesture estimation enable the robot to operate devices like human.

Indoor Surveillance System

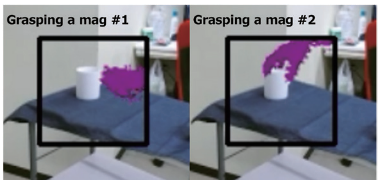
This system visually captures human activities in indoor scenes and recognizes them with computer vision. It can automatically detect objects a person places on or removes from a table. A user can ask “Who left this?” or “Who took the book from here?” through verbal and gestural interaction.

Food Processing Automation

Methods and system which enables robots to handle foods for factory automation and food processing at home.



Object operation by observing human demonstrations



Robotic Imagination for grasping a mag (Deep learning)

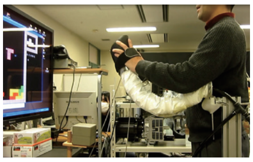
Biorobotics Laboratory

Research/Development Areas

Emotion, Perception and Motor Control Pneumatically Controlled Soft Mechanism

Head researcher: MITSUDA Takashi

The Biorobotics Laboratory has developed wearable robots and soft mechanisms actuated by air pressure. In addition to these studies, the laboratory has recently started to study cognitive psychology dealing with human emotion, perception and motor control. Human emotions and decisions are unconsciously affected by the environment. Human perceptions also vary according to the environment. Understanding the relationship between the environment and the human mind contributes to the development of human-friendly systems. Current research interests include preference formation, proprioception, haptic sensation and pneumatically controlled machine elements that change the rigidity.



Force display system

Odor preference judgments

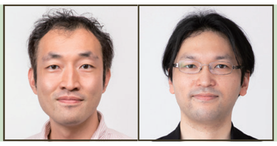
Force display by the use of constrictive pressure on forearms

Variable stiffness sheet

Playful Laboratory

Research/Development Areas

Research and practice on playful interaction design.



Head researchers: MATSUMURA Kohei, TAKAHASHI Haruki

We use human-centred design and tackle challenges real world problems in playful way. We are more than just researchers; As engineers, designers, practitioners, artists and geeks, we create digital technologies to solve real world problems.

Examples of our human-computer interaction (HCI), human-robot interaction, and digital fabrication research:

Service robot experiment at shopping mall

Research on “harmonious” service robot within a real situation. We do study on intelligence of a robot as well as interaction between human and robot.

Emoji input by drawing a curve

Research on “Face.” We develop a variety of novel user interfaces that utilizes Emoji such as questionaire with Emoji and Emoji input method by drawing a curve.

3D printing hair-like object

Research on “novel 3D printing” techniques. We are keen to seek a novel way to use digital fabrication machines.

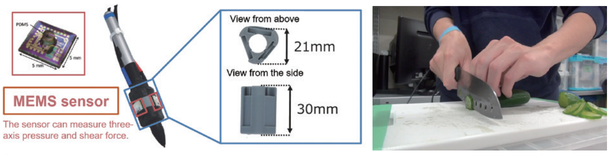
Media Experience Design (MxD) Laboratory

Research/Development Areas

Applied media technology for our daily life

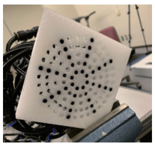
Head researchers: NOMA Haruo, ANDO Mitsuhito

MxD lab are exploring new experiences provided by the media technology for contributing to our real life. Our research target covering all fields such as daily life, education, transportation, medical care, games. Starting from actually observation and understanding the our activity, we try to find essential problems at the real site and then solve them with media technology.

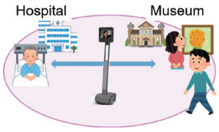

PDMS
5 mm
5 mm
MEMS sensor
The sensor can measure three-axis pressure and shear force.
View from above
21mm
View from the side
30mm

Signature recognition system and cooking procedure system using MEMS sensor.

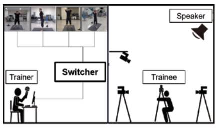
Procedure training system for NCPR



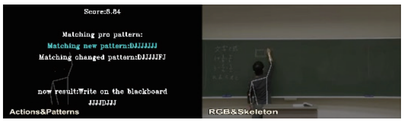
Cluster digital air cannon


Hospital
Museum

Telepresence robot for social inclusion


Speaker
Trainer
Switcher
Trainee

Remote exercise support system

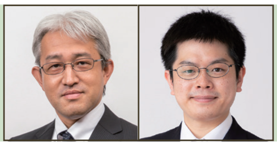

Score:8.84
Matching pro pattern:
Matching new pattern:DJJJJJJJ
Matching changed pattern:DJJJJJFJ
now result:Write on the blackboard
JJJJDJJJ
Actions&Patterns
RGB&Skeleton

Visualization system of trial class

Mobile Computing Laboratory

Research/Development Areas

Research for Enhanced Information Space Using Mobile Devices

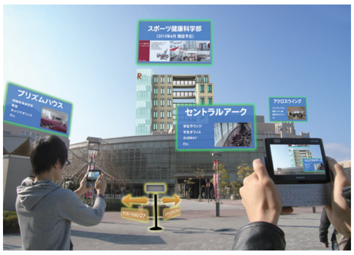


Head researchers: SHIBATA Fumihisa, NAKAMURA Fumihiko

"Mobile computing" is a key technology for creating an enhanced information space integrating the real world and the virtual world. We are conducting research by using mobile devices which are equipped with various sensors to improve our daily lives in the near future. The functions of mobile devices are further refined every year, and which is enabling us to develop common core systems using mobile devices that cleverly, casually, and gently support various activities in our daily lives.

