Department of Electrical Engineering

Laboratory	Professor / Associate Professor	Theme of research
Energy Device Engineering (High Frequency Nano-Magnetics)	Yasushi ENDO, Associate Professor	In order to achieve the next-generation energy saving type new spin devices with high-performance high efficiency, the materials and the processes of the new spin devices composed of a nano-magnet and a magnetic film and the process are totally research and developed, and the base electric/magnetic measurement techniques are also established. (1) Development of new high frequency magnetic measurement techniques (2) Study on magnetic materials constituting new spin devices (3) Study on the next-generation energy saving type spin devices
Energy Device Engineering (Green Power Electronics)	Tetsuo ENDOH, Professor	In order to realize the low-power society (low carbon society) in future, the high-efficiency power device technology, power conversion circuit technology and power management technology are very important, which can effectively convert and supply the electrical energy. Moreover, the semiconductor integrated circuit technology combining the hardware and software builds the indispensable foundation for the next-generation advanced information society. In this laboratory named by green power electronics laboratory, aiming at the further progresses of the low-cost, low-power, high-performance semiconductor device and integrated systems, the research and development on the device technology, circuit technology and system architecture technology are subjected systematically and coherently with the following five topics. (1) Research on the low-cost and high-efficiency GaN/Si hybrid power device (2) Research on the high-efficiency power supply circuit and system for realizing intelligent power management (3) Research on the green semiconductor integrated circuit (logic/memory circuits) for AI/ IoT applications (4) Research on the real-time image recognition LSI for next-generation automotive/robotic applications (5) Research on the high-performance device/circuit with novel architecture and principles like 3D structures
Energy Device Engineering （Ubiquitous Energy）	Shin YABUKAMI, Professor (Graduate School of Biomedical Engineering) Akihiro KUWAHATA, Associate Professor	Measurement and translation techniques of bio-information from human body by electromagnetic field approach are developed. We develop minimally invasive medical devices and welfare equipment by using electromagnetic phenomena. 1. Evaluation of bacteria using magnetic nanoparticle and its application for health care and welfare devices 2. Development of bio-magnetic sensors operating at room temperature 3. Position sensing and translating system for minimally invasive medical and welfare applications 4. Development of broad bandwidth thin film evaluation system for bio magnetic sensor

Laboratory	Professor / Associate Professor	Theme of research
Electrical Energy Systems Engineering (Applied Electrical Energy System)	Makoto TSUDA, Professor	In order to realize a sustainable society in the future, it is necessary to construct a new electric energy system that is not limited by conventional concepts. Superconducting technology is one of the important fundamental technologies of future electric energy systems. In our laboratory, a wide range of research on electric energy system is conducted to realize a next-generation electric energy system with high efficiency and high reliability. (1) Future energy system combining superconductivity and hydrogen (2) Highly efficient and highly reliable next-generation power transport system (3) Highly efficient and highly reliable electric power system utilizing energy storage device/system (4) Wireless power transmission system utilizing superconducting technology (5) Next-generation MRI and accelerator for cancer treatment using superconducting coil (6) Magnetic levitation type seismic isolation system using superconductor (7) Next-generation space propulsion system using superconducting coil
Electrical Energy Systems Engineering (Energy Generation System) (High Density Energy Control)	Akira ANDO, Professor Kazunori TAKAHASHI, Associate Professor	We have pursued high density plasma physics and technology, especially for aerospace and fusion researches in the 21st century. We investigate space thrusters using electric propulsion, ion beams for fusion research, atomospheric discharge plasma for plasma actuator, and electrodeless plasma sources for innovative device processes. (1) Production of a fast-flowing plasma and application to advanced space thruster (2) Development of ion beam sources for fusion plasma heating (3) High voltage and atomospheric pressure discharge and application to plasma actuator (4) Development of electrodless plasma thrusters (5) Research and development of plasma sources for innovative device processes
Electrical Energy Systems Engineering (Electric Power Network System)	Hiroumi SAITOH, Professor	In order to prevent global warming and to realize safe societies, renewable energy resources (RES) such as wind power generation and photovoltaic generation need to be integrated into existing AC power network systems of which the stability is maintained by controllable generation such as large scale thermal and hydro power plants. The most important goal in this century is to make such integrated electric power networks and to deliver clean and affordable electric energy with high quality to all consumers. We are studying the following issues in order to construct sustainable power networks by use of information and communication technologies and optimization techniques. (1) Power system control and operation utilizing ultra-distributed power resources in demand side (2) Application of multi-agent system technologies such as consensus control to power systems (3) Optimization of power systems to integrate RES into existing AC networks (4) Enhancement of stability of the RES integrated power networks by wide-area synchronized measurement

