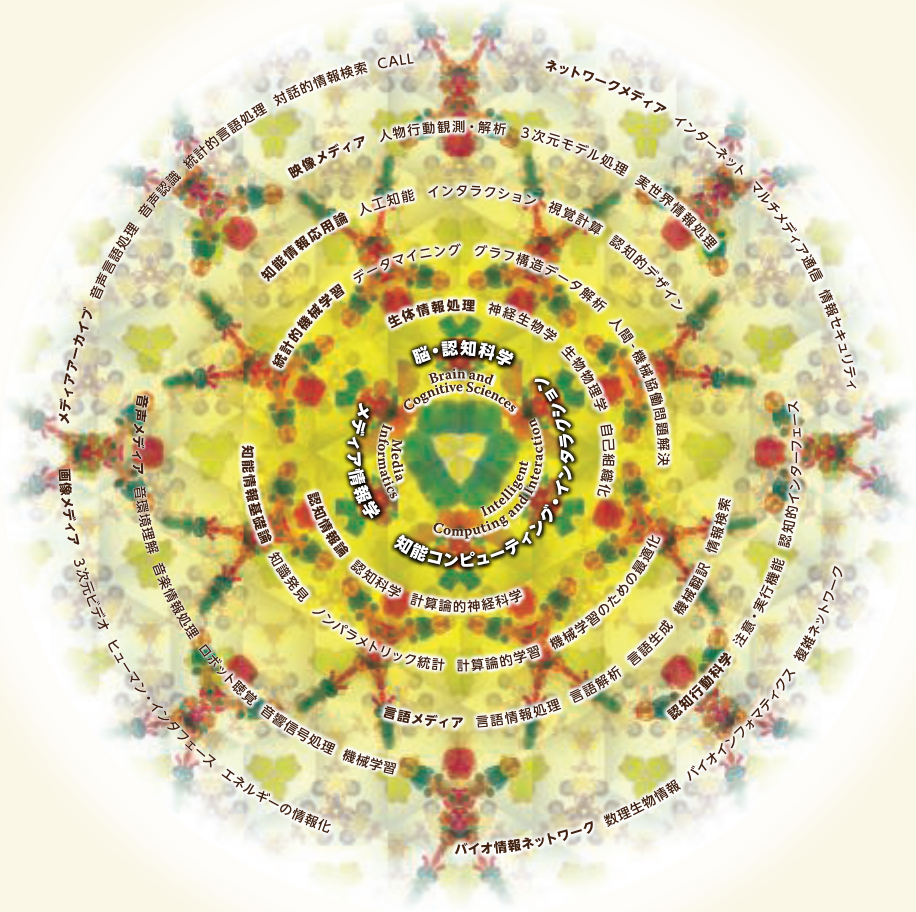
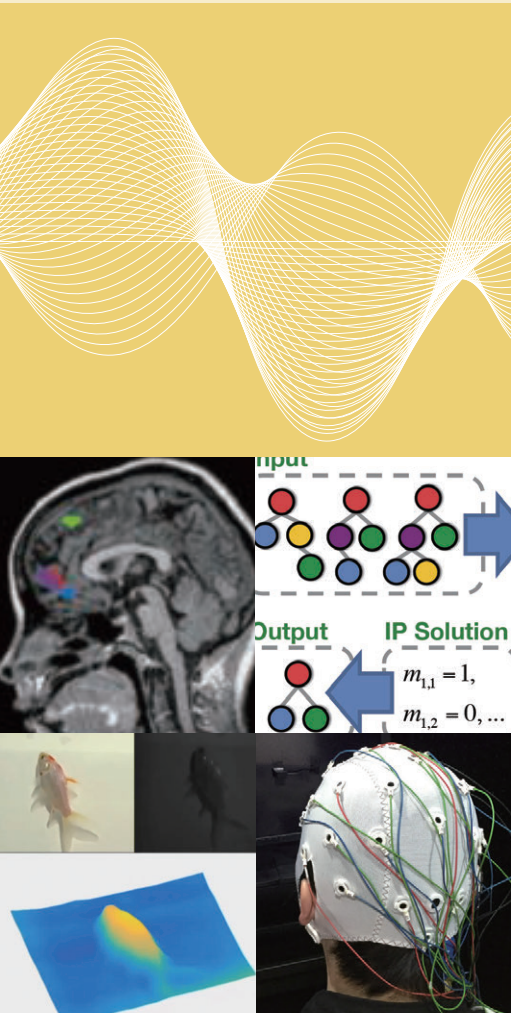
Construction and Elucidation of Intelligence, and Realization of Flexible, Human-like Information Processing.

