

Ⅲ. 大学院学位論文

DISSERTATIONS

A. 大学院博士課程論文梗概

Doctor's Dissertations

電気工学専攻

A1. 電界電子放出電流を振動検出機構に用いた真空マイクロメカニカル共振子に関する研究

山下 清隆

A Study on Vacuum Micro Mechanical Resonator using Field Emission Current as Oscillation Pickup Mechanism

By Kiyotaka Yamashita

We propose a novel RF (Radio Frequency)-MEMS (Micro Electro Mechanical Systems) BPF (Band Pass Filter) that utilizes the field emission (FE) current to detect the micro or nano-metric motion of the mechanical resonator. Recent development in the field of wireless communication devices and systems for ubiquitous network has opened up a wide range of electronic applications including cellular phone, wireless LAN (Local Area Network).

MEMS technologies have been intensively studied to meet the demands of further miniaturization of hardware and for lower cost production. Conventional RF-MEMS mechanical filters and recently developed devices utilize capacitive coupling for both excitation and detection. However, the capacitance diminishes quickly when the device dimension decreases, which makes signal detection difficult.

Recent vacuum micro-electronics achievements have widen the room for more application opportunities based on the field-emission effect. Micro or nano-mechanical resonators have the advantages of generally high Q-factor at high vacuum, batch fabrication capabilities, and well-established MEMS processes. As device dimensions such as tip radii and anode-cathode gap decreases, field-emission current increases.

This research investigates the possibilities of signal detection by integrating the field-emission effect on MEMS device.

The explanation of our proposal device is between the sharp silicon cathode-anode tips, an electrically biased silicon micromachined resonator is located along the field-emission current path, which is intervened by the resonator as an

attempt to modulate the signal that transmits along the FE current. The electrons that pass the fixed screening aperture gates are finally detected by the anode, by which a signal component of a particular frequency is band-pass filtered. The higher the level of vacuum we can achieve, the easier it is for field-emission to be excited, and since air damping is reduced, the micro-resonator can be oscillated at a larger Q-factor. Frequency signal picked up by the antenna is pre-processed and fed into the driving electrode for the resonator. The objective of the research is to correlate the information carried by the FE current and the dynamic characteristics of the MEMS resonator.

In the fabrication for MEMS vacuum tube device, we began the process with a silicon-on-insulator (SOI) wafer. After oxidizing and patterning the oxide mask, the mask pattern is transferred to the device layer by using the deep reactive ion etching (DRIE) process. Once the tips were sharpened by the anisotropic wet etching of silicon in a TMAH (tetra-methyl ammonium hydroxide) solution, the oxide mask can be remove in a buffered HF (BHF) solution. As leakage current is related to the surface conditions at the interface between the BOX layer and the handle layer, the timed partial BOX etching, becomes a critical step. The overall fabrication process contains only one photolithography step, one deep RIE step, and several chemical etching steps.

The experimental setup includes a semiconductor parameter analyzer (SPA Agilent E5263A) and the vacuum chamber that provides the 2×10^{-8} Torr (2.7×10^{-6} Pa) vacuum environment. The current flow through the anode channel and cathode channel as can be measured simultaneously by the SPA. A multi-channel electrical interface is used to provide electrical feed-through to the chipset from outside the vacuum chamber. In our experiment, one output channel of the SPA provides a constant positive anode voltage which is equipotential to the gate voltages and the other output channel sweeps a negative cathode voltage while the SPA simultaneously captures the electrical current variation along the circuit in the nA range.

The bare p-type SOI device with a 5 μm distance between anode and cathode was measured to be 4 nA field-emission current at 300 V potential difference. After mask improvement, the bare p-type SOI device with a 1.5 μm

distance between anode and cathode was measured to be 54 nA FE current at only 3 V potential difference.

In addition, we aimed at more effective and stable FE current by using lower work function (WF) metals. The Au/Y(WF=2.9 eV) deposited n-type SOI device with a 1.5 μm distance between anode and cathode was measured to be 101 nA field-emission current at only 1.6 V potential difference.

We can achieve the proof of FE current by MEMS device, therefore we tried to certify the FE current modulation by a mechanical resonator.

For fabrication for the integrated mechanical resonator device, until TMAH solution is the same process for MEMS vacuum tube device. After that we used vapor-phase HF etching to prevent movable components from sticking to the substrate. The etching time must be adequate to sacrificially release the MEMS resonator but not too long to completely remove the exposed BOX layer.

We succeeded in the FE current modulation by using a Au/Y deposited n-type SOI device, however we have not certified whether this modulation is due to mechanical modulation or electric modulation, yet.