Laboratory	Professor / Associate Professor	Theme of research
Research Institute of Electrical Communication (Electromagnetic Bioinformation Engineering)	Kazushi ISHIYAMA, Professor	We are working on magnetic phenomena for creating electromagnetic information and realizing control systems in human body and invironments. We are also working on the establishment of ultra-sensitive sensors and systems for capturing electromagnetic fields generated by human body or electrical equipments. (1) Research on ultra-sensitive sensors for bioelectromagnetic measurement (2) Research on high-frequency sensor systems for measuring environmental electromagnetic information (3) Research on medical magnetic micromachines (4) Research on measurement system of biological movement (5) Research on wireless magnetic sensing system (6) Research on functional magnetic materials
Research Institute of Electrical Communication (Real-World Computing)	Akio ISHIGURO, Professor Takeshi KANO, Associate Professor	Animals exhibit surprisingly adaptive and resilient behaviors under unpredictable and unstructured real wordl environments. In order to understand the control principles underlying such behaviors, we employ a synthetic approach based on robotics, biology and mathematics. We are currently focusing on the following animals: (1) Legged animals (quadrupeds, myriapods, etc.) (2) Snakes (3) Extinct animals (4) Social animals (vampire bats, etc.)
Information Energy Systems (Comprehensive biomedical and system engineering)	Norihiro SUGITA, Associate Professor (Department of Management Science and Technology)	To realize a healthy well-being society, we are developing advanced medical systems based on systems engineering and information and communication technologies, such as cyber-physical systems, human interfaces, and computational intelligence systems for medical and healthcare applications. (1) Cyber-physical system in medicine and healthcare (2) Virtual reality systems for medical care (3)Computational intelligence for computer-aided diagnosis and treatment systems (4) High accuracy signal matching based on stastical signal processing
Advanced Power Engineering	Hiroumi SAITOH, Professor (Masafumi YASHIMA, Visiting Professor)	High reliability is required for the "electric power" as the fundamental energy that supports the modern society, and new technological developments to response to energy issues, the global environment and further advance as a social infrastructure are required for electric power equipment that is responsible for stable electric power supply. At the Advanced Power Engineering Laboratory, the research theme is focusing on the electric power technology related to safe and stable electric power supply even in uncertain energy situations such as expansion of introduction of renewable energy generation and electricity liberalization, and cooperative technology with renewable power generation, advanced maintenance technologies of power equipment, development of electric power technology harmonized with the new era, etc. are regarded as main issues, as follows. (1) Operating conditions of electric power facilities corresponding to expansion and introduction of renewable energy generation. (2) Advanced diagnosis technology of electric power equipment, and proposal of sensor utilization monitoring system. (3) Clarification of degradation mechanism of polymer insulating material, and construction of deterioration simulation method. (4) Evaluation of adaptability of functional materials to electric power equipment.

Department of Communications Engineering

Laboratory	Professor / Associate Professor	Theme of research
Intelligent Communication Network Engineering (Human Interface) (Multimedia Communication)	Akinori ITO, Professor Takashi NOSE, Associate Professor	Human beings transmit the intention using speech, letters, facial expression or gestures, and the receiver interprets the intention by combining the multi-modal information. It is strongly desired for a machine to exploit this kind of flexible interpretation in a human-machine communication. This laboratory aims to research the mechanism of human communication and apply that for the engineering purpose. (1) Development of recognition, understanding and synthesis method using a specific medium (2) Development of multi-modal intelligent communication system (3) Development of multi-media network and coding technologies
Communication Systems Engineering (Image Information Communications)	Shinichiro OMACHI, Professor Yoshihiro SUGAYA, Associate Professor	In this laboratory, a wide range of researches from basics to applications on technologies for effective processing and communication of multimedia information such as images are conducted. In particular, we focus on novel algorithms for image recognition, understanding and coding, and efficient information processing and communication algorithms for IoT. (1) Image recognition and understanding (2) Image processing (3) Image and video coding (4) Deep learning (5) Internet of Things (IoT)
Communication Systems Engineering (Information Measurement and Processing)	Yuji MATSUURA, Professor (Graduate School of Biomedical Engineering)	We handle general optical applications for the minimally invasive diagnosis and treatment. In addition to investigating the optical characteristics of various biological tissues, we will conduct research and development on diagnosis and healthcare monitoring devices that use laser light and the other various light sources emitting light with wavelengths from soft X ray to terahertz wave. (1) Research on infrared remote spectroscopy system for medical diagnosis (2) Development of laser medical optical fiber and transmission system (3) Research on healthcare monitoring devices using ultraviolet and infrared light (4) Research on optical transmission devices that apply the photonic band gap
Communication Systems Engineering (Communication Systems)	Hiroki NISHIYAMA, Professor	We are engaged in researching technologies involved in a huge variety of communication systems for CPS/IoT. Especially, we aim to develop communication technologies based on the new concept of autonomous decentralized cooperation, which is totally different from the existing centralized and distributed systems. (1) Locally centralized communications (2) Direct communication among mobile devices (3) Performance analysis of relay communications (4) Performance evaluation of communication systems (5) Resilient communication systems

