Reliability for Electronic Components and System

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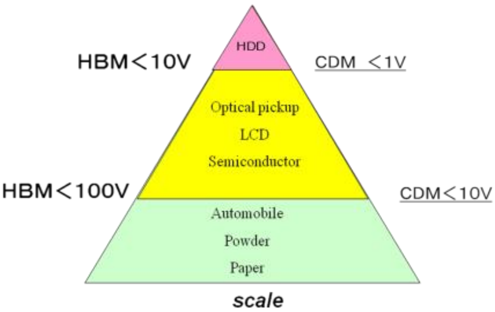
Job Title	Professor	Degree	Doctor(Engineering)
Academic Society and Association	The Institute of Electrostatics Japan The Institute of Electrical Engineers of Japan		
Research Keywords	Electromagnetic environment, ESD measurement, Plasma surface treatment		
Technical Fields and Topics possible for collaboration	・ Measurement technology of Electrostatic discharge phenomenon. ・ Development and evaluation technology of ESD protection materials. ・ Surface treatment by atmospheric pressure plasma. ・ Support for product development using TRIZ.		

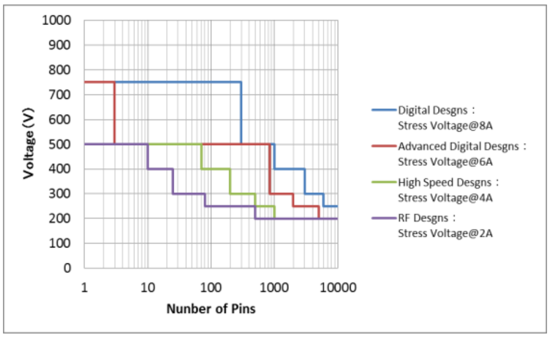
Details of the Research Theme

Reliability improvement for Electronic Components and System for Nursing robots, Communication robots, Automobile, Self-driving car, Drone transport, Manufacturing Process, Medical equipment, Aerospace aircraft, Next-generation power supply network.

【1】 ESD protection Technology

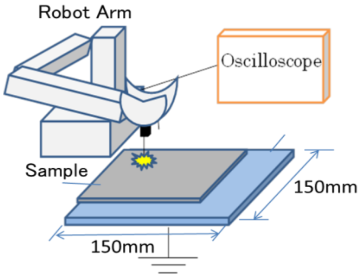


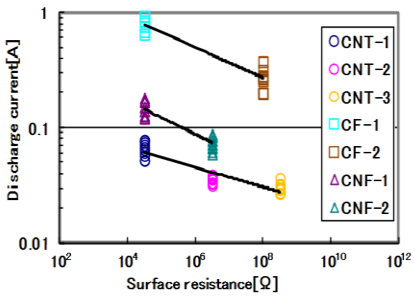
Hierarchy of ESD protection



ESD voltage roadmap of semiconductor

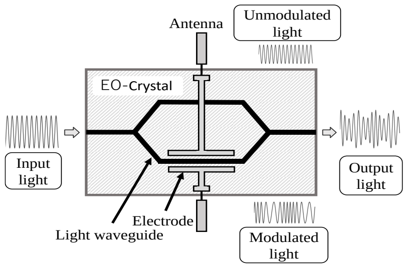
【2】 Material development and Evaluation





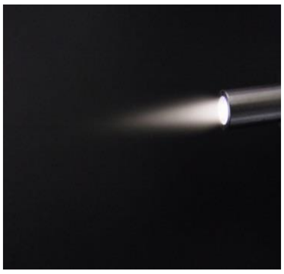
Characteristic of ESD protection material

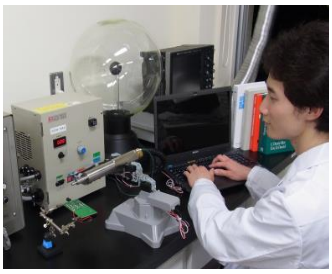
【3】 Measurement Technology



Optical E-Filed sensor

【4】 Surface treatment by atmospheric pressure plasma





Atmospheric pressure plasma

Inverter Control Using Vector Frequency Modulation

Name	Takano Akio	E-mail	takano@numazu-ct.ac.jp
Job Title	Professor	Degree	Doctor of Engineering
Academic Society and Association	IEEJ, IEEE		
Research Keywords	Power Electronics, Energy Conversion		
Technical Fields and Topics possible for collaboration	・ Inerter Control Using Power Electronics Techniques ・ Motor Control ・ Vector Frequency Modulation for Power Converters		

Details of the Research Theme

Inverters are power converters that convert direct current into alternating current. A typical modulation method for the inverters is pulse width modulation (PWM). This method, in principle, requires a comparator, and when applied to three-phase, it is necessary to generate a signal for each phase. .

