Computer System Laboratory

Research/Development Areas
- Operating Systems
- Database Systems
- Computer Networks

Head researchers: Yoshitoshi Kunieda, Hiroaki Kuwabara

Focusing on the system programs that form the core of computer systems, the High Performance Computing Software System Laboratory is working on several research approaches to increase overall computer system performance, efficiency, and functionality. The Lab’s specific system software research and development work on these objectives is always oriented toward what is feasible and practical. This work currently includes:

1. Researching and developing ways to increase the execution speed and utility of advanced parallel processing/distributed processing methods such as Cloud Computing;
2. Researching concrete system software approaches to creating safe and secure systems highly resistant to ‘Impersonation Attacks’ and ‘Process Hijacking’ (two of the major insidious software cracking techniques);
3. A software engineering approach to creating highly reliable software, through both theoretical and applied research on areas such as program analysis, model checking, concurrent computation models and type theory.

Computer Software Laboratory

Research/Development Areas
- Operating Systems
- Database Systems
- Computer Networks

Head researchers: Eiji Okubo, Yusuke Yokota

Primary research topics of the Computer Software Laboratory are operating systems, database systems, distributed systems and computer networks from a point of view of system software development. Currently we focus on the research area of sensor network systems as software infrastructure of ubiquitous computing environments. A sensor network system is composed of a large number of sensor nodes with sensors and wireless communication devices, which realizes intelligent and sophisticated tasks with coordination of numbers of nodes. Our current research projects include: personal sensing systems, sensor database, event-driven sensor network systems, high accuracy indoor localization systems, clustering techniques for energy saving, embedded systems, and P2P microstorage systems. We approach these projects from the aspect of sensor network and its related technologies.

Distributed and Collaborative Systems Laboratory

Research/Development Areas
- Creating Distributed Computing Environments to Support Coordinated Activities

Head researcher: Hideyuki Takada

Today’s computing environments have not yet reached their goal of supporting collaborative human activities. The Distributed and Collaborative Systems Laboratory is working on four areas of collaborative media research designed to promote the coordinated activities that arise in daily life.

1. “Urban Memories”. An information-sharing environment that enables mobile terminals to exchange information autonomously, promoting serendipitous discoveries of information.
2. A learning environment that lets schoolchildren work on creative collaborative activities in the classroom.
3. A collaborative development support system that enables various types of knowledge generated on software/system development sites to be organized and shared.
4. A P2P replicated object computing environment built on Java (a platform used to construct various collaborative systems).

The learning environment described in item 2 above has been incorporated into regular school curricula and holiday workshops under a partnership with organizations such as Ritsumeikan Primary School and a nonprofit organization for science education.

High Performance Computing Software System Laboratory

Research/Development Areas
- High-performance, High-reliability Software Systems

Head researchers: Yoshihito Kunieda, Hiroaki Kuwabara

Focusing on the system programs that form the core of computer systems, the High Performance Computing Software System Laboratory is working on several research approaches to increase overall computer system performance, efficiency, and functionality. The Lab’s specific system software research and development work on these objectives is always oriented toward what is feasible and practical. This work currently includes:

1. Researching and developing ways to increase the execution speed and utility of advanced parallel processing/distributed processing methods such as Cloud Computing;
2. Researching concrete system software approaches to creating safe and secure systems highly resistant to ‘Impersonation Attacks’ and ‘Process Hijacking’ (two of the major insidious software cracking techniques);
3. A software engineering approach to creating highly reliable software, through both theoretical and applied research on areas such as program analysis, model checking, concurrent computation models and type theory.

Computer Systems

Head researcher: Shigeru Oyanagi

The Computer System Laboratory researches and develops both hardware and software designs to boost the performance of the computer systems that realize infrastructure for information society.

Hardware

Parallel processing is a key issue for increasing computer system performance. Superscalar processor executes multiple instructions simultaneously. We aim to reduce instruction-level dependency by speculative execution such as branch prediction and load value prediction. Multi-core processor executes multiple processes simultaneously. The interconnection network is a key issue for decreasing communication overhead between cores. We aim to develop low cost and low latency routers for on-chip network.