Laboratory	Professor / Associate Professor	Theme of research
Wave Communication Engineering (Electromagnetic Wave)	Qiang CHEN, Professor Keisuke.KONNO, Associate Professor	The electromagnetic wave is widely used not only in the communications and broadcasting, but also in the measurement, imaging, wireless power transfer and so on. Both fundamental and applied researches on the antennas and wireless systems for various applications of electromagnetic wave are undertaken in this laboratory. (1)Antennas for microwave and millimeter-wave. (2)Wireless power transfer (3)Large-scale and multiphysics computational electromagnetics (4)Passive millimeter-wave radar for airport security. (5)On-body and in-body wireless devices for healthcare application.
Wave Communication Engineering (Microphotonics)	Hirohito YAMADA, Professor Nobuyuki MATSUDA, Associate Professor	We study on micro-photonic devices, optical waveguides, optical integrated circuits, light sensing, optical conputing technologies for use in next generation network which support IoT societies. We also study electric power transmission with infrared lightbeam, and power grid based on solar power generation and batteries, etc. (1) Research on optical functional devices and optical integrated circuits (2) Research on various sensing technologies and imaging with infrared lightwave (3) Research on optical conputing (4) Research on infrared optical wireless power transmission (5) Research on next generation micro-grid based on solar power generation
Wave Communication Engineering (Acoustic Physics Engineering)	Shin YOSHIZAWA, Professor	Minimally invasive treatments have been required to sustain quality of life in the aging society. For the clinical use of noninvasive ultrasound treatments, we are developing novel methods for therapeutic ultrasound focusing and noninvasive monitoring and targeting by ultrasound imaging. (1) Therapeutic ultrasound transmission method and sequnece for ultrasound-guided ultrasound treatment (2) Ultrasound imaging to monior tissue change in real time (3) Measurement method of medical ultrasound pressure field
Research Institute of Electrical Communication (Ultrahigh-speed Optical Communication)	Toshihiko HIROOKA, Professor Keisuke KASAI, Associate Professor	We are engaged in research on ultrahigh-speed optical transmission, digital coherent optical transmission, and high-speed and spectrally efficient optical transmission by combining these two approaches. With a view to supporting innovative new ICT services such as 5G and IoT, our goal is also to to develop novel transmission schemes integrating optical and wireless communications. (1) High-speed and spectrally efficient optical transmission and signal processing (2) Digital coherent optical transmission and its integration with wireless communications (3) Frequency-stabilized lasers and their applications to metrology and microwave photonics (4) Multi-core fibers and other innovative fibers with new functionalities