We are also interested to look into the following issues in order to make the operation of the device portable. First, a FE current modulation device is integrated with an RF wave-guide for impedance matching. Second, the effect of an oxygen-free and low noise working environment on the FE current will be studied. We will investigate how to effectively and reasonably package the device such that expensive high vacuum packaging is not needed.

A2. 配電系統における分散型電源導入の供給信頼性度および系統電圧に対する影響

チャイタッサニー スラチャイ

Impact and Contribution of Distributed Generation to System Reliability and System Voltages in Distribution Systems By Surachai Chaitusaney

In recent years, Distributed Generation (DG) has attracted more and more attention from both distribution utilities and electricity users. The advantages of DG are of both engineering and economic view points. The advantageous applications of DG can be summarized as follows: backup generation, voltage regulation, loss reduction, grid expansion postponement, environmental concerns, peak load service, rural and remote application, combined heat and power generation, and financial and trading purposes. This dissertation concentrates on the issue of backup generation and voltage regulation.

As for the first part, DG can be applied as backup generation when the main supply from the upstream side is interrupted. Without the main electricity source, isolated system is formed and obtains electricity supply from the DG located in the isolated area. As backup generation, DG is supposed to improve the system reliability if the related concerns are deliberately considered and the solutions are strictly

implemented. However, protection miscoordination, especially recloser-fuse miscoordination, can have a considerable adverse impact on the reliability of typical radial distribution systems. The installation of DG can interfere with the existing recloser-fuse coordination by changes in fault current, and cause improper sequential operation of the protection system. IEEE standard 1457-2003 requires DG to be disconnected during system abnormality, including the case that DG itself operates abnormally, so that the fault current from DG cannot interfere with the existing protection coordination. Although the risk of DG continuing to operate (i.e. failing to be disconnected) and contribute to the fault current is low, it is not zero. Furthermore, it cannot be guaranteed that all DG sources will be disconnected faster than the operation of system protective devices, which usually operate within only a few cycles. Besides, disconnection is not always preferable, especially when the DG penetration is very high. In such cases, the protection systems may be interfered with and even lose their coordination, e.g. the coordination between recloser and fuse.

According to the above facts, the first part of this dissertation pays attention to the impact and contribution of DG to system reliability. To understand the impact on system reliability and the prevention of reliability degradation, the evaluation and comparison of system reliability are carried out for outage cost and load point indices. The two load point indices are SAIFI (System Average Interruption Frequency Index) and SAIDI (System Average Interruption Duration Index). In regards to the energy index, ENS (Energy Not Supplied) is evaluated. In addition, the prevention of reliability degradation due recloser-fuse miscoordination is proposed. The investigation and the application of the proposed methods have been implemented in a typical distribution and RBTS Bus 2 test systems.

As for the second part, DG can be used to regulate or support the system voltage profile if the installation has been well studied and carried out in an appropriate direction. With the varieties of dispersed locations, operating modes, and installed capacities, DG, in contrast, can be properly designed and controlled to help system voltages be maintained within their standard levels. For example, DG with constant voltage has the advantage of voltage support at remote areas. In addition, DG with capacitive power factor can intentionally help increase the voltage profile at low voltage areas. This kind of DG is over-excited synchronous generators. Likewise, DG with inductive power factor can help decrease the voltage profile at high voltage areas. This latter kind of DG is under-excited synchronous generators and induction generators. However, as is known, the installation of DG, especially ones that derive energy from renewable resources, can bring about the voltage fluctuation and violation to distribution systems. For instance, the installation of DG may raise the voltage profile until the upper voltage limit is exceeded, especially when voltage regulator and/or capacitor bank are operating. These problems are derived mainly from the counter flow and reactive power change. On the other hand, the installation of

DG may cause the voltage profile to be lower than the lower limit. This is possible when DG is shut down immediately and the existing voltage regulation cannot respond in time. The types and operating modes of DG also play an important role for the reactive power injection or consumption that is substantially related to the voltage variation.

The second part of this research utilizes the varieties of locations, modes, and capacities to balance and maintain the system voltage profile in conjunction with the existing voltage regulation. As reinforcement for the prevention of voltage fluctuation, the uncertainty of renewable energy sources, e.g. solar and wind, that is considered the main factor of voltage fluctuation is modeled by Probabilistic Load Flow (PLF). Afterwards, this uncertainty is integrated into the optimization process whose objective function is to regulate the voltage profile to prevent the voltage violation and momentary interruptions. The effectiveness of PLF is not only for the reduction of voltage violation, but also for other applications such as the maximization of DG in a distribution system. The investigation and the application of the proposed methods have been implemented in IEEE-34 Bus test system.