In an advanced information-oriented society, information processing with flexible, human-like information capabilities becomes essential. Information processing in human and animal organic systems is unparalleled in nature which has developed through structural and functional adaptation to the environment in the long process of evolution. Intelligence Science and Technology is a multidisciplinary field that aims to elucidate the mechanisms of biological-, particularly, human-information processing for the development of higher-level information processing.





Welcome to Intelligence Science and Technology Course

Intelligence Science and Technology is an interdisciplinary research field in which we study sophisticated human information processing and develop new technologies on the basis of an understanding of human intelligence. By "intelligence," we do not mean simply "artificial intelligence" but rather a wider scope embracing intelligent aspects of human, systems, and information technology. More specifically, foci of our research and educational activities include (i) basic mechanisms of human beings, such as life, brain, cognition, and behavior, (ii) information media related to language, speech/auditory, and visual information, and (iii) a broad range of topics related to intelligence and informatics, such as interaction between human and intelligent systems, artificial intelligence and machine learning, and software and networks.

One of our distinguishing features is integration of these topics under a unique discipline, "intelligence science and technology," notwithstanding that these topics are also investigated in separate research fields such as neuroscience, psychology, engineering, and computer science. Faculty members and students coming from a wide variety of academic backgrounds devote themselves to cooperating in pursuit of this common goal. We hope that, in this unique academic environment, many young students will engage in this exciting research field, tackle the mysteries of complex human intelligence, and develop new ideas for addressing challenging issues regarding intelligent media and computation.

Our course welcomes outstanding students from various fields besides those of computer science and engineering. We provide interdisciplinary curricula and research projects. Join us, and enjoy an intellectually exciting experience!

Shin'ya Nishida

Professor, Intelligence Science and Technology Course

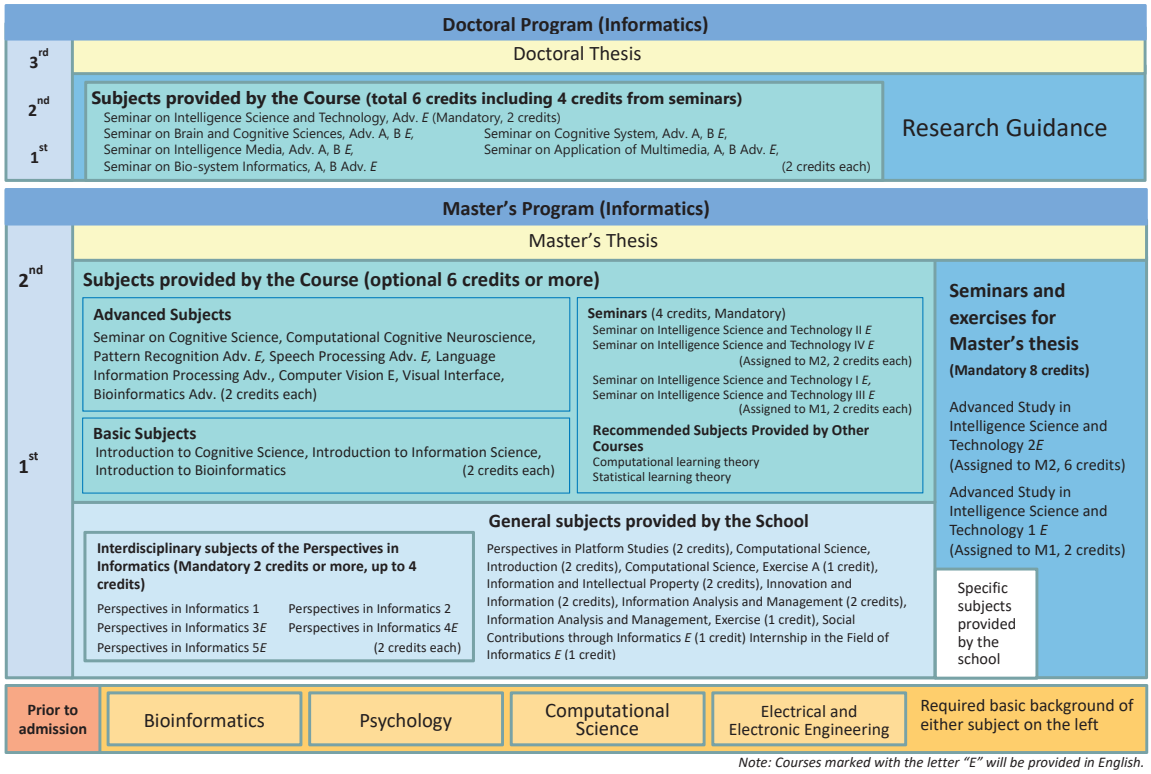
1990 Research Associate, ATR Auditory and Visual Perception Laboratories
1992 Research Scientist, NTT Basic Research Laboratories
1996 Ph.D., Kyoto University
1999 Research Scientist, NTT Communication Science Laboratories
2019 Professor, Kyoto University