Laboratory	Professor / Associate Professor	Theme of research
Research Institute of Electrical Communication (Advanced Wireless Information Technology)	Noriharu SUEMATSU, Professor	Toward the realization of a next-generation broadband wireless network, we are actively engaged in the research work on dependable and low power consumption advanced wireless ICT. We cover the whole technical fields from the lower to higher layers, i.e., signal processing, RF/Mixed signal device, antenna, modem and network technologies. (1) 1-chip transceiver for heterogeneous wireless communication (2) Digital RF transceiver (3) Millimeter wave and submillimeter wave beamforming antenna and device (4) Wireless systems and devices for in-vivo communication (5) Location and short message communication using quasi-zenith satellite system (6) Terrestrial and satellite integrated wireless communication network (7) Digital signal processing for broadband wireless communication
Research Institute of Electrical Communication (Information Storage Systems)	Yoichiro TANAKA, Professor Simon John GREAVES, Associate Professor	The amount of big data generated in the form of multimedia, IoT and AI information increases dramatically every year. Toward the next generation advanced ICT system, information storage system with high performance, high capacity and intelligence are required. We are conducting research into high density information storage based on perpendicular magnetic recording and magnetic devices invented in this laboratory. Magnetic materials and devices are modelled using micromagnetic simulations. The aim is to maximise the density and speed of the devices. In addition, we are conducting advanced information storage and conputing systems to handle Peta byte class mass data analytics by closely unifying both data store and processing. (1) Develop micromagnetic models of storage systems and devices(2) Research on high-density and high-speed data storage systems (3) Research on high density perpendicular magnetic recording device (4) Research on large capacity information storage system (5) Research on advanced data analytical platform in close proximity to storage
Research Institute of Electrical Communication (Ultra-Broadband Signal Processing)	Taiichi OTSUJI, Professor Akira SATO, Associate Professor	The electromagnetic wave spectrum of several hundreds to several tens of microns in wavelength located between the radio waves and light waves is called the terahertz wave band, and its effective use is thought to be indispensable for future advanced information communication technology society. In this laboratory, we are conducting research on the creation of semiconductor devices and circuits that can operate in this unexplored area and their applications to the next generation information communication and measurement systems. (1) Research on novel terahertz electromagnetic wave generation / detection / signal processing devices. (2) Creation of terahertz lasers using new material graphene as a gain medium. (3) Research on ultimately high-speed transistors by new materials / new device structures. (4) Research on novel terahertz circuits and systems by controlling the electromagnetic wave propagation modes. (5) Research on advanced information communication and measurement technology exploiting the millimeter wave and terahertz wave devices and circuits.

Laboratory	Professor / Associate Professor	Theme of research
Research Institute of Electrical Communication (Environmentally Conscious Secure Information System)	Naofumi HOMMA, Professor	We are pursuing research and development on the fundamental technologies and their applications for building secure information communication systems in the next-generation infor mation environments and applications. In particular, we are exploring the design and analysis technologies of cryptographic systems. (1) Hardware algorithms for next-generation cryptographic technologies (2) Secure implementation of embedded systems (attack and defense) (3) Security design and evaluation technology of cyber physical systems (4) Security-oriented information processing (5) Theory of AI/mobility/avionics security (6) Creation of security functions for next-generation devices
Research Institute of Electrical Communication (New Paradigm VLSI System)	Takahiro HANYU, Professor Masanori NATSUI, Associate Professor Naoya ONIZAWA , Associate Professor	To meet the expectations of artificial intelligence (AI) hardware, we achieve high functionality and multi-functionality at the device and circuit level, and develop a systematic design methodology for high-performance, ultra-low energy VLSI systems based on sophisticated hardware algorithms. This aims to establish a new paradigm VLSI computing that overcomes the performance limits of the current VLSI systems. Specific research subjects are as follows: (1) Nonvolatile logic-in-memory VLSI processors and their applications, (2) New paradigm VLSI integrated-circuit technologies and their AI applications, (3) Design of IoT-oriented AI hardware based on new paradigm VLSI architecture, (4) Establish new paradigm VLSI-computing architecture based on intelligent device modeling, (5) Design of probabilistic computing and its application to network-on-chip (NoC) systems, and (6) Design of adaptively controlled and/or regilient VLSI processors.