Vector frequency modulation (VFM) does not require a comparator in principle, and when applied to three-phase, batch processing can be performed. VFM is a modulation method developed in our laboratory. VFM is a complete software process, and is suitable for digital control of electric motors. Currently, we are promoting the application to various inverters of VFM.

Fig. 1 is the example of the system structure. Fig.2 is the magnetic flux of the motor. The flux rotation speed is controlled by VFM . In this case, f is a frequency command, ○ is a zero voltage vector, and a black line is a non-zero voltage vector's orbit. Fig. 3 shows the voltage waveforms of the VFM inverter in steady state. Fig.4 shows the transient current waveforms and the motor speed when the automatic phase-change is performed.

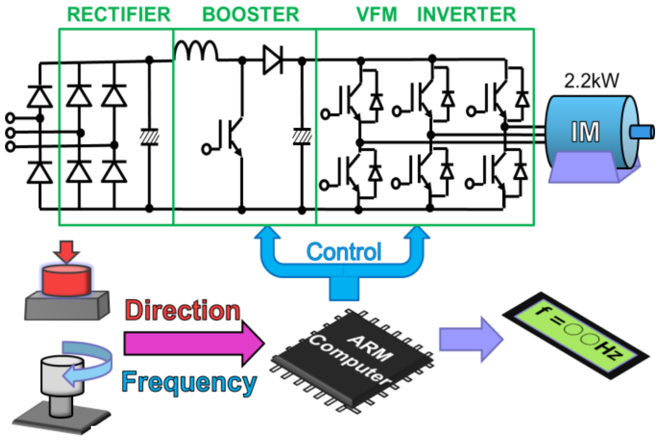


Fig. 1 System structure

Fig. 3 Voltage waveforms in steady state

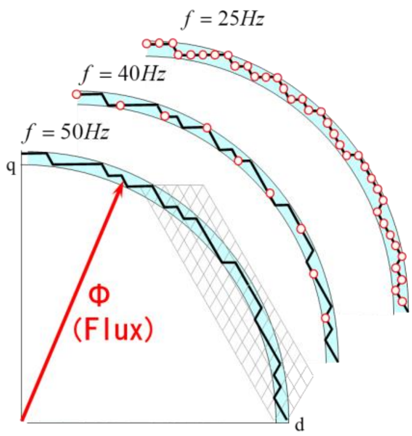


Fig. 2 Magnetic flux controlled by VFM

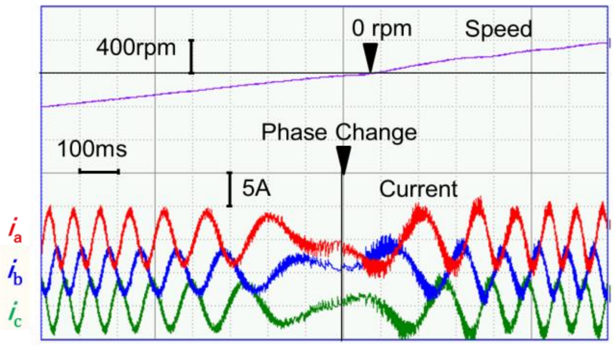


Fig. 4 Automatic phase-change in transient state

Simulation of surface wall interactions in nuclear fusion plasma

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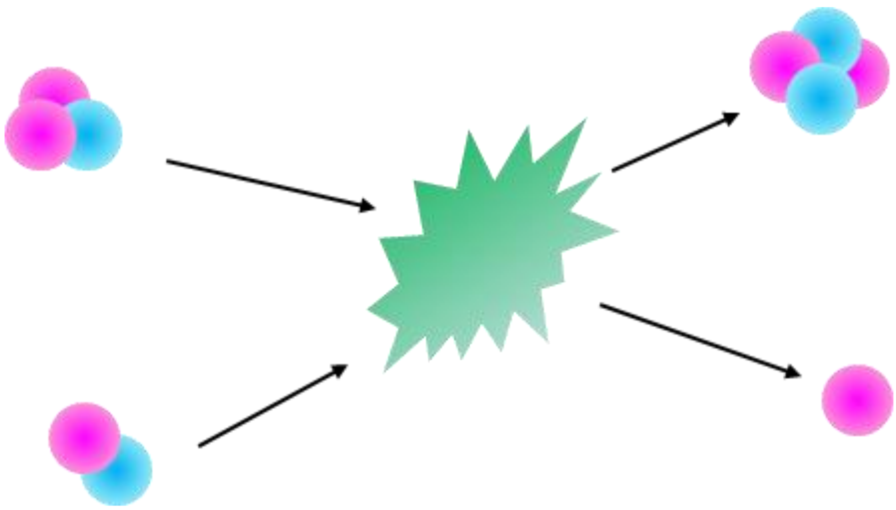
Job Title	Professor	Degree	Doctor of Engineering
Academic Society and Association	The Japan Society of Plasma Science and Nuclear Fusion Research The Institute of Electrical Engineers of Japan		
Research Keywords	Nuclear Fusion, Plasma, Simulation		
Technical Fields and Topics possible for collaboration	・ Analysis of the transportation process of the hydrogen isotope fuel in gas and the solid ・ Simulation of surface wall interactions in nuclear fusion plasma		

Details of the Research Theme

About a nuclear fusion study, simulation programing to develop a nuclear fusion reactor is carried out to contribute to the solution to energy problem. The nuclear fusion generation is relatively safe and is a clean generation system. As the fusion reaction was the same as a phenomenon to be taking place in the sun, the artificial sun would be made if this was realized. Materials evaluation to make such a device, the evaluation of the materials which are appropriate by the development of the simulation program to analyze in pursuit of various processes and the program are performed.