Outline

Group and Teaching Staff

Group	Teaching Staff
Neuroinformatics	Yukiyasu Kamitani/Professor Yukiori Goto/Associate Professor Hiroshi Hosokawa/Senior Lecturer Yoshihiro Nagano/Assistant Professor Shingo Maegawa/Assistant Professor
Psychoinformatics	Takatsune Kumada/Professor Ryoichi Nakashima/Associate Professor
Cognitive Informatics	Shin'ya Nishida/Professor Hiroaki Mizuhara/Associate Professor Kiyofumi Miyoshi/Assistant Professor
Computational Cognitive Neuroscience (Adjunct Unit)	Hiroyuki Nakahara/Adjunct Professor Wataru Sato/Adjunct Associate Professor(RIKEN)
Computational Intelligence	Akihiro Yamamoto/Professor Nozomi Akashi/Assistant Professor
Collective Intelligence	Hisashi Kashima/Professor Koh Takeuchi/Assistant Professor Han Bao/Program-Specific
Conversational Informatics	
Language Media Processing	Sadao Kurohashi/Program-Specific Professor Yugo Murawaki/Senior Lecturer Chenhui Chu/Program-Specific Associate Professor Fei Cheng/Program-Specific Assistant Professor Yin Jou Huang/Program-Specific Assistant Professor
Speech and Audio Processing	Tatsuya Kawahara/Professor Kazuyoshi Yoshii/Associate Professor Koji Inoue/Assistant Professor Keiko Ochi/Program-Specific Assistant Professor Eita Nakamura/Program-Specific Assistant Professor
Computer Vision	Ko Nishino/Professor Shohei Nobuhara/Associate Professor Marc Aurel Kastner/Assistant Professor
Human Sensing	Yuichi Nakamura/Professor Kazuaki Kondo /Associate Professor Kei Shimonishi/Assistant Professor
Text Media	Shinsuke Mori/Professor Hirotaka Kameko/Assistant Professor
Biological Information Networks	Tatsuya Akutsu/Professor Takeyuki Tamura/Associate Professor Tomoya Mori/Assistant Professor

Curriculum of Intelligence Science and Technology Course

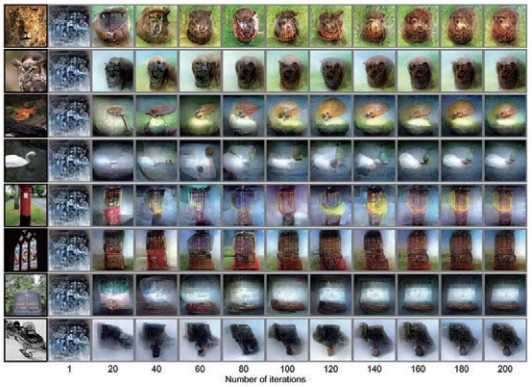


Note: Courses marked with the letter "E" will be provided in English.

Brain and Cognitive Sciences

Decoding neural codes

Brain signals can be seen as "codes" that encode our mental contents. We study methods for modeling brain functions and representations using information science and technology including machine learning and artificial neural networks. Our approach is based on data-driven predictive models that relate brain data and mind states via analysis of massive neural, behavioral, and multimedia data. Using these models, we aim to understand basic principles of neural information processing, and seek to develop real-life applications such as brain–machine interfaces that exploit decoded brain information.