Software

Data mining is an important technology to extract hidden characteristics from a huge amount of data. We aim to develop efficient algorithms for handling a huge amount of data, and applications for practical use. We are conducting research and development such as real time burst detection algorithm, efficient recommendation algorithm for EC site, filtering harmful web pages, net patrol systems, and so on.
Cyberspace Laboratory

Research/Development Areas

Information Technology for a Barrier-free Information Age

Head researcher: Hideto Ikeda

Cyberspace technology creates a virtual space on a network so that remote users can communicate and collaborate as if they were all near each other. Recent advances in virtual reality technology have enabled systems that enable physically distant users to look and sound as though they occupy the same space, but there are still barriers to natural language-based communication that haven’t been overcome. The Cyberspace Laboratory is attempting to create a multilingual cyberspace by fusing today’s computer graphics technologies with natural language processing technology. The Lab is researching and developing multilingual systems that use these technologies (such as multilingual newspapers, chat, e-learning and dictionaries), along with ways to access the systems from mobile terminals such as iPhones. As an added benefit, these systems are environmentally-friendly types that will help protect the environment.

Information Security Laboratory

Research/Development Areas

• Coding Theory
• Information Security

Head researcher: Kenji Satake

Commercial applications of internet-based communication networks now go beyond just exchanging email. Today’s applications let users exchange monetary information such as the electronic money used to shop in virtual malls. But the security problems these technologies still have are readily apparent—in recent years, the media have reported several cases of falsified information circulating on networks, or users receiving bills for communication services they didn’t use. Since secure communication technologies are intended for general use, developed applications need to be user-friendly while also incorporating high-level security features. Meeting these conflicting requirements is a vital requirement. By examining existing technologies from several perspectives, the Information Security Laboratory is aiming to create new ways to make information security applications more practical.

New Generation Computing Laboratory

Research/Development Areas

New Computing Paradigm and it’s Design Methodology

Head researcher: Shigeru Yamashita

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
  - 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.

Software Science and Technology Laboratory

Research/Development Areas

Next-generation Software Development Environments

Head researchers: Katsuhisa Maruyama, Takayuki Omori

We are exploring principles and methods that can make software construction and maintenance easier and faster, and presenting software development environments embracing these 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.

The New Generation Computing Laboratory has also been researching on environmentally-friendly types of software development environments. It leverages various kinds of web technologies to support every human activity of software construction and maintenance.
Software Engineering Laboratory

Research/Development Areas

Technology Used to Define Software Requirements

Head researcher: Atsushi Ohnishi

The Software Engineering Laboratory researches methods of eliciting software requirements from clients or users, of analyzing the elicited results, of creating specifications from the elicited results, and of managing the specifications of such requirements (Software requirements are the information used to specify the functions, performance, design constraints and so on required for the software to be developed.) Among other things, the Lab is working on the research projects below.

Using scenarios to help elicit requirements
To find problems in functions and user interfaces, the Lab develops scenario languages and uses scenarios to express the behavior of software and users. This research work includes changing scenario points of view, generating scenarios from normal scenarios, generating scenarios by replacing parts of existing scenarios, and ways of assisting scenario classification.

Using ontology requirements to help elicit requirements
To assist software analysts without domain-specific knowledge who need to elicit requirements, the Lab prepares domain-specific knowledge in the form of ontology requirements. The Lab also researches ways of compiling the elicited results into semi-formal Japanese requirements specifications.

System Software Lab

Research/Development Areas

Aiming for a Software Revolution Using Cutting-Edge System Software

Head researcher: Koichi Mouri

We research on system software, mainly operating systems (OS) and virtual machine monitors (VMM). System software is software that controls the core of computer systems, and so its power is paramount. Even if applications try to access to files, or even if they try to send data to other computers through network, OS can deny the accesses. Using this mechanism, we are developing a new OS that prevents personal information leaks even though applications have a security hole. Do you know applications which steal private information, such as address book on a smart phone? Only OS can prevent such accesses. There are so many software called malware such as comput er viruses, Trojan horses, etc. They are spreading through the world rapidly. And new types of malware appear every day. In 2010, over 280 million malwares have been found by certain laboratories. It is very important to analyze their nature to protect your computer. But we do not have enough time to analyze them because a new malware appears every 9 seconds. To solve this problem, we are developing an analyzer for malwares with virtual machine technology.

Let’s challenge to solve problems from viewpoint of operating systems!

Data Engineering Laboratory

Research/Development Areas

Lifestyle/Community Services Created by Analyzing Lifelogs

Head researchers: Hiromitsu Shimakawa, Fumiko Harada

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.