Model of the fusion reaction by Deuterium and Tritium

Analysis of magnetic materials by micromagnetics simulation

Name	Ohsawa Tomokatsu	E-mail	t-ohsawa@numazu-ct.ac.jp
Job Title	Associate professor	Degree	Doctor of Engineering
Academic Society and Association	The Physical Society of Japan, The Magnetics Society of Japan		
Research Keywords	magnetic memory、micromagnetics simulation、spintronics		
Technical Fields and Topics possible for collaboration	▪ Analysis of magnetic materials by micromagnetics simulation ▪ Theoretical considerations on magnetism and conduction		

Details of the Research Theme

We aim to develop next-generation magnetic devices through micromagnetics simulation.

With the recent development of computers, it has become possible to numerically solve the problems of the magnetization structure in magnetic materials that could not be obtained so far by using micromagnetic simulation.Problems with the magnetic structure include miniaturization of HDD magnetic heads, improved stability, and increased surface storage density.

The Ohsawa Laboratory is paying attention to the race track memory, which is expected to be the next generation of magnetic memory. A racetrack memory is a magnetic device using a spin current, and is a magnetic memory in which magnetic walls that represent bits are arranged on a magnetic thin wire and those columns are slid by a spin current to read a magnetization state by a reading unit (Figure 1). Larger capacity can be expected compared to the current memory, and research and development are continuing toward practical use. Figure 2 shows a state of time evolution when a skyrmion is slid by a spin current using a magnetic structure called a skyrmion instead of a domain wall as an information carrier. It can be confirmed that the skyrmion is moving at the same speed by the spin current.