We are concentrating our energies into our research to develop a distributed framework for mobile mixed reality (MR) systems that enable users to experience the real world enhanced with electronic information provided through mobile devices. We have developed mobile MR applications based on the developed framework: a campus guide, a wiring and facilities inspection system, and so on.

In the future, we will expand the range of research into automobiles and UAV (Unmanned Aerial Vehicle)to think extensively about "mobile computing".


スポーツ健康科学部
（2010年4月 開設予定）
プリズムハウス
セントラルアーク
学生ラウンジ
学生オフィス
SUBWAY
Etc.
アクロスウイング

Experiencing MR campus guide using mobile devices

Reality Media Laboratory

Research/Development Areas

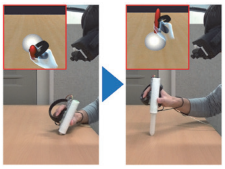
Mixed Reality and Human Interfaces Technology for Next Generation

Head researchers: KIMURA Asako, MORITA Marie

We are conducting research on next-generation human interfaces (HIs) using Virtual Reality (VR) and Mixed Reality (MR) technologies. VR allows users to experience a simulated world, while MR merges the real world with the virtual world. Our studies focus on how intuition and experience can enhance these interfaces. We also investigate human perception and cognition in these environments. Our research includes gesture user interfaces, similar to those seen in science fiction movies. We explore haptic devices and pseudo-haptic feedback systems that let users touch or feel the weight of virtual objects. We also study body augmentation and collaborative avatars in virtual worlds. Additionally, we examine how experiences in VR and MR spaces affect users' sense of self-motion, body perception, sense of body ownership, and sense of agency.

The effects of experiences in VR and MR spaces on users' sense of self-motion, body perception, body ownership, and sense of agency

Gesture user interfaces using hands, foot, eyes etc…



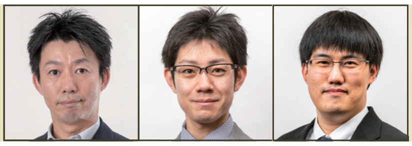
ExtickTouch: Interactive haptic device for getting contact-feeling of virtual objects

Media Technology Course

Acoustics & Signal Processing Laboratory

Research/Development Areas

R&D into the analysis, understanding, reproduction, and synthesis of acoustic sound environments.



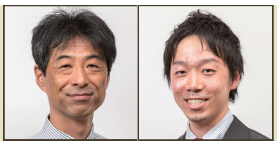
Head researchers: NISHIURA Takanobu, IWAI Kenta, Yuting GENG

We are researching the analysis, understanding, reproduction, and synthesis of acoustic sound environments using media technology for building a more pleasant living environment. In particular, we research on daily basis topics in the area of "Acoustic Sound", such as "Audio Spots" based on spotlights of acoustic sound, "Acoustic Sound Sensors" based on abnormal sound detection techniques, "Hands-free Voice Interfaces" based on the distant-talking speech capturing techniques, "Optical Laser Microphone" based on the sound reproduction techniques by scanning from vibration objects with laser, "3D Acoustic Sound Field Reproduction" based on highly realistic acoustic sound field reproduction techniques, "Active Control of Sound for Comfort Acoustic Environment" based on superposition of sound and auditory masking, and "Acoustic Planetarium" based on the design techniques of sound images with parametric loudspeakers.Furthermore, we also try to actively contribute to R&D for new acoustic systems based on the auditory scene analysis of human beings.

Spoken Language Laboratory

Research/Development Areas

Interface Technology Using Speech and Audio Signal



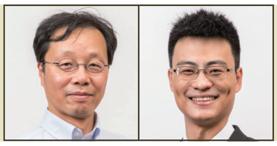
Head researchers: YAMASHITA Yoichi, FUKUMORI Takahiro

We are developing fundamental techniques for effective use, transmission, and generation of audio information such as speech and music. (1) Speech conveys paralinguistic information, which includes emotion, intension, attitude, and so on, as well as linguistic information. We extract the paralinguistic information from the user's utterance to realize a spoken dialog system which can know "what a user really wants". (2) Speech is uttered with different prosodic expressions according to the mental state of a speaker even if the linguistic contents are the same. We aim to realize a speech synthesis system which can generate expressive speech with various voice qualities. (3) Audio information plays important roles in entertainment applications. The research themes include synthesis and retrieval of a sound signal appropriate to special effects, and automatic estimation of impression and genre for music data. (4) We aim to recognize audio signals emanated in environments of daily life to understand human activities using audio information. (5) We develop a method of detecting abnormality based on audio signal analysis, such as detection of human shouts, machine noise by malfunctions, etc.