[Yukiyasu Kamitani , Yukiori Goto , Hiroshi Hosokawa , Shingo Maegawa , Yoshihiro Nagano]

Psychoinformatics

Toward understanding human cognition and applying it to human-machine interface

Human activities in daily life are supported by basic cognitive functions, such as perception, attention, memory and high-order executive control. We investigate the psychological and neuroscientific bases of these cognitive functions (especially focusing on attention and executive function), using psychological experiments, brain-imaging and computational techniques. We are interested in human behavior not only in well-controlled experimental settings in a laboratory, but also in real-world settings such as IT-equipment use and real car driving. We are also interested in cognitive functions in a wide range of populations, from healthy young adults to older or disabled individuals.

An experiment examining eye and action coordination

[Takatsune Kumada , Ryoichi Nakashima]

Outline

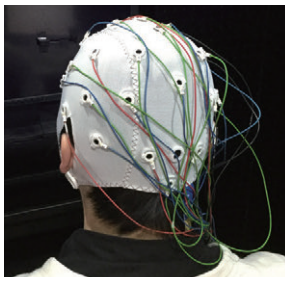
Cognitive Informatics

Understanding Human Sensory and Cognitive Information Processing

Our lab studies the computational principle and the neural mechanisms of human functions including perception, cognition and language processing, by means of psychophysics, computer simulations and EEG recordings. By comparing human brains with cutting-edge artificial intelligent systems, we attempt to reveal the characteristic nature of the human information processing. We are also interested in leveraging human scientific studies for innovation of information technologies.

[Shin'ya Nishida , Hiroaki Mizuhara , Kiyofumi Miyoshi]

Material perception is one of our research topics.



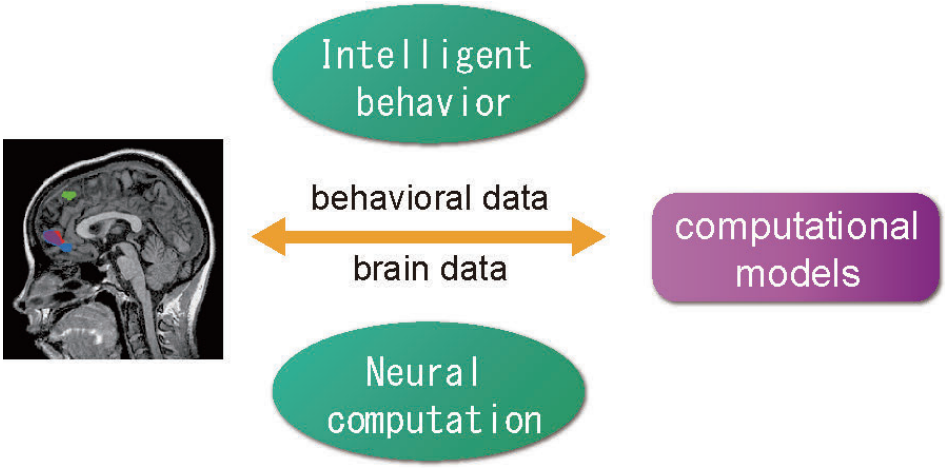
Brain researches by EEG measurements

Computational Cognitive Neuroscience (Adjunct Unit)

Neural information processing and computational models

We aim to understand the computational principles that underlie the way neural systems realize adaptive behavior and complex minds: e.g., decision-making, reinforcement learning, motivation and emotion, and social behaviors. Our approaches are tightly linked to statistical and information science including machine learning and neural networks, as well as to questions in neuroscience and psychology. To address our questions, we build computational and mathematical models, and develop data analysis methods for linking those behavioral functions and brain signals through computations. We use human fMRI to examine neural signals and computations, combined with those modeling and quantitative methods. We also seek to use our insights to be applied to constructing brain-based intelligence.

[RIKEN: Hiroyuki Nakahara , Wataru Sato]