Ubiquitous Computing and Networking Laboratory

Integration of Real World with Information Space

Head researchers: Nobuhiko Nishio, Eric Cooper, Takuya Azumi

Research and development for fundamental technologies on providing services that integrate the real world with information spaces amidst the numerous computers and sensors and ubiquity of networks environment.

Bridging Smart Phones to Cloud Services
Smart phones have been equipped with full of sensors and continuous connection to the internet. We developed smart phone based persistent sensing system along with the cloud hosts mining life-log data. Human activity sensing, recognition and near-future prediction research are investigated in order to realize TPO (Time/Place/Occasion) -based applications development.

Real-World-oriented Systems
Such technologies as organizing vast world of information contents concerning with real-world things and events and characterizing users preferences in accordance with access es to those information are investigated as well as development of interactive client systems in a real-world-oriented way; a panoramic viewer of the Umeda underground city and an interaction-based navigation system.

Embedded systems
An embedded system is a computer system which is embed ded devices such as automobiles, industrial machinery, and electronics. The embedded system is one of the key technologies for ubiquitous society. We are researching and developing platform of operating systems for embedded systems and mobile devices, communication framework, cooperation of robot middleware, GPGPU, and so on.
Head researcher: Jooho Lee

Various sensors are distributed all over the human living environment and the data obtained from the sensors are processed to extract useful information, which is then shared over the network.

In this space, since people is able to receive comprehensive support from the space, the people are freed from complex interfaces or knotted system operations.

In the lab, we aim to achieve this kind of Intelligent Space, broad research from elementary technology to practical technology is studied.

Furthermore, we are researching various topics such as disaster areas, persistent interaction with artificial objects, and multi-model interfaces and so on.

The spatial condition in the area is displayed in the location where the user is watching the Ubiquitous Display (UD); When the intelligent space identifies the information required by the person, that information is displayed by using the UD, which is a physical agent of the intelligent space. As the user does not need to move to find the information source or hold the information source, the Ubiquitous Display can be called a true human-centered system.

Head researchers: Fumio Hattori, Kenta Oku

The goal of our research is to realize cyber world in which intelligent agents supports humans’ everyday life, by bridging the real world and the virtual world.

Ubiquitous User Behavior Support
Agents get the behavioral context of users using sensors, and provide appropriate services suitable to user’s location and time.

Recommendation System
New paradigm of recommendation systems are studied: Context-aware recommendation systems, Serendipity oriented recommendation system which recommend unexpected items, Recommendation system based on user-generated contents in real world, and so on.

Information Therapy
Research on supporting communication and behavior of people with intellectual disabilities using information technology are studied. We have developed a system to present topic words on the screen which trigger the conversation with aphasic user.

Head researchers: Hitoshi Ogawa, Victor V. Kryssanov

The Intelligent Communication Laboratory adopts a distributed model of computation that rests on a network of intelligent cooperating agents deployed in uncertain environments with a common goal of assisting and safeguarding humans. Active research topics include: smart rooms and intelligent spaces, expert and decision support systems, network security, intelligent robots and “robot societies,” human cognitive modeling and behavior simulation, disaster mitigation applications, social network service systems, user multimodal interfaces, and mobile computing. These specific topics are motivated by the following larger research issues: How can computer systems provide services effectively while concurrently pursuing societal and individual preferences and goals? What are the most efficient user-system interactions (communication modalities) and interaction scenarios in different real-life contexts?

The Laboratory maintains a truly international atmosphere, where student projects and research seminars are conducted both in Japanese and English. The Laboratory routinely participates in national and international research meetings, while its students make reports at major international conferences and publish in the international periodicals on an annual basis. The collaborative network of the Laboratory includes universities and companies in Japan, Switzerland, The Netherlands, and Russia. Since its establishment, the Laboratory hosts the Open Seminar-a weekly interdisciplinary, inter-faculty, and inter-university cross-cultural research meeting.

Head researcher: Toshikazu Nishimura

Global Information
On global information networks, all entities such as business sites, user terminals, mobile computers and sensors, can be connected to interact with each other without a centralized mechanism. Our aim is to establish fundamental technologies for autonomous distributed cooperative algorithms and to implement network applications and systems.

Network Applications
Since home appliances are expected to operate independently, we believe we should introduce distributed mechanism to home appliance networks. Our network protocols combine multiple appliances cooperatively and control their use to support communications among family members.