Computer Graphics Laboratory 1

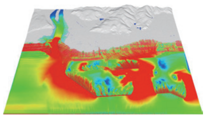
Research/Development Areas

Visualization, VR, and their application to science, medicine, and culture

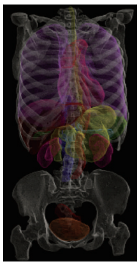


Head researchers: TANAKA Satoshi, Liang LI

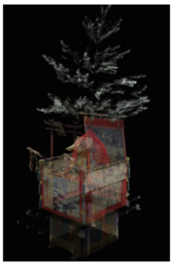
We are developing various state-of-the-art methods related to computer visualization, virtual reality, and three-dimensional (3D) computer graphics. In addition, we are advancing several research projects to utilize our methods for researches of natural science, medicine, and digital archiving of 3D cultural heritages. As for the field of natural science, by using output data of supercomputer simulation, we are visualizing the large-scale tsunami that occurred during the Great East Japan Earthquake in 2011. We are also conducting visual analysis of the tsunami that with a high possibility of occurrence in the future Nankai Trough Earthquake. As for the medical field, we are realizing ultra-high-quality 3D see-through imaging of human internal organs based on large-scale medical data that are acquired by medical measurement devices such as CT scanners. As for the field of digital archiving of 3D cultural heritages, we are digitally archiving festival floats and their background scenes of the Gion Festival in Kyoto, and we are reproducing them in the virtual space inside the computer. We are also realizing high-quality visualization of big point-cloud data obtained through 3D scanning of the World-Heritage Buddhism temple ruins of Indonesia.



Large-scale tsunami



Human internal organs



Hachiman-yama float in the Gion Festival, Kyoto Thanks: Hachiman-yama Preservation Society

Computer Graphics Laboratory 2

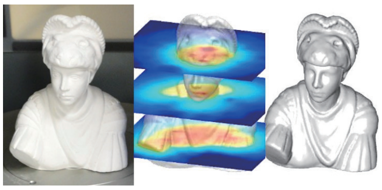
Research/Development Areas

Computer graphics and simulation of physical phenomena

Head researcher: NAKATA Susumu

The main research topic is computer simulation of physical phenomena like deformation of solids, flow of fluids and propagation of electromagnetic waves. Our approach is to combine the simulation with the techniques of computer graphics (CG) in order for accurate expression of three-dimensional geometry, intuitive operation and high visibility. We developed original techniques for shape representation of three-dimensional surfaces that contribute to accurate and efficient computation of physical phenomena. Some of our simulation techniques allow users interactive manipulation during the simulation. In fluid simulation, users can modify obstacles in three-dimensional domain and, in electromagnetic simulation, users can change shape and material parameters of objects located in the space. In addition, our shape representation is designed for effective parallel computation and efficient visualization.

Fluid simulation



Three-dimensional shape modeling

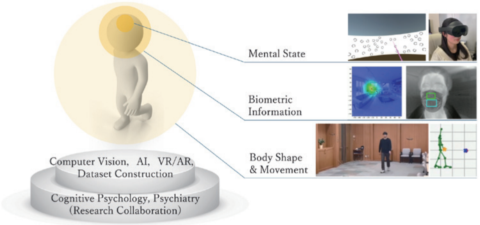
Computer Vision Laboratory

Research/Development Areas

Computer Vision Research for
Estimating People’s Mental States

Head researcher: MITSUGAMI Ikuhisa

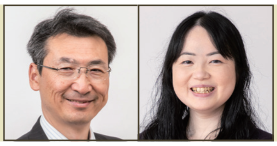
With our eyes, we can not only perceive the shape, color, texture, and other physical characteristics of objects, but we can also perform sophisticated recognition and inference of what the object is, who the person is, and what situation he/she is in. Computer vision is a research field that realizes such advanced recognition capabilities through cameras and computers. Computer Vision Laboratory focuses on computer vision in general, but we are particularly interested in the development of techniques for estimating mental states such as a person's intentions, emotions, and level of understanding. Specifically, we are working on methods to measure a person's body shape and movement, to acquire biometric information such as gaze and respiration, and to use this information to estimate the person's mental state. Furthermore, we aim to develop new knowledge and innovative technologies by taking a cross-disciplinary approach, such as using VR/AR technology to present visual information to people, and developing collaborative research to analyze and interpret human behavior in cooperation with experts in psychology, brain science, and psychiatry.


Mental State
Biometric Information
Body Shape & Movement
Computer Vision, AI, VR/AR, Dataset Construction
Cognitive Psychology, Psychiatry (Research Collaboration)

3D Vision Laboratory

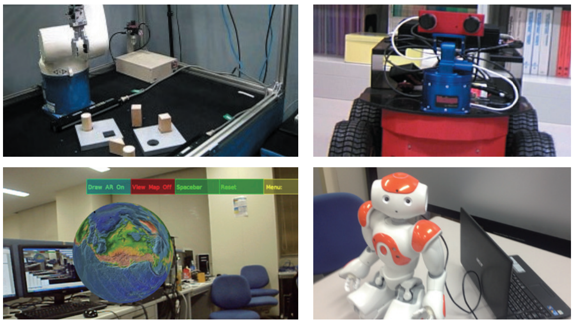
Research/Development Areas

3D Vision for Robots



Head researchers: Gang XU, TAKEMOTO Yuki

In our laboratory, we are involved in various research subjects for developing algorithms and systems to achieve 3D vision for computers so that it can be used as “eyes” for robots to operate in real environments. Some technologies developed in this laboratory have been used in products of 3D Media Co., Ltd. for factory automation. With an industrial robot, a mobile robot, a Nao humanoid robot, and various 3D vision sensors, our students enjoy research using these "expensive toys". With vision, an industrial robot can pick up, arrange and assemble industrial parts into products. With vision, a mobile robot can walk around in our building. Other examples of the systems we have developed so far are a 16-camera 3D system for realtime tracking of field sports, mixed reality with a see-through stereo head-mounted display, SLAM with a stereo camera head, 3D scanning and integration system using Kinect, etc.