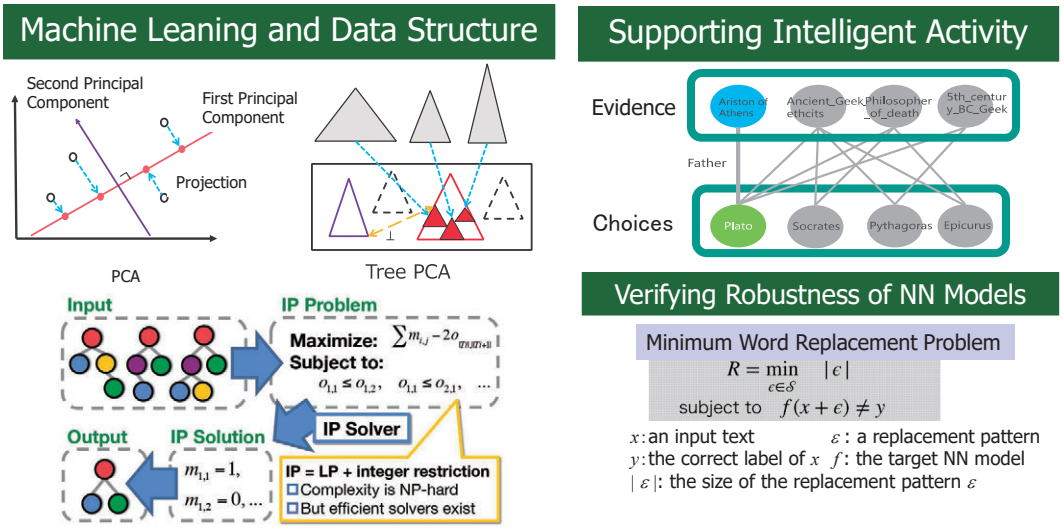


Computational Intelligence

Formulation of principles to support intelligent information processing

We will formalize the intelligent information processing seen in human activities and conduct studies on the basic principles that underlie these processes, as well as realization methods. Specifically, this will involve education and research relating to artificial intelligence information processing such as inductive logic, knowledge discovery, hypothetical reasoning, and evolvable computers, using mathematical logic, inference procedures, machine learning theories and self-organization.

[Akihiro Yamamoto , Nozomi Akashi]

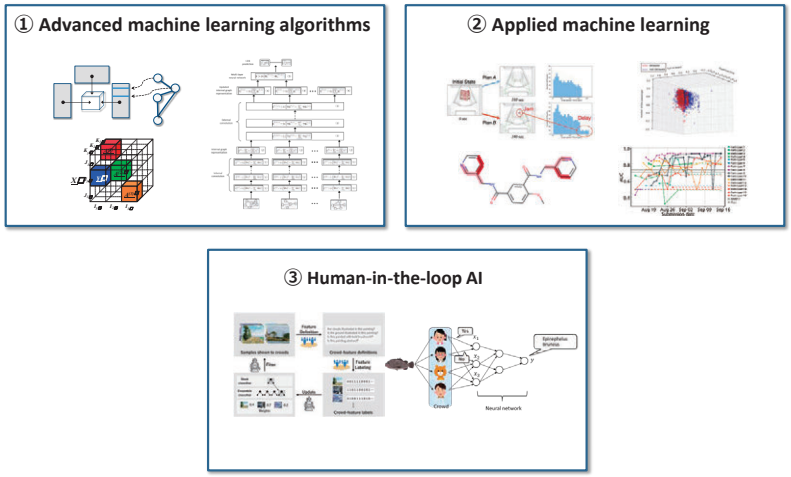


Collective Intelligence

Machine Learning That Matters

Our research focus is on the development of fundamental technologies for intelligent information technology, with a focus on machine learning, and their real-world applications. While pursuing R&D on new problems and methods of machine learning and data analysis, we also tackle various challenges in science and business. At the same time, we conduct research on methodologies for solving challenging problems that are difficult to address by AI or humans alone, by combining AI with human power.

[Hisashi Kashima , Koh Takeuchi , Han Bao]

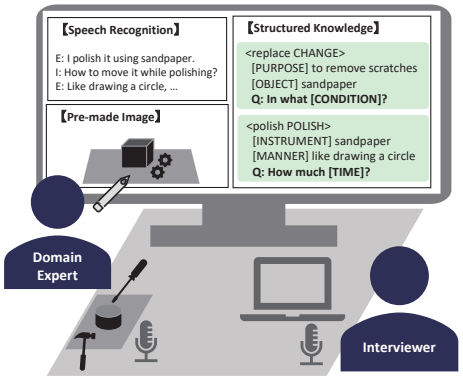


Outline

Language Media Processing

Making computers that can understand language

Since language lies at the core of human intellectual activity, the emergence of computers capable of freely manipulating language will significantly impact society in a broad variety of ways. With this goal, we are engaged in research to shed light on how humans utilize language and to enable computers to communicate using language in human-like ways. We are pursuing both pure research on language understanding based on large-scale language models and applied research for useful real-world purposes, such as translation, dialogue, and knowledge structuring.