A3. 空間メモリによる実空間における人の活動支援に関する研究

新妻 実保子

A Study on Aiding Human Activity by Using Spatial Memory in Intelligent Space By Niitsuma Mihoko

This thesis proposes the spatial memory as an aid system for human activity utilizing externalized knowledge in Intelligent Space (iSpace). This thesis addresses two important issues of Intelligent Space: (1) how the iSpace can support human activity and how the interface between human and the iSpace is designed, (2) how the iSpace can design services to provide for people according to their current situation.

The Intelligent Space (iSpace) is a space which provides both information and physical support to humans and robots in order to enhance their performance. In previous works, position estimation of mobile objects and mobile robot control under iSpace have been studied in order to implement an environment where mobile robots can provide services for humans.

Enhancement of human creative activities is also an important target iSpace should pursue, as well as that of interaction between humans and robots. To enhance human creative activities, knowledge acquired through experiences and memories is essential. Especially, externalized knowledge in the form of documents, images, web pages, etc. is useful to recall other related knowledge and to conceive novel ideas. Smoothly retrieving and storing knowledge can improve our creative work. Therefore, this paper deals with externalized knowledge in the form of computerized information, and proposes a spatial memory system which enables humans to access and store externalized knowledge instantaneously and intuitively.

Smooth and stress-free access to externalized knowledge

requires the ability to easily recall necessary knowledge to achieve human activities and to have an easy access to such knowledge. For recalling such necessary knowledge, an appropriate arrangement of externalized knowledge should be considered. A strategy of arrangement of externalized knowledge for recalling easily should be decided by the user itself, since “the first law of arrangement is to decide ‘the location’ of object”. There have been several approaches to discuss arrangement methods of computerized information regarded as externalized knowledge or human memories. These researches described approaches to present spatial arrangements of computerized information to utilize a large amount of computerized information. In order to retrieve the stored computerized information, the users require operating computer interfaces while watching a computer display in details, because the information was arranged only on a display. Of course we understand that there may be many cases direct computer uses. However, actual human activities are not directly associated with computer uses. Therefore, a more human-intuitive essentially arrangement method of computerized information, which should be not restricted on computer displays, must be necessary.

Thus, in order to achieve intuitively and instantaneously access and store externalized knowledge by reducing additional tasks required for accomplishing such human activities, three requirements must be satisfied simultaneously as follows:

- The users are able to arrange externalized knowledge at a suitable location.
- The users are able to recall the whereabouts of stored knowledge without forgetting them.
- The users are able to get access to stored knowledge without disturbing human activities and burdening stress.

This thesis presents a new framework of a spatial memory that allows the users to operate externalized knowledge by their own eyes and own gestures in the real world.

The spatial memory system enables human users to store computerized information into the real world by assigning a three-dimensional position to the information, and to retrieve the information by directly indicating the point using their own hands. In the spatial memory system, what associates computerized information with a three-dimensional position is called “Spatial-Knowledge-Tag (SKT)”.

In this thesis, the sections are organized as follows:

In Section 2, previous approaches for aiding human activities are reviewed. We point out importance of “information (externalized knowledge)” for human activities. In Section 3, the specifications of the spatial memory and implemented system are described. In Section 4, usability of the spatial memory is evaluated from the viewpoints of human performances, including the accessibility of the spatial memory and the effectiveness of memorizing the stored knowledge. Experimental results show that human subjects were able to memorize the whereabouts of stored SKTs even after about four weeks. Also, the efficiency evaluation of a task performance when using the spatial memory by comparing

with the efficiency when using only a personal computer is presented. More specifically, we quantitatively evaluated the completion time of a specified task. Experimental results show that the spatial memory was able to decrease the access/store time to accomplish the specified task, and also show statistical significance between two results: availability and non-availability of the spatial memory system.

In Section 5, the second issue of this thesis is discussed. In order for an intelligent environment to provide various services for people in a wide range of situations, current intended purposes of the activities should be recognized. Users actively create SKTs based on their need. As a result, arranged SKTs in an environment correspond to activity histories of the users. Also, users' intended purposes for the environment are reflected in the arrangement. Therefore, classification of arranged SKTs leads to classification of human activities and estimation of intended purposes for places.

Finally, conclusion and future works are described in Section 6.

A4. MEMS 技術による極微小デバイスを用いた生体分子高速・高感度計測

新田 英之

High speed and highly sensitive biomolecule measurements by MEMS based microdevices

By Hideyuki Arata

To establish general purpose methods and tools for experiments in subsecond time scale is an essential requirement in future research in molecular biology such as protein folding-unfolding or denaturing properties because most of the functions of living organisms in molecular level take place in this time scale. The methods and the devices which realize experiments in sub-seconds time scale and also with high sensitivity of chemical detection were established by MEMS based top-down technologies. Experiments of motor protein and enzymatic activities in 1 second time scale were achieved by the micro thermodevice of 400 μm in size. Experiment of proteins denaturing and quenching measurements of DNA in millisecond time scale were achieved by the micro thermodevice of 20 μm in size. The micro container for detecting enzymatic chemical activity in single molecule level was also manufactured. Besides the main advantages of high speed and highly sensitive chemical detection of these devices, shortening of experiment hours by the other advantages such as mass production and on chip parallel assay were also achieved. These devices are capable of handling any kinds of biomaterial; they do not require any mutations or biochemical treatment to the material itself, therefore, it is a device of general purpose. Further study with these devices and methods may give a break through of the research field in protein analysis in molecular level and act as powerful tools in general biology.