Intelligent Image Processing Laboratory

Research/Development Areas

Intelligent Image Processing,
Image Understanding and
Image Recognition

Head researchers: Yen-Wei CHEN, Yinhao LI, Jiaqing LIU

Medical Image Processing and Computational Anatomy

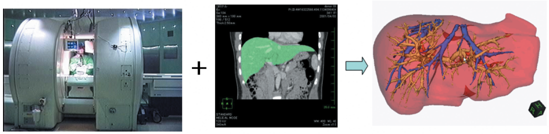
In recent years, computational anatomy has become a hot topic in medical image analysis research fields. We are working on the construction of a digital atlas of human anatomy such as the liver. The digital atlas can capture an organ’s variability, such as its position, shape, and voxel intensity (texture) from a training set, and then be used for computer assisted diagnostics.

Automatic Image Annotation and Image Indexing

With the development of digital imaging technology, more and more information is nowadays conveyed in the form of digital images or video clips. We are developing an automatic image annotation method/system in which computer vision and pattern recognition techniques are used to understand the semantic meaning of an image. Metadata, such as captions and keywords can be automatically annotated to the image for image indexing.

Facial Image Processing and Beautification

Quantitative characterization of facial appearance is an important issue in many fields and applications including cosmetic foundation design. We have constructed a multi-angle view, illumination, and cosmetic facial image database (Ma-VIC) for appearance studies. Several morphing techniques have also been developed for beautification studies.


Open magnetic resonance system (Shiga University of Medical Science)
Automatic segmentation of liver and blood vessels
Visualization and modeling of liver and blood vessels

Surgical navigation system for treatment of liver tumors

Vision and Imaging Laboratory

Research/Development Areas

Computer Vision and
Computational Imaging

Head researchers: TANAKA Kenichiro, KUSHIDA Takahiro

We develop new technologies of visual information acquisition and understanding. We do this by building computer vision and computational imaging systems that tightly couple sensing hardware and computational algorithms. Specifically, we have three main pillars of research topics: 1. Computational imaging technology to acquire new visual information by co-designing hardware and software, 2. Optical sensing device development to acquire and analyze light transport, and 3. Physics-based computer vision framework that estimates scene information including 3D shape and materials by incorporating the properties of light.

Imaging is fascinating.

Computational Neuroscience Laboratory

Research/Development Areas

Elucidating Brain Information Processing Mechanisms Using Mathematical Methods

Head researcher: KITANO Katsunori

The brain contains cells called neurons which number in the tens of billions, and which are thought to enable various functions through the trading of electrical signals called action potentials, but the mechanism itself is still not well understood. We are researching this brain functions mechanism using mathematical methods such as theoretical analysis and computer simulations. By modeling the electrophysiological characteristics of neurons, the aim is to clarify the informational processing mechanisms of the neural circuits comprising groups of neurons, and the mechanisms of information transmission at the level of the individual neurons. If this explication of the brain's information processing mechanisms advances, we hope to be able to apply it to developing methods of treating brain injuries and in interfaces that enable the brain to be accessed directly.

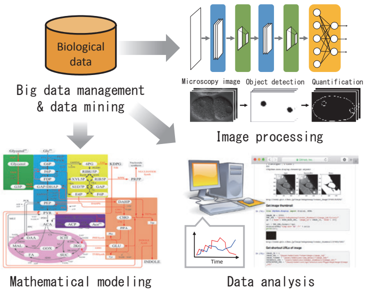
Computational Biology Laboratory

Research/Development Areas

Computational Analysis and Modeling for Biological Dynamics Data

Head researcher: TOHSATO Yukako

Recent advances of measuring and manipulating technologies in life sciences are generating biological experimental data including spatiotemporal dynamics within and between molecules, cells, tissues and entire organisms. Computational approaches for such large-scale multi-dimensional data have the potential to improve our understanding of biological phenomena such as development, aging and disease causation – toward a data-driven science. We are therefore pursuing research and development of algorithms, methods, and software tools that will enable comprehensive interpretation of such data; for example, image processing and data analysis methods using statistics, machine learning, and artificial intelligence techniques, and mathematical modeling methods based on physical and chemical laws. Our aim is to understand biological phenomena and to predict how they will be regulated under various perturbations.



Neural Information Processing Systems Laboratory

Research/Development Areas

Understanding the key mechanism of neural information processing and development of methods for measuring and analyzing neuronal data

Head researcher: TSUBO Yasuhiro

The brain is considered to use relatively small amount of energy for its efficient information processing. The goal of our researches is to clarify the principle of information processing in the brain: a flexible and energy-saving computer with low power consumption. In particular, we focus on stochastic information processing on a characteristic architecture "cortical local circuit", which is commonly observed among various cortical areas. To this end, we construct electrical measurement systems for cortical activity, record neural activities by physiological experiments, analyze the data using statistical techniques, construct mathematical models, and extract rules for cortical information processing and nonlinear dynamics. We expect taking various approaches to "cortical local circuits" gives new perspective to physics, engineering, and neuroscience.