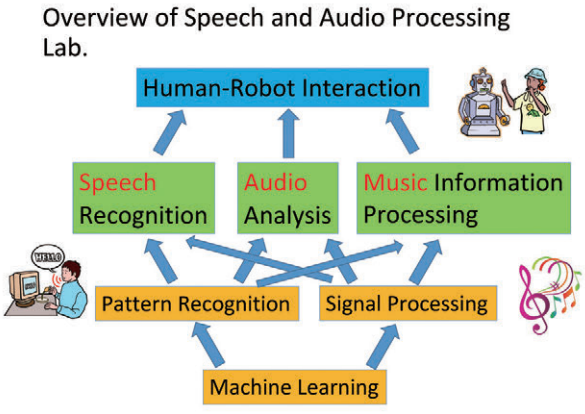


[Sadao Kurohashi , Yugo Murawaki , Chenhui Chu , Fei Cheng , Yin Jou Huang]

Speech and Audio Processing

Recognition and understanding of speech, audio and music

Speech communication plays a key role in human intelligence. We are studying the intelligent processing of speech, audio and music as exchanged by human beings for automatic recognition, understanding and interaction systems, specifically (1) automatic speech transcription of meetings and lectures, (2) analysis of audio scenes and music signals composed of multiple sound sources, and (3) humanoid robots capable of natural interaction by combining non-verbal information.



[Tatsuya Kawahara , Kazuyoshi Yoshii , Koji Inoue , Keiko Ochi , Eita Nakamura]

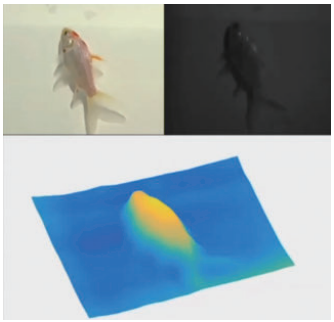
Computer Vision

Making Computers See

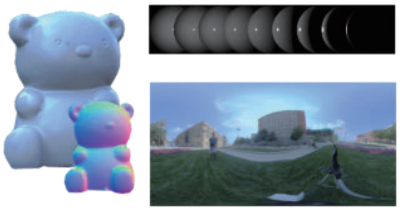
Neural substrates dedicated to vision are said to occupy about 40 percent of the cerebral cortex. Realizing computer vision as a truly intelligent perceptual modality is fundamental for artificial intelligence, and would also inform our understanding of human visual intelligence. Towards computational visual intelligence, our research is focused on establishing the theoretical foundations and efficient implementations of computational methods for better understanding people, objects and scenes from their appearance in images and video, as well as the development of novel computational imaging systems that can see beyond what we see.

[Ko Nishino , Shohei Nobuhara , Marc Aurel Kastner]

Tracking People in Crowds



Shape from Water



Reflectance and Natural Illumination from a Single Image

Outline

Human Sensing

Toward human-centered information and machine systems through visual and embodied interactions

The main purpose of this group is to create information media and mechanical systems that support human with respecting their subjective actions.

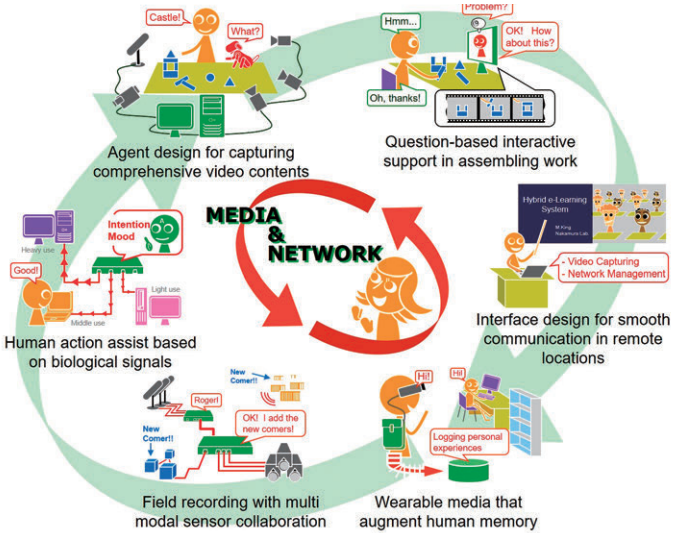
Such media include watching over humans to provide supports in appropriate way and time, supplying only deficient force in motions, interfaces that connects humans and computers, and assisting human memory.

A common approach in all of these media is that information or mechanical systems notice human's intention and augment their abilities for meeting what they want to do.