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 mechanism for WiFi 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 WiFi Hotzones.

Research on Socialware using Agent Technology
http://www.acl.cs.ritsumei.ac.jp/

Robots are controlled by autonomous intelligent agents, while a robot simulator is used to test the agents and inspect the robots’ behavior.

Head researcher: Hitoshi Ogawa, Victor V. Kryssanov

The Intelligent Communication Laboratory adopts a distributed model of computation that rests on a network of intelligent cooperating agents deployed in uncertain environments with a common goal of assisting and safeguarding humans. Active research topics include: smart rooms and intelligent spaces, expert and decision support systems, network security, intelligent robots and “robot societies,” human cognitive modeling and behavior simulation, disaster mitigation applications, social network service systems, user multimodal interfaces, and mobile computing. These specific topics are motivated by the following larger research issues: How can computer systems provide services effectively while concurrently pursuing societal and individual preferences and goals? What are the most efficient user-system interactions (communication modalities) and interaction scenarios in different real-life contexts?

The Laboratory maintains a truly international atmosphere, where student projects and research seminars are conducted both in Japanese and English. The Laboratory routinely participates in national and international research meetings, while its students make reports at major international conferences and publish in the international periodicals on an annual basis. The collaborative network of the Laboratory includes universities and companies in Japan, Switzerland, The Netherlands, and Russia. Since its establishment, the Laboratory hosts the Open Seminar-a weekly interdisciplinary, inter-faculty, and inter-university cross-cultural research meeting.

Head researcher: Toshikazu Nishimura

Global Information
On global information networks, all entities such as business sites, user terminals, mobile computers and sensors, can be connected to interact with each other without a centralized mechanism. Our aim is to establish fundamental technologies for autonomous distributed cooperative algorithms and to implement network applications and systems.

Network Applications
Since home appliances are expected to operate independently, we believe we should introduce distributed mechanism to home appliance networks. Our network protocols combine multiple appliances cooperatively and control their use to support communications among family members.

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 mechanism for WiFi 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 WiFi Hotzones.

Research on Socialware using Agent Technology
http://www.acl.cs.ritsumei.ac.jp/
Head researchers: Kyoji Kawagoe, Hung-Hsuan Huang

We are developing technology to efficiently search multimedia information such as photos, music, video, and actions, etc. We are forcefully promoting research into similar search technology for multimedia information and its applications to music databases. In addition, we are developing technology to do similarity search of photo, video and human moving trajectories, etc. Further, we are also involved in improving web information search technology. For example, we are researching recommended responses that apply to users of Q&A websites, easy-to-understand classifications of web search results, and searches tailored to user wishes. We are researching and developing data engineering (databases) and network services that efficiently manage and analyze vast amounts of information with the aim of achieving efficient information access in this era of information explosion. Finally, we are doing research on embodied conversational agents and the framework software for realizing smooth and smart human-computer interaction using the conversational agents.

Head researcher: Kazuhiro Kuwabara

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 as an online platform. In particular, we are developing specific applications by applying next-generation internet, and so-called semantic web technology and multi-agent technology. For example, we are developing “Mixchat”, a multi-lingual chat system that enables text chat using multiple languages by employing language resources such as machine translation services provided by the Language Grid. Furthermore, we are developing Yubisashi-chat ("Finger-Pointing Chat"), a software program that can share words and images that comprise chat materials in remote locations using a web browser with the aim of supporting communication with people with a cognitive handicap such as aphasia or dementia.

Head researcher: Ryozo Kishimoto

Business information systems are transforming from the existing business information systems held by individual companies into a business information service used online by many companies. These information technologies are collectively called “crowd computing”. To achieve diverse crowd computing services, algorithms are required that can detect the intelligence called the “wisdom of crowds” to accomplish search and recommendation services.

In the lab, we are researching new search and recommendation algorithms. Moreover, in the 21st century, to deal with the problems of the drying up of fossil fuels and global warming, power grids are being sought that use natural energy such as sunlight. Natural energy output fluctuates, however, so it cannot be handled using existing power systems. In the lab, we are developing proposals and protocols for smart grid architecture, which will revolutionize power grids.