A5. MEMS 針端の形状変化の TEM その場観察と電気・機械特性の同時測定

In-situ TEM Observation of Structural Change of MEMS tips and Simultaneous Electrical/Mechanical Measurement

By Tadashi Ishida

Nanotechnology has greatly contributed to the continuous development of the semiconductors according to the Moore's law. It is necessary to develop the nanotechnology for the future development of the semiconductors. Scanning tunneling microscope (STM) was invented in 1980, resulting in the atomic observation and manipulation. It was probable that the surface of the STM tip and the surface was deformed each other because high electric field was occurred between them. In order to visualize the surface of them, STM was introduced into the transmission electron microscope (TEM). The system achieved the observation of the surface and found the new phenomena, such as the formation of the nanowire during the contact and retraction between two tips. However, it is difficult to apply several signals, such as stress, electric field and heat, with the system. We propose that MEMS should be introduced into TEM to overcome this difficulty.

In chapter 2, MEMS for investigation of nano interface (MINI) is designed to demonstrate nano specific phenomena with opposing tips in TEM. We study 3 kinds of material combinations for the opposing tips, silicon-silicon, gold-gold, and silicon-gold. The fabrication processes are optimized in each device.

In chapter 3, the real-time visualization method using TEM is introduced. MINI can be actuated in TEM and measure the electrical and mechanical properties between the tips using TEM sample holder for MEMS. The influence of TEM electron beam towards the sample is theoretically analyzed and that towards the properties is experimentally analyzed. The experimental procedure and the method for measuring the electrical and mechanical properties of nanocontact are explained.

In chapter 4, silicon nanocontact tensile test is mentioned. The approach-contact-retraction-fracture process using silicon opposing tips is explained. In that process, tunneling phenomenon and atomic rearrangement are occurred, resulting in the formation and elongation of silicon nanocontact. The relationship between the structural change of silicon nanocontact and electrical/mechanical properties is discussed. The structural change due to the electromigration is also explained.

In chapter 5, gold nanocontact tensile test is mentioned. The approach-contact-retraction-fracture process using gold opposing tips is explained. In that process, tunneling phenomenon and atomic rearrangement are occurred, resulting in the formation and elongation of silicon nanocontact. The relationship between the structural change of silicon nanocontact and electrical/mechanical properties is discussed. The structural change due to the electromigration is also explained.

In chapter 6, the diffusion process is observed at the nano

interface between the silicon tip and the gold tip. The surface diffusion driven by the electromigration is observed with 100 micro A in electrical current. Gold nanoclusters are distributed due to the electric discharge between the silicon tip and the gold tip. The gold nanocluster diffusion into silicon tip is also observed at room temperature. This diffusion is discussed, comparing to the high temperature case. In chapter 7, we decide that MINI will be a powerful tool to study the nanoscopic region because it achieved the observation of nano ordered deformation and the measurement of electrical/mechanical properties between the tips. Moreover, it will achieve the observation and the measurement under several conditions using a micro-heater, multi probes and micro sensors.

A6. 超電導磁気エネルギー貯蔵装置を用いた電力系統のダイナミクスのオンライン同定

米津 武則

On-Line Identification of Power System Dynamics by use of Superconducting Magnetic Energy Storage By Takenori Yonezu

Power system must be always operated on stable conditions. For the stable operation, eigenvalue calculation and simulation of dynamic performance of power system are carried out.

For the calculation and simulation, a lot of parameters, such as constants of generators, impedance of transmission lines, and so on, are necessary.

However, such parameters obtained by simple test-codes may change by operating conditions of power systems. The values of parameters may not be obtained accurately.

Therefore, power system may be operated with a certain margin for the calculation results.

If dynamic performance can be identified directly in operating power systems, eigen modes of power system can be identified accurately. Then, power system operation will be more economical and reliable.

If eigen modes (eigen frequencies, real parts of eigenvalues and eigen vectors) of power systems can be measured directly from operating power systems, the accuracy of evaluation may be improved.

Then the operation will be more stable and more economical.

On-line identification of eigenvalues by use of Superconducting

Magnetic Energy Storage (SMES) has been proposed.