Department of Electronic Engineering

Laboratory	Professor / Associate Professor	Theme of research
Microelectronics Engineering (Spin Material Electronics) (Spin Correlation Electronics)	Shin SAITO, Professor Tomoyuki OGAWA, Associate Professor	Magnetic material is one of the most significant elements playing a functional role in electronic devices, and their nanostructure influences on the performance of devices directly. In our laboratory, Extreme high performance for spin controlled electronic device is created through fabrication and synthesis of magnetic thin film, metallic nanoparticles and powders under sophisticated clean process. (1) Granular magnetic thin films for energy assisted hard disk device. (2) Enhanced magneto-optical and magneto-refractive effects with surface plasmon resonance for magnetic thin film. (3) Soft magnetic properties of magnetic micron particles for high frequency devices towards the next generation. (4) New magnetic powder synthesized by solid phase-gas phase reaction of reduction, nitridation, and carbonization. (5) Iron nitride nano particles contributing to rare-earth free magnets (6) Fe-based nanoparticle hybrid materials for GHz-band devices.
Electronic Control Systems (Electronic Control Systems)	Hiroshi KANAI, Professor Mototaka Arakawa, Associate Professor (Graduate School of Biomedical Engineering)	We are studying medical diagnosis using ultrasound in cooperation with graduate school of biomedical engineering in our university. Especially, the high-speed and high-resolution ultrasonic imaging and the dynamic and function measurements of biological tissues and organs are main topics. To achieve them, novel ultrasonic measurement methods and digital signal processing technologies are researched and developed while manufacturing electric control systems. The current main subjects are as follows: (1) High-speed and high-resolution ultrasonic imaging. (2) Evaluation of function and viscoelasticity of biological tissues and organs by accurately measuring their dynamics. (3) Microstructure estimation of biological tissues and organs by spectrum analysis of ultrasonic signals. (4) Development of new ultrasonic diagnosis equipment by ultrasonic electronics and electronic control.
Materials Engineering (Plasma Science Engineering) (Plasma Electronics)	Toshiro KANEKO, Professor Toshiaki KATO, Associate Professor	We will investigate the distinguishing properties of plasmas which could create interdisciplinary frontier science related to space, energy, material, environment, and life science. We will also develop the next-generation energy technology and nano-bio-medical science technology by intellectualizing the plasma generation and control. (1) Elucidation of nonlinear, transport, and interface phenomena in the frontier plasmas. (2) Creation of next-generation energy sources using plasmas (solar cell, nuclear-fusion power generation) (3) Synthesis of novel nano materials (nanoparticle, fullerene, nanotube, graphene, atomically-thin layered materials) using plasma technology. (4) Development research on new-functional nano-electronics devices using plasma technology. (5) Development research on advanced bio-devices using plasma-bio fusion technology (new-generation gene transfer device, future-oriented plant factory).

Laboratory	Professor / Associate Professor	Theme of research
Materials Engineering (Solid State Electronics)	Takeru OKADA, Associate Professor	To realize a safe, secure, and comfortable life, creation of novel function-merged devices is required heading toward the paradigm shift in semiconductor electronics. It enables to deepen an information network connecting intelligent and functional systems further. The object in this laboratory is to study the development of functional thin films and their physics. (1) Generation of functional thin films consisting of transparent metal oxides and their device application. (2) Development of sustainable devices for environmental conservation and creation of resource/energy. (3) Formation of phosphor thin films for superior color rendering white LED. (4) Investigation of electrokinetic phenomenon at heterophase interface and their energy device application.
Materials Engineering (Nano-Materials Engineering)	Masakiyo TSUNODA, Associate Professor	Functional thin film is one of the most important factors in electronics devices, and its nanostructure directly influences the device performances. In this laboratory, thin film fabrication processes for spin controlled electric device with high functionalities are investigated, based on understanding of electronic physics. (1) Spin electronics devices and spin transport properties (2) Development of thin film materials for high-performance spin electronics devices (3) Study of interface spins by synchrotron radiation
Electronic Systems Engineering (Image Science and Information Display) (Display Devices Engineering)	Hideo FUJIKAKE, Professor Takahiro ISHINABE, Associate Professor	Electronic image display devices featuring thinness, lightness, bending and high image quality must change future information-based society and lifestyle. In the field, we will research and develop innovative optical and electronic functions by self-assembly of anisotropic organic materials (liquid crystals, polymers, organic semiconductors, etc.) and by advanced control of molecular arrangement based on various surface effects. We intend to create next-generation flexible printable electronics. (1) Study on image quality improvement in flexible liquid crystal displays (2) Study on high functionality of electronic displays using liquid crystal and polymer properties (3) Study on coatable organic semiconductors using liquid crystal or crystal properties (4) Study on next-generation fast response liquid crystal materials and devices