Head researchers: Yoshiro Nakatani, Tomoko Izumi

We are studying “cognitive engineering”, which is used to design human-centered systems based on models of human psychological and behavioral characteristics. We apply our methodology to the following four major fields:

1. Disaster Mitigation (Resident and tourist evacuation support, business continuity management, disaster information collection, and disaster mitigation education and training, etc.)
2. Intelligent Transportation Systems (driver support information system, tourist navigation system, support people who have no sense of direction, Sunday drivers support when they restart driving, and winter road management, etc.)
3. Sensitivity Engineering (fashion coordinate support through coordination support system, tourist navigation system without detailed route information, support people who have no sense of direction, Sunday drivers support when they restart driving, and winter road management, etc.)
4. Memory Engineering (fashion coordinate support through coordination support system, tourist navigation system without detailed route information, support people who have no sense of direction, Sunday drivers support when they restart driving, and winter road management, etc.)
Network Systems Laboratory

Research/Development Areas

Research for Integration of Wireless technologies into the Internet

Head researchers: Makoto Kawai, Taku Noguchi

We are researching how to improve networks by integrating wireless technologies into the internet. We are researching communications protocols to achieve P2P(peer-to-peer) networks and increase network security, reliability and throughput, for IP multicast, ad hoc networks, and satellite communications networks. Moreover, we are also researching information network systems that not only gather, stock, analyze, display, and send disaster prevention information, but also support effective recovery from disasters without being affected by traffic concentrations or facilities damaged by disaster during an emergency.

The photo shows a video monitor system configured using PDAs (Personal Digital Assistants) and web cameras. This system consists of ad hoc networks where every wireless network device is connected each other without using any existing network infrastructure. Video information is gathered from multiple cameras via ad hoc networks, and can be delivered to multiple locations by using interconnection between the internet and ad hoc networks. We are achieving highly-scalable systems that are unaffected by disaster.

Wireless Network Systems Laboratory

Research/Development Areas

Developing intelligent wireless communication systems and new wireless spectrum resources

Head researcher: Tadahiko Maeda

Our research group, headed by Prof. T. Maeda, carries out theoretical analysis as well as experimental investigations in the field of wireless intelligent communications for the efficient use of the frequency spectrum, a scarce resource, in order to realize the emergence of a universal society with access to ubiquitous computing. Professor Maeda’s research activity covers a wide range of wireless communications. The research topics include microwave antennas, body mount antennas, Software Defined Radio, UWB systems, Adaptive MIMO systems, microwave imaging techniques, and RF measurement techniques, including the human body’s effect on antenna systems. Since 2002, our research group has also been heavily involved in research into Ultra Wide Band wireless systems and extremely high-speed data exchange networks for a future society of ubiquitous computing. In addition, our lab’s unique human equivalent phantom opens a new era in scale-model measurements, which enable scaling-up and down depending upon the practical requirements during the experimental investigations. These capabilities will allow our research group to develop new results, that few other institutions are capable of developing body area wireless networks as well as antennas for the systems.

Mobile Computing Laboratory

Research/Development Areas

Research for Enhanced Information Space Using Mobile Devices

Head researcher: Fumihisa Shibata

“Mobile computing” is a key technology for creating an enhanced information space integrating the real world and the internet. We are conducting research on ways of using mobile devices to improve our daily lives in the near future. The functions of mobile devices are becoming more refined year by year, which is enabling us to develop common core systems using mobile devices that cleverly, casually, and gently support various activities in our daily lives without the need to accommodate differences in the individual specifications of mobile devices.

We are focusing our energies on research into general-purpose architectures that enable users to experience augmented reality (AR) and mixed reality (MR), which can enhance the real world with electronic information provided through mobile devices. We have developed systems for a campus guide, wiring and facilities inspection, disaster simulation, and disaster preparedness training using just such applications. Furthermore, one of the most essential topics in the AR/MR field is geometric registration and tracking technology. We are also actively taking the lead in international standardization work to establish standard evaluation methods for geometric registration and tracking algorithms.

The photo shows a video monitor system configured using PDAs (Personal Digital Assistants) and web cameras. This system consists of ad hoc networks where every wireless network device is connected each other without using any existing network infrastructure. Video information is gathered from multiple cameras via ad hoc networks, and can be delivered to multiple locations by using interconnection between the internet and ad hoc networks. We are achieving highly-scalable systems that are unaffected by disaster.