In case of the methods by use of sinusoidal power changes, imaginary parts of eigenvalues were identified in any power systems.

However, real parts of them were identified only in one-machine infinite bus system.

This thesis describes a new method by use of sinusoidal power changes for identification of real parts of eigenvalues in multi-machine power system. Simulations and experiments in order to examine the method by use of an analogue type power

system simulator are also described.

A7. 分散されたセンサとオンボードセンサに基づく移動ロボットの制御スキームに関する研究

ブルシュチッチ ドラジェン

Mobile Robot Control Scheme Based on Distributed and Onboard Sensors By Drazen Brcsic

Mobile robots are becoming more and more sophisticated and the research on them is turning towards new applications. One of the desired advancement of mobile robots nowadays is their deployment in spaces that are populated by humans, like homes, offices, public spaces, etc. However up to this date, there are almost no working implementations of robots in such environments. The reason for that lies in the fact that the robotic intelligence has still not matured to a level that would allow easy coexistence with humans.

In this thesis we propose a different approach to the problem. This is to distribute the intelligence between the robot and the space it acts in, under the assumption that this kind of synergic combination of outside and inside intelligence will lead to a considerable advantage when compared to the standard all-onboard approach. We work on the control of the mobile robot in environments that have distributed sensing and computing power. These types of spaces are given the name Intelligent Spaces.

Chapter 2 gives an overview of what Intelligent Spaces are, what are their characteristics and what can be done with them. An overview of similar researches is also given, describing the basic trends and similar research areas, such as ubiquitous computing or sensor networks. After that the connection between mobile robots and Intelligent Spaces is described. Here we discuss what is that mobile robots offer when implemented in Intelligent Spaces. Following that, we discuss the main merits the introduction of Intelligent Space has for mobile robots.

Chapter 3 is concerned with the motion control of the mobile robot. Considering the type of application we are aiming at in this work, here we consider several methods for robot control and compare their characteristics. The control is divided into two parts: global path planning and local path following and obstacle avoidance. Each of these parts is explained and the methods explained and compared in experiments. The basic two-step method is also expanded in order to achieve better behavior in the vicinity of dynamic objects. We describe a rather simple but effective moving object avoidance algorithm based on the prediction of the future position.

The methods described in chapter 3 rely heavily on the measurement and estimation of the relevant variables, which in this case are the position and speeds of both the mobile robot and the humans in the space, and the position of walls and static objects; in other words the map of the space. These tracking and mapping tasks are dealt with in chapter 4, where sensing inside Intelligent Spaces is described. Here the accent is on the deployment of sensors that are distributed and

fixed at different locations in the space. A description of mainly used sensors for this type of applications is given, and afterwards the details of the implementation of tracking using the ultrasound positioning system and multiple laser range finders are described.

In chapter 5 sensing using the mobile robot's onboard sensors in addition to the distributed sensors of the Intelligent Space is discussed. The inclusion of a mobile sensor into the network of static sensors from chapter 4 is not straightforward, as the two types of sensors have different characteristics. This is analyzed here, and the main factor is pointed out: the motion of the mobile robot introduces correlations in the estimate (similar to the SLAM problem), which in turn can result in an increase of the computational and communicational burden of the tracking system. In order to avoid this, we introduce the use of the Covariance Intersection method, in which case it is possible to combine the two types of sensors directly, however at the cost of a higher uncertainty in the estimate, than in the case when not using this method.

In chapter 6 the results from the previous chapters are combined in order to obtain a complete mobile robot control system based on the cooperative sensing using both onboard sensors and sensors distributed in the space. Here we discuss the proposed control scheme and analyze what are the advantages that can be realized when external sensors from Intelligent Space are added in order to enhance the overall sensing abilities needed by the mobile robot. We also argue that this type of implementation greatly improves the robot's characteristics, to the point that its introduction into populated and dynamic spaces of our everyday life becomes feasible and even easy. The discussion is followed by experimental results, where the merits of the proposed scheme are demonstrated in several different situations. The experiments show that the novel scheme indeed has a great influence on the robot's performance.

The thesis concludes with a list of contributions, plans for future work and a comment on the perspective of mobile robots that move and work in our vicinity.

A8. 基本的実測を援用した端効果の数値解析に基づく車両駆動用リニア誘導モータのプラントモデル同定法

野崎 雄一郎

**Identification of Linear Induction Motor Plant Model with Significant Consideration of End-Effect – Intended for use in Rail-Guided Public Transportation Systems –
By Yuichiro Nozaki**

A linear induction motor (LIM) is a suitable choice for railway application of both wheel-suspended and contact-less types, such as Linear Metros and HSST in Japan. The LIM has myriad advantages including that it is simple to manufacture, capable of direct force, independent of adhesion, comparatively to maintain, and it can handle steep gradients and curves in the track.