[Current research interests]

* Stochastic information processing by neurons in the cortical local circuit
* Nonlinear dynamics of neuronal population
* Information analysis of physiological experimental data
* Statistical properties of dynamical systems of complex network

Biological Information Engineering Laboratory

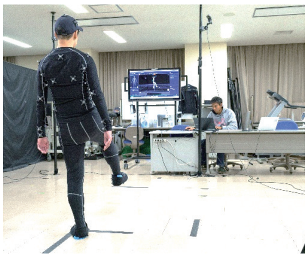
Research/Development Areas

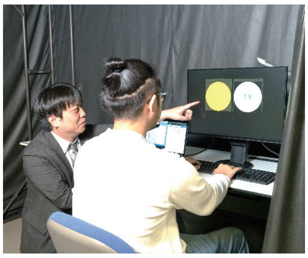
Evaluation of advanced brain activity and autonomic nervous activity by biological measurements

Head researcher: KASHIHARA Koji

The main theme of this laboratory is advanced brain activity (e.g., working memory) during cognitive processes, based on the time-frequency analysis of EEG and MEG recordings. The activation patterns of brain activity can be investigated by wavelet analysis and 3D-mapping data in a specific frequency band. In particular, we focus on the appearance of theta waves (i.e., EEG of 4–8 Hz) as neuronal activation in the frontal lobe because they indicate short-term memory and attention/concentration.

We also develop a feedback system to prevent accidents, analyzing the features of operators' attention/concentration and autonomic nervous activity (the pulse wave and ECG). Furthermore, we construct the human interfaces that reflect individual preferences and facilitate nonverbal communication, abstracting the emotional changes from microsaccadic activity and event-related potentials.





Intelligent Computer Entertainment Laboratory

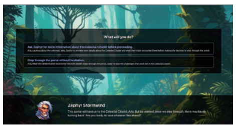
Research/Development Areas

Intelligent Techniques for Increasing the Value of Computer Games & Adaptive Artificial Intelligence in the Real World: Symbol Emergence in Robotics

Head researchers: Ruck THAWONMAS, TANIGUCHI Akira

We divide into two teams as follows.

Team RT:


What will you do?
Ask Zephyr for more information about the Celestial Citadel before proceeding.
Step through the portal without hesitation.
Zephyr Stormwind

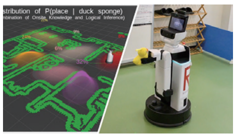
Our research emphasizes applying artificial intelligence and other intelligent methods to computer games for well-being games, live video game streaming, and digital humanities. Related basic research is conducted on a case-by-case basis as needed. We are currently pursuing the potential of generative AI, large-scale language models, and prompt engineering.

These technologies will enable us to provide more realistic and engaging — serious or non-serious — game experiences. These studies will also help game developers explore new game mechanics and create more engaging games for players.

Team AT:

Humans acquire concepts and behaviors through physical interactions with their environment and by imitating others, eventually enabling communication. To reveal such emergent intelligence will be essential for understanding human intelligence and society. This theme aims to understand human intelligence and create artificial intelligence by covering a wide range of fields including machine learning and robotics.

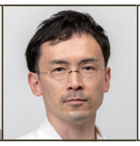
By participating in intelligent robot competitions, we have been challenging ourselves to realize robots capable of real-world communication. We are also focusing on collaborative learning between humans and machines and brain-inspired artificial intelligence.


stribution of P(place | duck sponge)

Computational Intelligence Laboratory

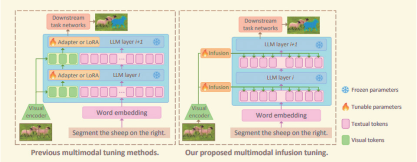
Research/Development Areas

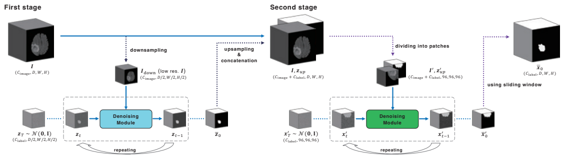
Development and Application of Computational Intelligence



Head researchers: NISHIKAWA Ikuko, SONODA Kohei, Yu SONG

Machine learning and optimization are developed for data recognition/generation, and system analysis/optimization. Deep neural networks are trained by the past data to recognize the future data or to generate required data, moreover, those are combined in a framework for the anomaly detection, domain adaptation, fine tuning of the huge general foundation model etc. The present research topics include 'Medical image segmentation based on diffusion models' to detect the small and complex shaped tumors; 'Fine tuning of the multi-modal foundation model' to train the adapters of the general backbone model for specialized complicated tasks; 'Universal domain adaptation' to transfer the acquired knowledge to other new domains. Different applications are based on common modelling and formalization frameworks which enables the training or optimization techniques. New challenges arise every year.


Downstream task networks
Adapter or LoRA
LLM layer i+1
LLM layer i
Visual encoder
Word embedding
Segment the sheep on the right.
Infusion
Frozen parameters
Tunable parameters
Textual tokens
Visual tokens
Previous multimodal tuning methods.
Our proposed multimodal infusion tuning.