Wireless communication system test bed for MIMO and SDR research

Self-adaptive power divider for reducing the effects of the human body

Video monitoring: systems using ad hoc networks
3D Vision Laboratory

Research/Development Areas

3D Vision for Robots

Head researcher: Gang Xu

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. used for factory automation. With an industrial robot, a mobile 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 follow roads and play football. Examples of the systems we have developed so far are binocular stereo cameras, active 3D sensing using stereo cameras and a projector, 3D object recognition using stereo cameras or a range sensor, 3D recognition and tracking of human body motion, simultaneous localization and mapping by mobile robots, etc.

Acoustics & Signal Processing Laboratory

Research/Development Areas

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

Head researcher: Takanobu Nishiura

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 "Acoustic Curtains" based on noise canceling techniques, "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, "Acoustic Sound Field Transcription" based on the archive techniques of acoustic sound fields with text, "3D Acoustic Sound Field Reproduction" based on highly realistic acoustic sound field reproduction techniques, 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

Head researchers: Yoichi Yamashita, Masanori Morise

The main research subject of our lab is the realization of a natural spoken-language interface that enables spoken dialog systems using speech recognition and speech synthesis. We are developing hands-free speech recognition techniques that can localize a sound source and segregate a target sound from background noise using a multi-microphone system instead of a close-talking microphone that is designed for use close to the mouse. We are also involved in speech synthesis research focusing on the generation of diverse characteristics in synthetic speech in aspects of speech quality and prosody. We are developing a tool to modify intonation for synthetic speech to express rich-emotional feeling, as well as to synthesize singing. Another research subject is spoken document processing to facilitate information retrieval for huge amounts of speech data. We are involved in the development of new techniques of term detection and automatic summarization for spoken documents.

Image Systems Laboratory

Research/Development Areas

Research on Digital Archiving of Tangible and Intangible Cultural Assets

Professors: Kouzaburo Hachimura, Ross Walker, Kyoko Hasegawa

Professor Hachimura has for a long time been engaged in research activities in the field of computer applications to the humanities, based on image processing and CG. Currently, he is conducting joint research with humanities researchers mostly from the School of Letters at the Art Research Center, Kinugasa campus. He is one of the leaders in “Digital Humanities Center for Japanese Arts and Cultures”, which fosters links between the humanities and information technology research. Because of this, the research topics in the lab are characterized by in-depth research into humanities-related fields. The current main research topics include image data analysis of historical paintings and documents such as Ukiyo-e paintings and classic books, and digital archiving and analysis of intangible cultural assets such as dance by using motion capture.

Department of Media Technology
We are researching 3D CG, computer-aided visualization, and related topics. In particular, we are interested in applying CG/visualization to various research fields such as physics, mathematics, medical science, geography, history, disaster prevention, the arts, and entertainment, among others. For example, to support science and engineering, we are researching function-based shape modeling, mesh-free structural analysis, GPU-based high-speed CG, simulation and imaging of time-varying 3D objects, 3D/4D visualization of plasma collision, and efficient visualization of global-scale ocean current simulation. In the field of medical science, we are researching imaging and auto detection of cancer foci and visualization of cancer-radiotherapy simulation. In the area of digital humanities, we are developing technology to create accurate digital archives of laser-scanned cultural assets such as Buddha statues, and festival floats of Kyoto, etc. The technology is derived from shape modeling and visualization based on dense 3D point sets and implicit surfaces. Automatic creation and visualization of modern/historical urban streets of Kyoto based on GIS data are also our research targets. Furthermore, in relation to all of the above, we are searching compression of large scale data related to CG and structural analysis.

A visualization system of a text by using metaphor of light and shadow in a photo.

Head researcher: Satoshi Tanaka, Susumu Nakata

Our research topic is related to processing written language which we humans use on a daily basis.

A Question Answering (QA) system is used to extract answers to a given question such as “What is …?” from a large number of documents on the Internet or newspaper articles. We are now improving our QA system to manage user interaction for ambiguous questions, and also to unify multiple similar answers into a single answer expression for a given question.

The aim of this research is to visualize linguistic information of documents. For example, our system extracts a series of numeric data such as stock and gasoline prices on from the Internet and automatically converts them into graphical representation.

In this research we analyze trend and comment information in Internet blogs and extract reputations such as positive and negative opinions. For example, our system analyzes comments and reputations of restaurants, new products, and so on, and summarizes the restaurants’ good and bad points including important opinions.

A visualization system of a text by using metaphor of light and shadow in a photo.