However, the LIM has inherent problems which do not exist in conventional rotary induction motors. The LIM has the end and asymmetrical winding. These cause the flux of air gap to become nonuniform. End-effect is also a major problem in the LIM, which makes the analysis, design, and control of motors difficult. The end-effect influences the characteristics of the LIM depending on the operation speed.

Methods for electromagnetic numerical analysis such as the Finite Element Method (FEM) and Finite Difference Method (FDM) have been widely used for electromagnetic machines and the controller designs. End-Effect can be described by such numerical calculations or by actual measurements, but this proves problematic for LIM.

In this paper, a combination of the consideration of substantial performance of an LIM and the plant model for LIM controller is described. The end-effect can be considered using 2D analysis, on the other hands the consideration of the edge-effect is needed for full-scale 3D analysis. In order to decrease the calculation cost, 2D numerical analysis supported by the use of a part of 3D-FEM model and an analytical method is used for the calculation of LIM performance. And the result of the calculation is validated by the rotary type LIM test equipment result and static test of a real Linear Metro's LIM.

For the controller design of an LIM, a direct application of the electromagnetic analysis to a transient simulation is restrictive because of the expensive calculation. It would be more convenient to use a simplified equivalent circuit for the controller design. However, the conventional equivalent circuit of a rotary induction motor is not directly applicable to the LIM. This paper also describes an identification scheme for circuit parameters based on numerical analysis and basic performance of vector controller of LIM based on the equivalent circuit.

This combination of a numerical electromagnetic calculation of LIM and a control theory of induction motor becomes effective mean for the development of high-performance LIM-driven transportation system.

A9. 無線協調通信システムにおける空間多重方式の設計と解析に関する研究

ダルマワン アンドレアス

**Design and Analysis of Cooperative Spatial Multiplexing System in Wireless Relay Networks
By ANDREAS DARMAWAN**

This dissertation presents and proposes a comprehensive concept of a particular type of cooperative communications called cooperative spatial multiplexing system. The main advantage of the system is that it allows for the realization of MIMO performance in single-antenna wireless terminals environment. This also means that the proposed systems will be superior to the currently existing SISO and MIMO schemes, especially in low-SNR conditions.

Transmission schemes for uplink/downlink amplify-and-forward and decode-and-forward relaying were

investigated and proposed. In the amplify-and-forward scheme, non-regenerative relays are employed such that they only amplify and forward different portion of the received signal at a reduced data rate to the receiver (destination). While in decode-and-forward scheme, the regenerative relays actually decode the received signal before forwarding it to the destination sink. MIMO communication is established for relays to destination data transmission. For downlink transmission, the relays may opt to forward the data to the destination by utilizing simple TDM transmission or Alamouti's space-time coding. The combination of transmitter, relays, and receiver forms a virtual MIMO system in single-antenna wireless terminals environment. Symbol decoding at the destination sink is done by SNR (Signal-to-Noise Ratio) and LLR (Log-Likelihood Ratio) based detection ordering schemes, along with successive interference cancellation process.

Theoretical analysis on the performance of the different above-mentioned transmission schemes based on Gram-Schmidt orthogonalization process is also presented. The analysis focuses on the outage probability and average BER performance of the system under Rayleigh fading environment. Closed-form solutions for 1x2x2 uplink and 2x2x1 downlink systems employing coherent BPSK modulation are presented. The theoretical analysis results are then confirmed with Monte-Carlo simulations in order to prove their validity and accuracy. We further derived the optimal and semi-optimal transmit power allocation schemes for the different systems by applying Lagrange multiplier optimization to the outage probability expressions. This allows the system to allocate power optimally between the source and relaying terminals, such that the outage probability and BER will be minimized for the given link conditions. Hence, as a result, performance improvements over the classical uniform power distribution scheme are expected.

A10. 高電圧 CMOS 駆動回路と SOI-MEMS アクチュエータのモノリシック集積化に関する研究 高橋 一浩

A Study on Monolithic Integration of High Voltage CMOS Driver Circuits and SOI-MEMS Actuators By Kazuhiro Takahashi

This dissertation thesis discuss a new designing and fabrication technique to integrate MEMS (Micro Electro Mechanical Systems) actuators and sensors into the blank space in a pre-fabricated high-voltage CMOS LSI (Complementary Metal-Oxide Semiconductor Large Scale Integration) in a manner similar to ASIC (Application Specific Integrated Circuit).