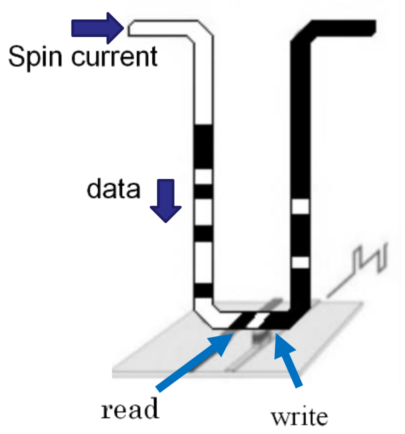


Fig. 1 Schematic figure of racetrack memory

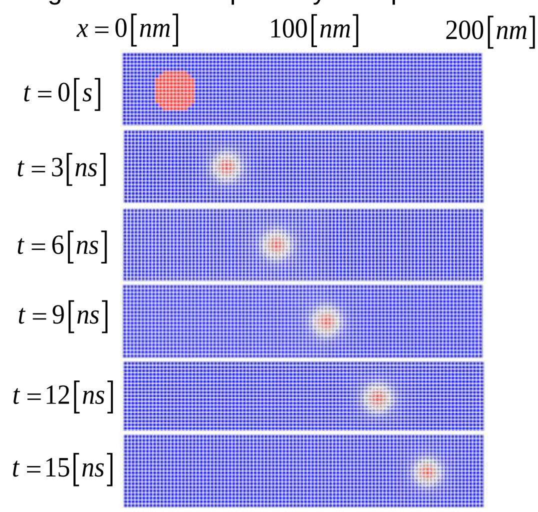


Fig.2 A state of skyrmion moving in a magnetic wire

Control of Self-Assembling Nanostructure and Nano-Templating Applications

Name	KOMURA Motonori	E-mail	m-komura@numazu-ct.ac.jp
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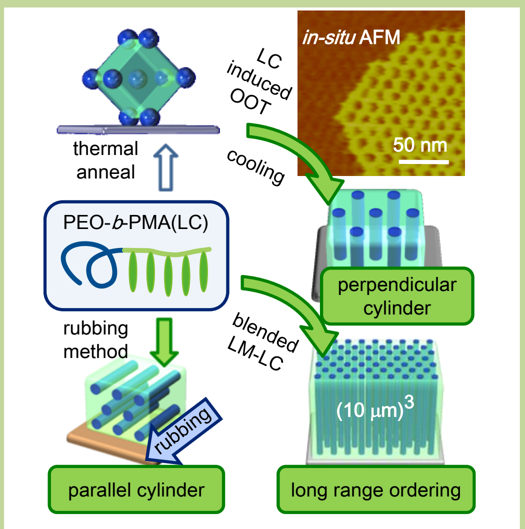
Academic Society and Association	The Society of Polymer Science, Japan, The Japan Society of Applied Physics, The Chemical Society of Japan		
Research Keywords	Polymer, Liquid Crystal, Self-Assembly, Scanning Probe Microscopy		
Technical Fields and Topics possible for collaboration	・Evaluation of nanostructure and nano-physical properties by SPM ・Nanostructure analysis of thin film by grazing incidence X-ray scattering ・Control of self-assembling structure of soft materials ・Measurements of mechanical, thermal and optical properties		

Details of the Research Theme

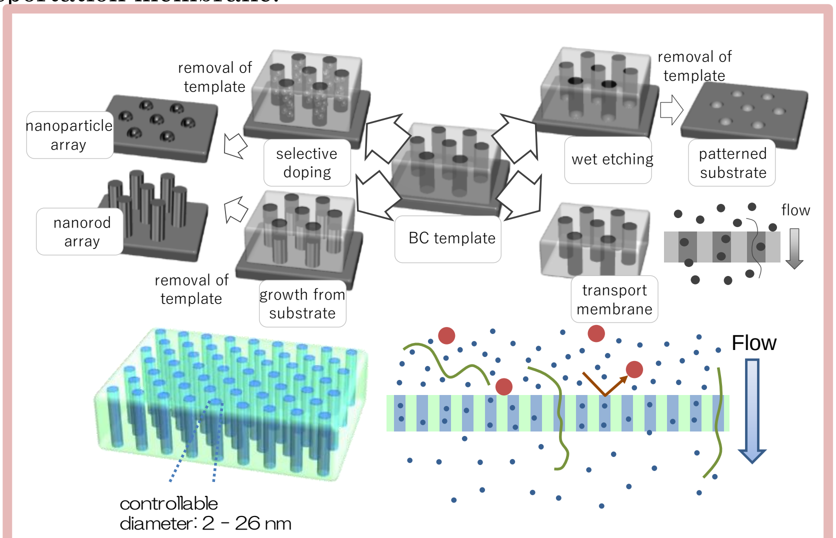
Fabrication of nanostructure by bottom-up method via molecular self-assembly. Expected applications: ultra-high density storage media, nanofilter, low dielectric constant material, wide interface solar cell, high sensitivity sensor, ion conductive membrane, etc.

Controlling the self-assembly behavior of a block copolymer (BC) allows for tailoring of the material's structure and properties for specific applications. Of particular interest are block copolymers that form cylindrical nanodomains that are perpendicularly oriented to a substrate surface and span the full width of the film, which is crucial for mass transport through the cylindrical channels in a membranous film. In comparison to the techniques for synthesizing conventional amorphous-amorphous block copolymers, the introduction of a crystalline or liquid crystalline polymer to a block copolymer molecule is an excellent synthesis approach for fabricating hierarchical structures. These hierarchical structures include microphase-separated nanostructures and crystalline or liquid crystalline structures. We focus on the side-chain liquid crystalline BC.