First stage
Second stage
downsampling
upsampling & concatenation
dividing into patches
using sliding window
Denoising Module
repeating
I $(C_{\text{image}}, D, W, H)$
I_{down} (low res. I) $(C_{\text{image}}, D/2, W/2, H/2)$
I, z_{up} $(C_{\text{image}} + C_{\text{label}}, D, W, H)$
I', z'_{up} $(C_{\text{image}} + C_{\text{label}}, 96, 96, 96)$
$\bar{x}_0$ $(C_{\text{label}}, D, W, H)$
$z_T \sim \mathcal{N}(0, I)$ $(C_{\text{label}}, D/2, W/2, H/2)$
z_t
z_{t-1}
$\bar{z}_0$
$x'_T \sim \mathcal{N}(0, I)$ $(C_{\text{label}}, 96, 96, 96)$
x'_t
x'_{t-1}
$\bar{x}'_0$

Human Vision & Color Science Laboratory

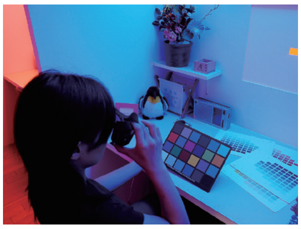
Research/Development Areas

Research on Human Visual Information Processing and Color Science using Psychophysics

Head researcher: SHINODA Hiroyuki

http://www.hvcs.ci.ritsumei.ac.jp

We investigate the characteristics of human vision systems, and apply the acquired knowledge to color science and visual environment engineering. Understanding of human characteristics is important for evaluating the functionality and comfortability of industrial products or visual environments. Light that is input to the visual system is "physical", whereas sight, which is the final output, is "psychological", so we use psychophysical methods to examine the functions and relationships that link the two. So far, we have contributed to the creation of many products, including UDcolor®, software for the colorblind, CRS®, a lighting system for the elderly, and Feu®, a brightness index for visual environment. In addition, we are pursuing a wide variety of research topics such as motion picture sickness, visual acuity defined by cortex, assessment method of cataract progress, display color management system that does not require colorimeter, and evaluation of display image quality in various visual vironments.



Advanced Computer Graphics and Digital Human Laboratory

Research/Development Areas

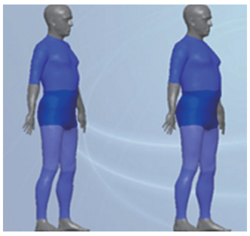
Digital Human Modeling; human motion, posture, and state analysis; healthcare, ergonomics, and sports applications; positioning and navigation; wearable sensors; motion intention prediction

Head researcher: Igor GONCHARENKO

Our laboratory research deals with human-oriented modeling and development of visualization systems using Computer Graphics and VR tools, sensory devices, and experimental databases.

We conduct body shape, posture, and motion modeling using Digital Body manikins and Digital Hand models. Digital Human Modeling is driven by real-time sensors and feedback devices (trackers, accelerometers, haptics) and utilizing experimentally collected data and Deep Learning.

Our lab also focuses on the research on pedestrian and cyclist safety systems to detect humans and recognize their motion intention. In addition, research on the usage of wearable sensors and smartphones for human motion analysis and prediction is conducted.



Affective Engineering and Computer Arts Laboratory

Research/Development Areas

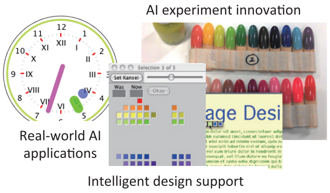
Affective Engineering, Artificial Intelligence, Computer Art Research

Head researcher: Eric W. COOPER

Affective Engineering and Computer Arts Lab (AECAL) researches and develops models to infer human affective, emotional, or sensual responses and applies these models to specific objectives. When a person is exposed to a stimulus, the experience may be associated with quantifiable internal and external responses. Because the objective systems are to satisfy specific, practical objectives, the models applied range from statistical models to methods of soft computing and intelligent systems (also known as artificial intelligence, or AI). AECAL develops new methods to meet those needs.

There are many areas where affective responses are central to the functioning of essential systems. In security, for example, user feelings lead to behaviors that may either protect or endanger data, systems, and people. In education, how students feel has a direct influence on how they. In healthcare, patient affect influences recovery and improving how patients feel is also a major final goal. In these and other areas, intelligent systems are discovering novel solutions to problems once considered beyond the scope of engineering.

AECAL also applies affective engineering and intelligent systems to the arts. Computers have often been tools for the arts but, more and more, intelligent systems are becoming full partners in the creation process in every media. In the past, many developments for the computer arts have become technologies we use every day. Computer arts today will become the innovative technologies of tomorrow because the arts have no borders.



Digital Governance Systems Laboratory

Research/Development Areas

Use of ICT and AI/ML in the public sector, applied to e-participation and e-government systems

Head researchers: Uwe SERDÜLT, Mate KOVACS, Shady SALAMA

In the Digital Governance Systems Lab we are mainly interested in how ICTs can be used to improve public services and ultimately the quality of living in a broad sense. Taking ethical considerations into account, students can either study the design of such systems or work with the data they are generating.

Key research topics in the lab include:

- Online voting advice applications (VAA), the lab experiments with and runs its own VAA;
- Internet voting systems design and usability studies, the lab is involved in further developing an open source internet voting application with a storage of votes in a blockchain;
- e-Petition systems, adding AI elements to make them more efficient for users and their administrators, analyzing petition signature dynamics;
- The use of distributed ledger technology and distributed autonomous organizations to enhance digital participation, and the analysis and visualization of time-stamped event participation network data in public administration;
- Applying NLP techniques like language modeling, automatic summarization, topic modeling, etc., to analyze and potentially improve digital governance systems, and e-petition platforms;
- Applying operations research methods and machine learning algorithms to optimize processes in industrial facilities and aid decision-making in the energy sector, a key pillar of Society 5.0.