Head researcher: Junichi Fukumoto

The laboratory researches interaction design methods among humans and information, in order to support for discovering new knowledge in creative activity.

Text data mining methods are used for discovering frequent appearing information and less-frequent but valuable information from the huge amount of data. The methods can predict new commercial items and new research themes that will be popular.

Information visualization methods are used for understanding easily what data is. The methods transform numerical data and text data into visualized images and graphs. The below figure visualizes a text by using metaphor of light and shadow in a photo. A text related to a theme of a text are lightened. Not-related sentences are shadowed. The distribution of light and shadow shows a readability of a text.

Conversation analysis methods are used for detecting activated parts of a conversation and extracting important utterances. The methods support for making meeting minutes.

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 aided 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 (MaVIC) for appearance studies. Several morphing techniques have also been developed for beautification studies.

Head researcher: Yoko Nishihara

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 aided 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 (MaVIC) for appearance studies. Several morphing techniques have also been developed for beautification studies.

Head researcher: Yoko Nishihara

Head researcher: Junichi Fukumoto

Head researcher: Yoko Nishihara

Head researcher: Yoko Nishihara

Head researcher: Yoko Nishihara

Head researcher: Yoko Nishihara

Head researcher: Yoko Nishihara
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.
Head researchers: Katsunori Kitano, Ryota Kobayashi

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 activity potential, but the mechanism itself is still not well understood. We are researching this brain functions mechanism using mathematical methods such as theoretical analysis and computational experiments. 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.

In addition, we are also conducting research into achieving "Multi-points haptic collaboration" through ultra-realistic haptic communications that share such "Tangible" virtual environments via networks.

Currently, two national leading projects are in progress in our lab: "Multi-points hands-on training system for Minimally Invasive Surgery" supported by MIC(Ministry of Internal Affairs and Communications-JAPAN) and "Mixed reality-based Digital Museum", supported by MEXT(Ministry of Education, Culture, Sports, Science and Technology-JAPAN) based on this research success.
BioRobotics Laboratory

Research/Development Areas

Elucidating the Control Mechanisms of Human Movement

Head researcher: Takashi Mitsuda

When a person extends their arm towards a cup in front of their eyes, they are moving their arm by sending commands from the brain to their muscles. So, what is the mechanism by which the brain sends commands to the muscles? Also, how does the brain identify the position of the cup? We are researching the mechanism that creates movement commands from visual information by analyzing nerve activity and kinematic properties using models of the musculoskeletal system. Further, we are also involved in developing force display units using illusions, developing brain/machine interfaces using functional near-infrared spectroscopy (fNIRS), and gait analysis, eye movement analysis, emotional measurements from brain activity. Our lab is characterized by broad research with free rein given to the imagination with the students having independent research topics.

Soft Intelligence Laboratory

Research/Development Areas

Sensibility-Rich and Human-Like Intelligent Systems

Head researcher: Katsuari Kamei

We are researching and developing decision support systems, expert intelligence and skill acquisition systems evaluation and modeling systems for human sensibilities and emotions, and human interface and usabilities using the soft computing technologies such as fuzzy logic theory, neural networks, evolutionary computing and Kansei (Japanese term having almost same meaning as sensibility) engineering. The keywords of our researches are "sensibility-rich" and "human-like." We are developing the above intelligent systems from the viewpoint of daily life standard rather than the engineering standard. Therefore, our systems are allowed to be neither precise nor the optimal if the output is satisfied, enjoyable or useful for users.

Research Example: Emotional Fitness Project

Physical fitness (PF) is exercise intended to maintain physical health, such as reducing weight and increasing physical strength. Unfortunately it ignores sensibilities such as fun and joy and focuses on only the exercise strength and calorie consumption. So everybody feels that the exercise is hard and tough, not fun. Consequently, the exercise is not continued. In our lab, we propose the emotional fitness (EF), which is an exercise to maintain the emotional and sensibility health care through the alleviation of stress and the good post-exercise feeling. According to our research results, the exercise strength of EF is lower than that of PF and there exists the personal optimal exercise strength. Now, we are verifying scientifically the validities of EF through the indoor and outdoor jogging experiments.

Emergent system laboratory

Research/Development Areas

Adaptive intelligence of human and society from the view of emergent system

Head researcher: Taniguchi Tadahiro

Human intelligence is never designed directly, but it is grown. Babies cannot walk and speak languageds when they are born, however, over time they acquire these behaviors by interacting with others and environments and by imitating others’ speech and movement. To understand human intelligence and dynamics of society, it is necessary to reveal properties of emergent intelligence.