To realize this support scheme, this group is engaged in basic researches involving (1) artificial intelligence and knowledge processing, (2) recognition of human physical and physiological activities using visual, acoustic, and biological measurements, (3) modeling human behaviors in motion and communication, while (4) designing and implementing the human-centered supporting media using (5) robotic and artificial agent control technology.

- Interface of visualizing human intentions inferred from motions
- Wearable computers for recording and supporting personal/group experiences
- Motion assist based on behavioral analysis using electromyography
- Facial expression recognition for health science and care of dementia persons
- Joint research using image analysis and AI with other laboratories and research centers within and outside of Kyoto University

[Yuichi Nakamura , Kazuaki Kondo, Kei Shimonishi]



Text Media

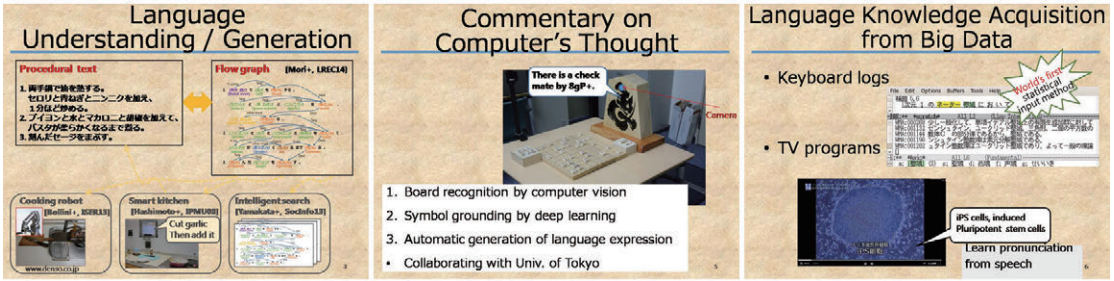
Speech and Natural Language Processing for Multi-media Archives

Since time immemorial human knowledge has been recorded as text. The research activities of this group focus on computers capable of understanding these texts and describing new knowledge. As a basis we are studying fundamental natural language processing. And we are studying natural language generation to explain data analysis and future prediction by computer or to describe other media such as video and speech.

Specifically, we deal with real-world media, including procedural texts such as cooking recipes with execution videos, academic knowledge such as history/geography research, and game/data analysis by computers.

We also try to expand human knowledge based on our research results.

[Shinsuke Mori , Hirotaka Kameko]

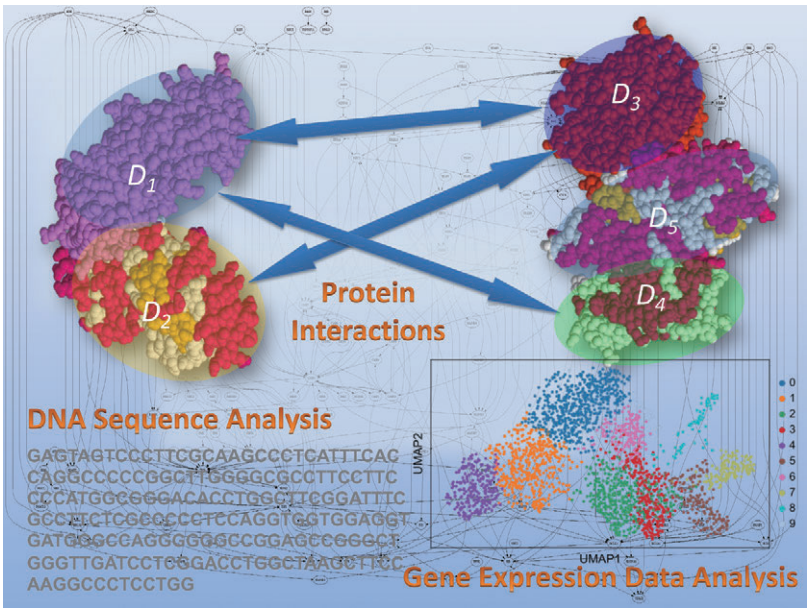


Biological Information Networks

It for analysis of biological information

We develop algorithms for inferring interactions among genes, proteins and chemical structures, and for analyzing their interactive networks based on mathematical methods. We also develop algorithms and software tools for other problems in bioinformatics, including sequence analysis and inference of higher-order structures and functions of protein.

[Tatsuya Akutsu , Takeyuki Tamura , Tomoya Mori]



Analysis of three-dimensional structures and interactions of protein