The lab maintains research and educational contacts in Japan (Kobe, Kyoto and Waseda University) as well as internationally in Austria, Cyprus, Germany, and Switzerland.

e-Society Laboratory
"ICT for Human Enhancement"

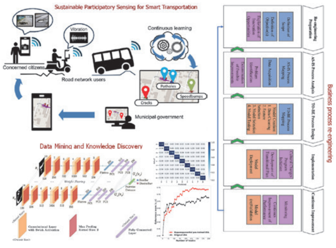
Research/Development Areas

Simulation and Modeling, Social Media Analysis, IoT, e-Society, Smart City, Smart Agriculture, Business Intelligence

Head researchers: Victor KRYSSANOV, Valentinus Roby HANANTO

The e-Society Laboratory is a multi-disciplinary, international research and learning space centering its work around individuals, social groups, organizational networks, as well as public administrations in the age of digitalization. Classical IT projects are envisaged in a broader environmental and social perspective, encompassing the exchange with experts from urban planning, mariculture and farming, management, linguistics and sociology, but also from engineering and physics. One of the distinctive features of the laboratory is its international character. The working language is English. Student members of the Laboratory are typically expected to discuss results of their work at professional meetings, including international conferences, while graduate research projects are to produce results that would be reported in international journals. Graduate student work is often coupled with overseas partners of the laboratory that include research groups from Universitas Brawijaya, Universitas Dinamika (STIKOM Surabaya), and The Technische Hochschule Nürnberg Georg Simon Ohm.

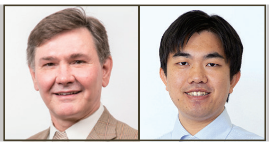
Laboratory social events include birthday tea-and-cake parties, cross-cultural picnics, and city tours.



Intelligent Robotic Systems Laboratory

Research/Development Areas

Robot dynamics, motion planning and motion intelligence, human movements, biological motor control

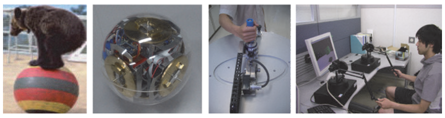


Head researchers: Mikhail SVININ, Wenbin LIU

The research directions of this laboratory are in the fields of robotics and biological systems that demonstrate aesthetically "beautiful" agile movements and provide a motivation for developing dexterous intelligent machines and robots. While living creatures demonstrate motion intelligence, our understanding of their motor behavior is not complete. On the other hand, we possess a much better understanding of how modern robots work, although they clearly have shortcomings. One of the paths toward bridging the gap between robotic and biological systems is in designing intelligent machines and control systems, based on biologically-inspired principles, classical mechanics, and control theory.

[Biological Motor Control]
- Mathematical analysis and modeling of natural human movements
- Self-organization, learning control, and emergence of motion patterns
- Biologically-inspired principles, computational models and control strategies of force and stiffness distribution in cooperative movements
- Human-robot interaction, haptic interfaces, and acquisition of skillful movements in artificial dynamic environments

[Robot Dynamics and Control]
- Dynamic models and motion planning for underactuated and non-holonomic robotic systems
- Internal forces, stability, and control strategies for cooperative movements by muscle-like parallel mechanisms and multi-fingered robotic hands
- Optimal control-based algorithms for motion and force redundancy resolution.
- Driving principles and gait control of rolling robotic systems



Visual Information Engineering Laboratory

Research/Development Areas

Visual information analysis, coding, and processing; quality assessment; perceptual modeling; image/video compression, enhancement, restoration; natural-scene statistics

Head researchers: Damon CHANDLER, Nicko CALUYA

Research in the Visual Information Engineering lab broadly concerns analysis, coding, and processing of visual information. These days, there are many sources of visual information, including digital images, video, 3D images/video, computer-generated content, and composited versions. Our research explores how these sources of information can be utilized to help society. Our overarching goal is to research and develop software and systems to: (1) make fast and reliable decisions from visual sources, and/or (2) to assess/improve the appearance, security, and usefulness of the visual content. A key theme of our research is to consider both the computational perspective and the perceptual perspective; this approach allows us to engineer models and algorithms that are aware of how the visual information is perceived by humans, and how that perception is altered based on changes to the source content, the viewing environment, and the task at hand.

Our key research topics include:
- Image/video enhancement, restoration, and compression via perceptually guided and/or machine-learning based methods
- Quality assessment of natural and synthetic images, video, 3D content
- Traditional and AI-based analysis, including detection, segmentation, and classification
- Computational modeling of the human visual system using natural-scene statistics and visual psychophysics
- Real-time analysis and processing

Some applications of our work including automatic detection and scoring of streamed visual content, perceptually lossless compression and watermarking, visual guidance for the blind, and detection, segmentation, and correction of driving video.