MEMS is an enabling technology to develop micromechanical structures by using the semiconductor micro fabrication techniques. Advantages of using the MEMS technology is in the capability of developing intelligent micro machines as a result of multi-functional assembling of micro actuators, micro sensors, and micro processors onto a

monolithic chip of substrate. The conventional LSI application has spread in wide range of electronics applications of mass-production, MEMS has not yet found a large market in the consumer electronics but it is even experiencing difficulty in commercially releasing productions for small market. The difficulty arises from the fact that the fabrication is costly even for a trial-and-error phase of development, due to various types of materials used other than semiconductors, such as metals plastics, and polymers, and that the MEMS process cannot be standardized. Successful practicing of MEMS technology depends on the fabrication flexibility towards such various applications produced in small quantity.

Based upon such technical and economical background of MEMS, in this thesis, we propose a new designing and fabrication technique of the CMOS-MEMS platform that is adaptive to small-quantity MEMS products. We also point out a possibility of using single crystalline silicon of SOI (silicon-on-insulator) wafer to develop micro actuators of superior performance to those made by the conventional surface micromachined CMOS-MEMS technology. This work also presents a new technology of monolithic integration of high-voltage driver circuits for the sake of high performance and high reliability of MEMS actuators.

Chapter 1 of this thesis gives the state-of-the-art MEMS integration technologies and points out the technological tasks left unsolved. It presents the aim of general purpose CMOS-MEMS technology. A list of tasks to improve MEMS actuators performance is also presented.

In Chapter 2, we discussed a new MEMS integration process to make circuits first on the SOI wafer and then post-process MEMS onto it, which gives flexibility in post-designing MEMS variation. The conventional post-CMOS MEMS technologies only allowed the surface micromachining technique. On the contrary, the SOI bulk micromachining presented in this work has enabled us to design micromechanical components of higher aspect-ratio and better reliability.

In Chapter 3, we present the results of high voltage driver circuits for MEMS integration. The driver circuits have been made in collaboration with TOSHIBA R&D Center, where they have designing and processing technology for 40V driver LSI. Use of high voltage for MEMS drive gives us more margins in designing micro actuators, namely faster mechanical response and larger mechanical displacement.

In Chapter 4, we summarize the compatibility issues between the integrated circuits and MEMS processes. Studies are made on (1) the design and fabrication of the MEMS-circuit electrical interconnection, (2) the effect of dry-etching plasma on the circuit characteristics, and (3) the sacrificial etching process to release the micro structure. The chapter also reports a successful result of a comb-drive electrostatic micro actuator that has been monolithically integrated with a driver circuit.

Chapter 5 gives an example of the CMOS-MEMS. An XY-stage micro actuator has been produced by using a layer-separation designing technique of the SOI wafer. A

high fill-factor of device layout has been possible by allocating the electrical function such as actuators electrodes and mechanical functions such as suspensions and frames to the different layers of an SOI wafer. The developed micro XY-stage can be used for a movable stage for the optical microscope and for medium translating stage for the AFM (atomic force microscope) type data storage.

Chapter 6 presents another example of the CMOS-MEMS technology, an array of grating light valves integrated with the IC drivers, developed for a digitally controlled image projection display. Each unit cell of the grating could be laterally controlled in an individual manner to pixel-wise tune the diffraction angle of light. The line image created by the MEMS is then scanned with a galvano scanner to create 2D image. We observed the electrostatic operation and its optical effect of the gratings by applying drive voltage. An improved model of the MEMS gratings to avoid the overlap between the 1st and the 0th order diffraction patterns has been developed by giving a skew angle to the gratings array. A high-speed and high-voltage level shifter driver circuit and the MEMS grating have been integrated to show the potential of MEMS approach for constructing the image projection optical system of high definition and high contrast.

Chapter 7 discusses the optimization technique to connect the driver circuit to the MEMS actuator. The chapter also discusses the advantages of making a tiled array of CMOS-MEMS over the stacked version.

Chapter 8 is the conclusion of the dissertation thesis.

A11. マイクログリッドの設計・構築のための解析・評価法の基礎検討

西川 勝也

Fundamental Research on Analysis and Evaluation Methods for Design and Construction of Microgrid By Katsuya NISHIKAWA

電子情報学専攻

A12. 検索エンジンを利用したウェブからのエンティティ情報抽出手法と応用に関する研究

森 純一郎

Entity Information Extraction from the Web Using Search Engine: Methodology and Application By Junichiro Mori

The current developments of Web applications such as Blogs and Wiki enable users to easily create and disseminate their content in the Web. As the contents on the Web are rapidly growing, the quantity of information is recently becoming more important in the Web. With the large quantity of information, the Web has now turned to the huge corpus that can be easily accessible using search engines; this opens new possibility to handle the vast relevant information and mine important structures and knowledge.