We have developed amphiphilic PEO-*b*-PMA(Az) thin films that have anomalous, orientation-defined, microphase-separated nanostructures, i.e., hexagonally arranged PEO cylindrical domains surrounded by PMA(Az) domains that are perpendicular to the surfaces of various types of substrates due to air-surface induced formation of microphase-separated nanostructures. Another important characteristic for applications process is that the cylindrical domains are not physical pores; instead, they are filled with undercooled PEO at room temperature. The PEO-containing block copolymers work directly as a soft template. We have utilized the PEO-*b*-PMA(Az) template to fabricate nanoscale functional materials using the PEO cylindrical domains as ethereal, permeable channels. Both ends of the cylinder domains are open as air and substrate interfaces. The following figure summarizes the templating processes in four categories: domain-selective doping, etching mask with molecule-transport channels, domain-selective growth on conductive substrates, and molecule-transportation membrane.



Evaluation and control of self-assembling nanostructure



Template application and nanofilter of self-assembling nanostructure film

High Fidelity Color Reproduction

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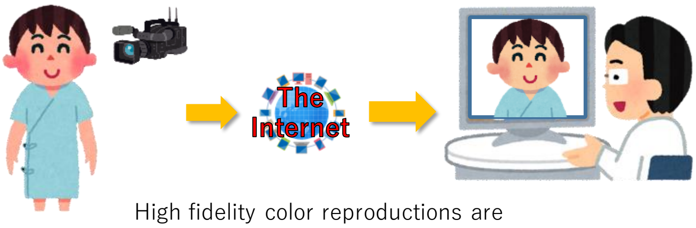
Job Title	Associate professor	Degree	Ph.D.
Academic Society and Association	Society for Information Display		
Research Keywords	Color reproduction, Imaging, Information display		
Technical Fields and Topics possible for collaboration	▪ Color universal design. ▪ Color matching between LCD and color printers. ▪ Display calibration. ▪ Display profile analyzing.		

Details of the Research Theme

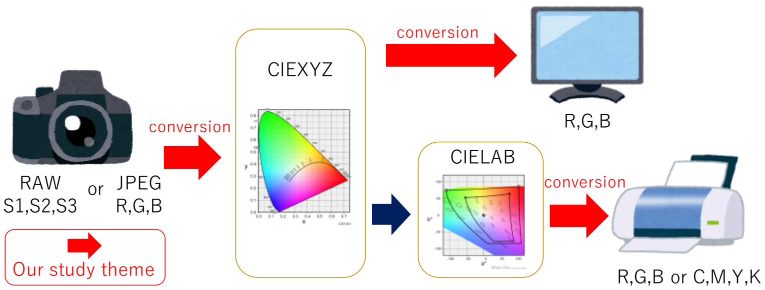
We provide a technical solution about color reproduction or color matching.

Imaging devices are designed for achieving preferred color reproduction instead of accurate color reproduction. Color reproduction errors cause critical troubles in some situations such as online shoppings or telemedicine.

Some color conversion methods for hi-fi color reproduction were proposed in our laboratory. In order to evaluate our methods, we have a technique of measuring colors and calibrating devices. In addition, we try to evaluate color perception which caused by diversity of human vision. A multi-spectral camera and a multi-primary display are adopted to evaluate it.



High fidelity color reproductions are important in tele-medicine.



PSE system for healthy seedlings' selection

Name	Manabe Yasuhiko	E-mail	manabe@numazu-ct.ac.jp
Job Title	Associate Professor	Degree	Master of Engineering
Academic Society and Association	・The Japan Society for Computational Engineering and Science ・Information Processing Society of Japan		
Research Keywords	Problem Solving Environment, Plant Growth Detection, Plant Factory		
Technical Fields and Topics possible for collaboration	▪ Problem Solving Environment for a plant factory ▪ Plant growth detection for a plant factory ▪ System administration of a Linux based PC		

Details of the Research Theme

Our study aims to automate healthy seedlings detection for a plant factory. Our study reduces cost of a plant factory.