Core Education Program Coordinators

Jeremy WHITE

Mobile assisted language learning, Mobile learning, Digital literacy

SUGINO Naoki

Theories of second language acquisition, English language teaching

SUGIMORI Naoki

Corpus linguistics, English language teaching

Harry DAUER

English language teaching

TANIMURA Midori

English language teaching, Communication research

KATO Masaki

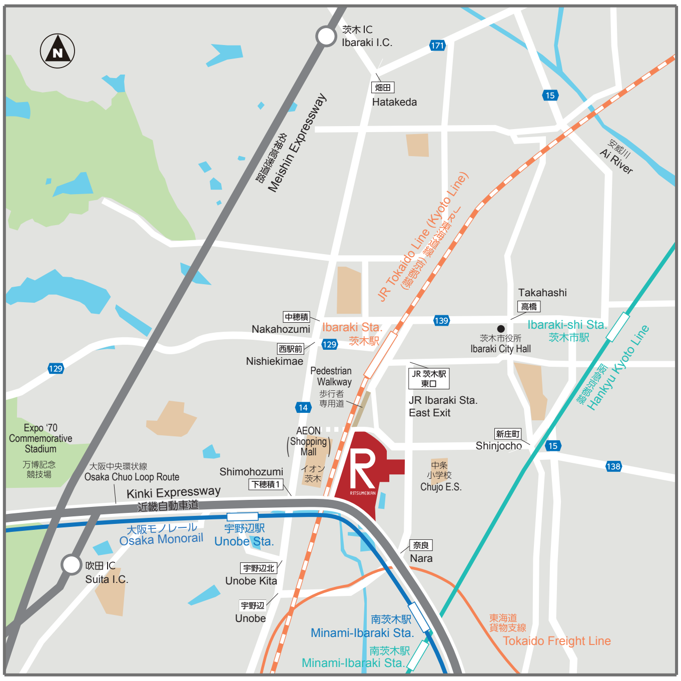
Special functions

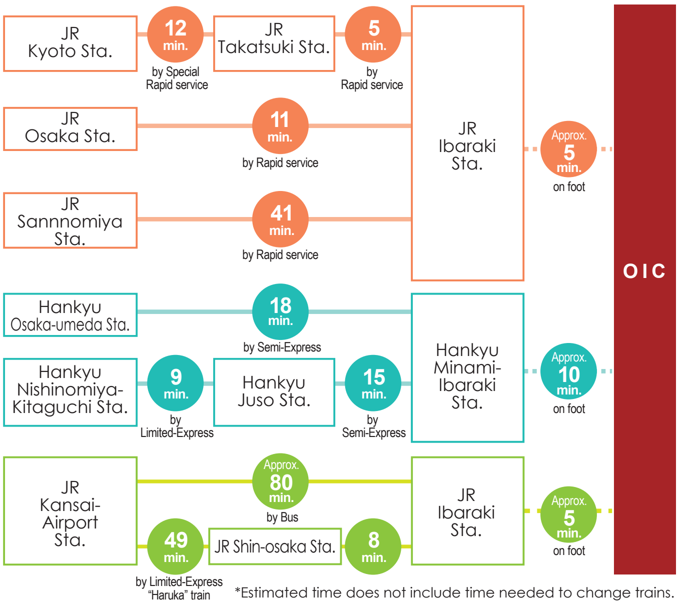
HIRAOKA Takahiro

Number theory: Arithmetic theory in quadratic form using Clifford algebra

YOSHIKAWA Toru

Japanese language education, Theories of second language acquisition


N
茨木IC
Ibaraki I.C.
171
畑田
Hatakeda
15
名神高速道路
Meishin Expressway
安威川
Ai River
JR Tokaido Line (Kyoto Line)
東海道線（京都線）
Takahashi
高橋
中穂積
Nakahozumi
Ibaraki Sta.
茨木駅
139
茨木市役所
Ibaraki City Hall
Ibaraki-shi Sta.
茨木市駅
西駅前
Nishiekimae
129
Pedestrian Walkway
歩行者専用道
JR 茨木駅 東口
JR Ibaraki Sta. East Exit
阪急京都線
Hankyu Kyoto Line
14
Expo '70 Commemorative Stadium
万博記念競技場
AEON (Shopping Mall)
イオン茨木
新庄町
Shinjocho
15
138
大阪中央環状線
Osaka Chuo Loop Route
Shimohozumi
下穂積1
中条小学校
Chujo E.S.
RITSUMEIKAN
Kinki Expressway
近畿自動車道
大阪モノレール
Osaka Monorail
宇野辺駅
Unobe Sta.
奈良
Nara
吹田IC
Suita I.C.
宇野辺北
Unobe Kita
宇野辺
Unobe
南茨木駅
Minami-Ibaraki Sta.
東海道貨物支線
Tokaido Freight Line
南茨木駅
Minami-Ibaraki Sta.


JR Kyoto Sta.
12 min.
by Special Rapid service
JR Takatsuki Sta.
5 min.
by Rapid service
JR Osaka Sta.
11 min.
by Rapid service
JR Sannnomiya Sta.
41 min.
by Rapid service
JR Ibaraki Sta.
Approx. 5 min.
on foot
OIC
Hankyu Osaka-umeda Sta.
18 min.
by Semi-Express
Hankyu Nishinomiya-Kitaguchi Sta.
9 min.
by Limited-Express
Hankyu Juso Sta.
15 min.
by Semi-Express
Hankyu Minami-Ibaraki Sta.
Approx. 10 min.
on foot
JR Kansai-Airport Sta.
Approx. 80 min.
by Bus
49 min.
by Limited-Express "Haruka" train
JR Shin-osaka Sta.
8 min.
JR Ibaraki Sta.
Approx. 5 min.
on foot

*Estimated time does not include time needed to change trains.

RITSUMEIKAN

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College of Information Science and Engineering

http://en.ritsumei.ac.jp/ise/

Graduate School of Information Science and Engineering

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