Laboratory	Professor / Associate Professor	Theme of research
Electronic Systems Engineering (Biomedical Electronics)	Tatsuo YOSHINOBU, Professor (Graduate School of Biomedical Engineering) Ko-ichiro MIYAMOTO, Associate Professor	Chemical sensors based on semiconductor devices are advantageous for miniaturization and integration with peripheral circuits, which promoted the development of various measurement systems. The laboratory of biomedical electronics is engaged in the development of the chemical imaging sensor, which can detect specific ions or molecules in a spatially resolved manner and generate chemical images and movies. Our projects include (1) development of high-performance chemical imaging sensors, (2) development of analytical chips combined with MEMS technology, (3) application to the study of material surfaces, and (4) application to cell analysis
Research Institute of Electrical Communication (Nano-photoelectronics)	Satoshi KATANO, Associate Professor	Our main interest lies in studying the physical and chemical phenomena that take place in nanometerscale regions and their applications in nanophotoelectronic devices. We explore material properties of individual nano-structures with high spatial, energy, and time resolutions. Development of novel probing methods is also targeted. (1) Investigation of various photoelectronic phenomena in nanometer-scale spaces. (2) Study on interaction between the electron tunneling and light. (3) Development of efficient and broad-band light sources and detectors. (4) Development of vibrational spectroscopy with atomic resolution. (5) Development of STM light emission spectroscopy with ps time resolution.
Research Institute of Electrical Communication (Solid State Electronics System)	Hirokazu FUKIDOME, Associate Professor	TBA

Laboratory	Professor / Associate Professor	Theme of research
Research Institute of Electrical Communication (Dielectric Nano-Devices)	Kohei YAMASUE, Associate Professor Yoshiomi HIRANAGA, Associate Professor	We are expanding the frontiers of nanotechnology and nanoscience especially in the field of dielectrics. In more precise, we have been developing our unique microscopy method called scanning nonlinear dielectric microscopy (SNDM) with the highest measurement performance in dielectric polarization imaging in the world. Based on this outstanding technique, we are carrying out innovative research on a super-high density ferroelectric data storage system for ongoing explosive data growth, an advanced nanoscale measurement and analysis for emerging semiconductor materials and devices, novel electronic devices based on ferroelectric nano-domain engineering, and so on. I Atomic resolution SNDM: (1) Atomic dipole imaging by ultra-high vacuum (UHV) SNDM (2) UHV multifunctional scanning probe microscopy system achieving simultaneous SNDM/STM/NC-AFM imaging II Ferroelectric data storage system: (1) HDD-type super-high density data storage system (2) High-speed data reading and writing technologies III Advanced measurement and analysis of semiconductor materials and devices: (1) High-performance miniaturized semiconductor devices (2) Next generation power devices such as SiC and GaN (3) Post-Si materials such as graphene and other two-dimensional materials.
Research Institute of Electrical Communication (Materials Functionality Design)	Masafumi SHIRAI, Professor Kazutaka ABE, Associate Professor	The research objectives in our laboratory are theoretical analyses of quantum phenomena in materials used in the next-generation devices, computational design of materials which possess new functionalities, and development of advanced materials design scheme utilizig high performance computors. (1) Theoretical design of spintronic materials based on first-principles calculation and machine learning (2) Theoretical analysis of transport properties in spintronic devices (3) Development of simulation methods for design of materials and device functionalities (4) Matter in high densities (5) Metallization and superconductivity of hydrogen and hydrides (6) Development of first-principes structural search methods
Research Institute of Electrical Communication (Spintronics)	Shunsuke FUKAMI, Professor	Towards new electronics, spintronics, in which charge and spin of electrons are jointly used, researches on development and understanding of spintronics materials and devices, fabrication and characterization of nanostructures, and their application to electronics are conducted. (1) Research on spintronics (2) Research on physical properties of spintronics materials and devices (3) Research on control of magnetization of magnetic metals for applications to functional devices (4) Research on nonvolatile spintronics devices and their application to nonvolatile memories, new integrated circuits, and artificial intelligence hardware.