We propose a PSE system for a plant factory. (PSE means Problem Solving Environment; It aims to solve various problem by using computational science.) Generally the selection of seedlings in a plant factory is performed by experienced staffs. The cost of this selection process is estimated about 25% of the total cost in a plant factory. Our system automates seedlings' selection by using an image processing and a 3-axis-control robot. Therefore, our system would reduce the total cost of a plant factory. The system consists of the seedling detection and a seedling movement part. First, the system takes pictures of the seedlings. The system evaluates whether the seedlings are healthy from the pictures taken using an image processing. The healthy seedlings are moved by a 3-axis-control robot. Only the healthy seedlings are collected and aligned onto a tray for the next planting. Then in a real plant factory the tray is transferred to a cultivation room.

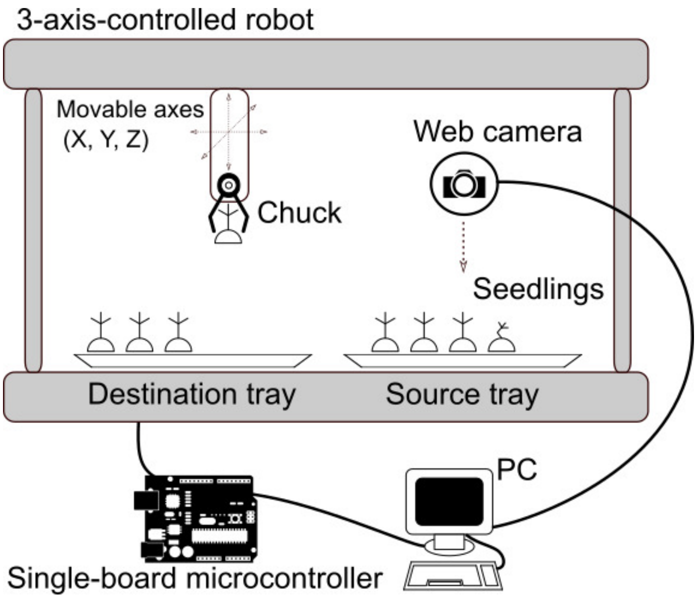


Diagram of our system

Research of haptic transmission system

Name	YAMANOUCHI Wataru	E-mail	yamanouchi@numazu-ct.ac.jp
Job Title	Associate Professor	Degree	Ph.D.
Academic Society and Association	IEEE, IEEJ		
Research Keywords	Motion Control, Haptic communication, tactile sensation		
Technical Fields and Topics possible for collaboration	▪ Position control ▪ Force control ▪ Estimate of real-world force sensation ▪ Remote control		

Details of the Research Theme

Technological innovations and/or effective breakthroughs may find by applying haptic techniques to existing technologies.
This solution offers the basic haptic techniques for your needs.

Haptic sensation is third sensation in remote transmission. Audio-visual sensation was already implemented in many transmission systems. However, haptic transmission application doesn't be used in general.

The interactive characteristics of haptic sensation make it difficult haptic transmission as compared to audio-visual transmission (Fig. 1).

Haptics include the measurement, processing, store, transmission, represent, of the real-world force sensation (Fig. 2). For example, soft actuation of industrial robot, safety communication between human and robot, recording human techniques, remote communication feeling tactile sensation, and so on.

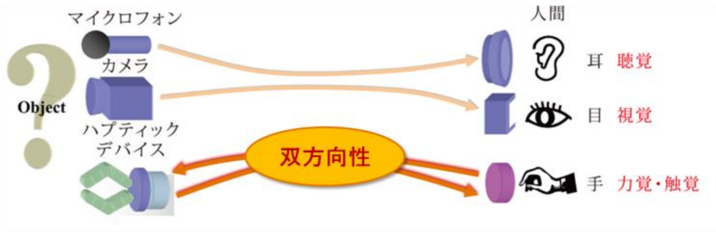


Fig.1 Multimedia communication

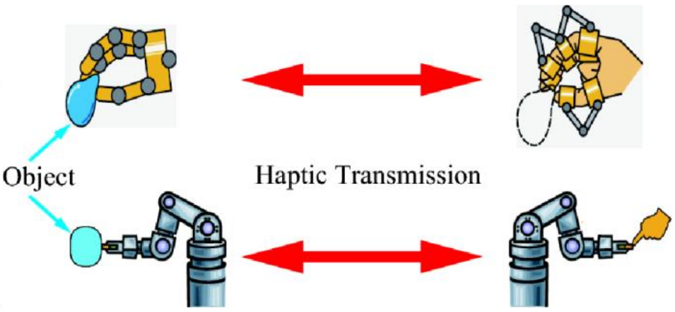


Fig. 2 Bilateral control for haptic communication