To understand human intelligence we are employing constructive approach. We adapt several techniques including machine learning, robotics, and agent simulation to imitate the human developmental adaptation process. In addition, we are also focusing on the application of intelligent information technology to society and the communication of the various natural languages.

Intelligent Computer Entertainment Laboratory

Research/Development Areas

Intelligent Techniques for Increasing the Entertainment Value of Computer Games

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

Head researchers: THAWONMAS, Ruck, RINALDO, Frank

Artificial Intelligence Applications

Here we research applications of artificial intelligence (AI) techniques, such as machine learning, to automatic game controllers and non-player characters (NPCs). In addition, we aim at being the first at the related international AI contests. We came in first at the CEC 2011 Ms Pac-Man vs Ghost Team Competition for our believable bot and at the 2K BotPrize 2011 (IEEE CIG 2011) for our believable bot.

Community Mining

In order to win the online-game market, it is essential to create contents that suit with the users. Current main research projects include “visualization of player movements”, “bot detection with artificial intelligence techniques”, and “prediction of game retirement timings”.

Automatic Comic Generation

The main aim here is to assist players recall their play memory and to use comic for promoting communication among them. We are currently optimizing the following algorithms: “frame extraction”, “page layout”, and “camerawork-control”. We won the KES IMSS 2011 Best Research Paper Award.
Computational Intelligence Laboratory

Research/Development Areas
Development and Application of Computational Intelligence

Head researchers: Ikuko Nishikawa, Kazutoshi Sakakibara

Computational Intelligence is developed and applied to various systems, through the system modeling, simulation and analysis. Our research fields include the optimization of social systems, the prediction in bioinformatics and the analysis in neuroscience. The present targets are:

1. Bioinformatics: Protein glycosylation is predicted by machine learning to elucidate the mechanisms, followed by the biological experiments. A joint research with a bioinformatics group.
2. Brain simulation: A whole brain of an invertebrate is modeled based on the latest multi-scale experimental data, and simulated on the supercomputer, aiming to understand the adaptation mechanism in the brain. A joint project with a neuroscience group.
3. Optimization and scheduling in the transportation system: Heuristic and exact approaches are used for the optimal transportation by an adaptive scheduling of the production, storage, allocation and routing.
4. Decentralized autonomous network of the renewable energy: A stable and efficient energy network is analyzed based on the real data.

Human Vision & Color Science Laboratory

Research/Development Areas
Research into Human Visual Information Processing and Color Engineering Using Psychophysics

Head researchers: Hiroyuki Shinoda, Yasuhiro Seya

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 Peuv, a brightness index for visual environment. In addition, we are pursuing various research topics such as research into the motion picture sickness, the development of methods to measure eye strain, the development of methods to easily measure glaucoma, the visual acuity controlled at the level of the brain, evaluating legibility by measuring eye movement, and color management that does not require colorimeter.

Human Robotics Laboratory

Research/Development Areas
Human Modeling and Its Application to Design and Control of Advanced Human Machine Systems

Head researchers: Takahiro Wada, Seiji Sugiyama

Human Robotics Laboratory conducts research on intelligent mechanical systems which are operated or worn by humans such as rehabilitation robots, prosthetic systems and automobiles. Our research areas span understanding human functions and its application to design and control methodology of intelligent mechanical systems with comfort and high usability.

[Car Robotics]
- Advanced driver assistance systems
- Modeling motion sensation characteristics and comfortable vehicle motion control
- Driver status estimation methodology
- Intelligent transport systems (ITS)

[Rehabilitation Robotics]
- Development of lower extremity prosthesis (artificial leg) with capability of stair ascent
- Development of powered orthosis systems

[Intelligent Robotics]
- Navigation methodology of mobile robots
- Motion generation method for humanoid robots

Micro EV with driver assistance system
Lower extremity prosthetic system
The purpose of my research is to create a usable security system. My research method focuses on meeting security demands by integrating scenario, prototyping, and aspect oriented design with demand and software engineering tools to create a safe and easy to use security system. In addition, my research is expanding to include using IT management and offshore techniques.

Professor: Chidori Nakamura
Linguistics, Japanese language teaching

Associate Professor: Harry Dauer
English language teaching, LZ Reading and Schema Theory.