Laboratory	Professor / Associate Professor	Theme of research
Research Institute of Electrical Communication (Nano-Integration Devices and Processing)	Shigeo SATO, Professor Masao SAKURABA, Associate Professor Hideaki YAMAMOTO, Associate Professor	To develop the next generation information technology, we study on device and process technology for new Si based devices realized by ultimate resolution control, its application to brain computing system, and also the mechanism of information processing in the brain. (1) Study on neuromorphic devices (2) Study on neruromorphic integrated circuits (3) Study on plasma CVD process of group IV semiconductors (4) Study on group IV semiconductor quantum nanodevices (5) Study on information processing in biological neuronal networks (6) Study on biomimetic neurocomputing systems
Research Institute of Electrical Communication (Applied Quantum Optics)	Hiroshi YASAKA, Professor Masato YOSHIDA, Associate Professor	Novel functional photonic devices including high function semiconductor laser sources, photonic devices and monolithically integrated semiconductor photonic circuits are being investigated to realize photonic functional devices based on new principle and explore new-generation photonic network systems. Main research themes are listed below. (1) Ultra-high speed control of semiconductor photonic devices by signal light injection (2) Highly functional semiconductor light sources (3) Highly functional semiconductor optical modulators (4) Novel functional semiconductor photonic integrated circuits
Research Institute of Electrical Communication (Quantum-Optical Information Technology)	Keiichi EDAMATSU, Professor	TBA
Research Institute of Electrical Communication (Quantum Devices)	Tomohiro OTSUKA, Associate Professor	In solid-state nanostructures, exotic phenomena like quantum effects occur. We are exploring interesting properties of the nanostructures and developing new devices utilizing artificial nanostructures. We will contribute to new information processing and communication technologies through quantum and nanoelectronics. (1) Electronic properties of nanostructures and nanodevices (2) Quantum devices utilizing nanostructures (3) Informatics approaches in material and device science
Research Institute of Electrical Communication (Nano-Bio Hyrid Molecular Devices)	Ayumi HIRANO-IWATA, Professor	We are working on development of novel devices based on the combination of nanotechnology and biomaterials that have highly sophisticated functions. (1) Development of novel electronic/ion devices based on artificial cell membranes. (2) Development of microfabricated silicon chips for detecting drug side effects. (3) Construction of artificial neuronal networks based on cultured neurons. (4) Modelling of biosystems and neuronal circuits.

Laboratory	Professor / Associate Professor	Theme of research
Frontier Research Institute for Interdisciplinary Sciences (FRIS), Advanced Interdisciplinary Research Division (Nano Intelligent System)	Takehito SHIMATSU, Professor	We have been conducting two research efforts based on sputter film deposition in a UHV atmosphere: development of room-temperature bonding techniques of wafers and fabrication of magnetic films for use in future high-capacity magnetic storage and memory devices. The former study examines atomic diffusion bonding of two flat wafers with thin metal films. This technique is gaining wider use for electrical and optical devices fabrication. The latter study is aimed mainly at energy-assisted magnetization switching of granular magnetic films for use for future ultra-high-density recording media for hard disk drives.
Center for Innovative Integrated Electronic Systems(CIES) (Nano- Spin Memory)	Shoji IKEDA, Professor	TBA
Biomedical Engineering for Cancer	Tetsuya KODAMA, Professor (Graduate School of Biomedical Engineering)	Most cancer cells are invasive and metastatic, and they become disseminated to distant anatomical site by invasive-metastasis cascade. We will develop diagnosis and treatment methods of lymph node metastasis at the early stages. Our research is interdisciplinary or integrated research based on fluid dynamics, optics, molecular cell biology, oncology, and pathology. Our research subjects are as follows. (1) Mechanisms of lymph node metastasis (2) Drug delivery system (DDS) targeted for lymph node metastasis using nano-particles (3) Assessment of treatment for lymph node metastasis using noninvasive multimodal *in vivo* imaging techniques such as high-frequency ultrasound, bioluminescence and micro-CT.
Biomedical Nanoscience	Makoto KANZAKI, Associate Professor (Graduate School of Biomedical Engineering)	The recent progress in molecular biology has greatly contributed to revealing the biological properties of individual molecules. The Kanzaki Lab focuses on understanding how the supra-molecular complexes (biological nano-systems) achieve diverse physiological and pathophysiological events by employing a cutting-edge bio-imaging techniques. (1) Live-imaging analysis and Biomedical Nanoscience (2) Cell/Tissue Engineering for the next generation medical applications (3) Biological Nano-system and their impairments in life-style-related diseases (4) Plasma Medicine
Neural Electronic Engineering	Takashi WATANABE, Professor (Graduate School of Biomedical Engineering)	We are conducting studies on therapeutic and rehabilitation systems, neural prosthesis, assistive technology for motor and sensory disabilities focusing on electronic external control of the neuromuscular system, and measurement and evaluation of motor function. (1) Movement control of paralyzed limbs using functional electrical stimulation (FES) (2) Estimation of evaluation index of motor function by artificial neural network (ANN) (3) Prediction and correction of movements by ANN (4) Neurorehabilitation system for motor relearning