In addition to the trend of "Web as corpus", another important aspect of the current Web is that our daily life is reflected in the Web. For example, social networking services (SNSs) where users maintain an online network of friends have recently received much attention on the Web. Information about tens of millions of people and their relationships are currently available in the Web. Communication and information sharing in the real world are also reflected in the Web. As users publish their daily activities and communicate in the Web, the Web is now becoming another form of our society.

With the current trends of "Web as Corpus" and "Web as Society", the large amounts of information which is originated from our daily activities in the real world are available on the Web. These new trends are forming a new tendency of information retrieval that users search for the "entity-based" information rather than documents. Here, the entity is defined as an object in the real world such as person, location, and organization. In addition to single entity information, relation information among entities from the Web is also becoming important information to be retrieved by users.

Users are currently searching for entity-based information and entity relations on top of existing document-based Web information. The Semantic Web is one approach to realize the entity-based information retrieval. In the Semantic Web, every resource is annotated with metadata using ontology. Users can easily search and find the entity-based information using the annotated metadata. However, because data should be annotated with metadata in advance to fully use the Semantic Web technologies, there is a major problem of metadata annotation in the Semantic Web. Therefore, there is still a huge gap between the current Web where most data are unstructured and the Semantic Web.

Aiming at realizing information services based on entity-based information and entity relations as a next stage of current information retrieval, in this thesis we propose methods for extracting entity information and entity relations from the Web. The key features of our approach are to leverage existent search engines and obtain several Web-scale statistics such as hit counts and snippets in order to assess entity-related information. Applying several text processing techniques such as named entity recognition and clustering to the information obtained from search the engine, our methods extract entity information, entity relations and social networks.

The extracted information can be applied to several applications. We first develop the researcher search system in which the information about researchers and relationships are automatically extracted from the Web. We also develop the information sharing system and the expert finding system using the extracted social networks.

Overall, in this thesis we address two research questions for extracting entity information from the Web: (1) how search engines can be used to access the Web corpus and extract entity information from the Web, and (2) how the extracted entity information can be used to support users in entity-based information services.

For first question, we propose a method of keyword extraction for extracting entity information from the Web. The proposed method is based on the statistical features of word co-occurrence that are obtained from search engine. We also propose a method that extracts descriptive labels of relations among entities automatically such as affiliations, roles, locations, part-whole, social relationships. Fundamentally, the method clusters similar entity pairs according to their collective contexts obtained from search engine. The descriptive labels for relations are obtained from the results of clustering. Finally, We propose a method that automatically extracts social networks from the Web. The method leverages search engine to build social networks by merging the information distributed on the Web.

For second question, we develop the researcher search system. The system is a Web-based system for an academic community to facilitate communication and mutual understanding based on entity information and social networks extracted from the Web. We also develop a real-world-oriented information sharing system. The system enables users to determine who has access to particular information based on the social networks and network analysis. We finally develop the expert finding system which locates relevant and socially close experts for information seekers. The system leverages the entity information and social networks of a Web community in order to find experts who have appropriate expertise.

A13. 分散センサの統合によるエリア内人物追跡と動線推定

小林 貴訓

People Tracking and Trajectory Estimation by Integrating Observations from Distributed Sensors for Local Area Surveillance By Yoshinori Kobayashi

For security reasons, surveillance cameras are installed everywhere these days. Although it is obvious that monitoring with surveillance cameras is effective in preventing crimes, a massive amount of surveillance footage is difficult for security guards to monitor in real time. In fact, most stored surveillance footage will be discarded after several days. In contrast, if we can recognize human activities by analyzing surveillance footage automatically, we can detect unusual behavior.

Another problem is that when monitoring public or commercial facilities, it is difficult to get high-quality observations everywhere in the whole area due to obstacle or occlusion caused by people's interaction. Therefore, we need to develop a technique to estimate people's trajectories in the whole area by using a sparse network of multiple sensors.

This work is focused on tracking people in a drugstore or a supermarket where several people can be found at the same time. 3D position and the orientation of people's heads are tracked by using multiple cameras. The information from a sparse network of multiple cameras is used to estimate people's trajectories in the whole area including unobserved areas.

The challenge for tracking people's heads is how to cope with many inherent difficulties such as the low image quality

of surveillance cameras, changes in the target's appearance due to its motion and varying illumination conditions, and cluttered image backgrounds. In this work, I propose a method for 3D human head tracking by incorporating a face detection technique. In regard to face detection, Viola and Jones proposed the face detection technique by using AdaBoost-based classifiers based on Haar-like features. Their face detector has become popular because of its accuracy and robustness against low resolutions and varying illumination conditions. However, in the framework of tracking objects, it is not efficient to search for faces of various sizes over a whole image exhaustively for each video frame.

Therefore, I present a novel method for 3D human head tracking based on a particle filter framework incorporating classifiers for hypothesis evaluation. In particular, the state of a human head is represented by its 3D position and orientation. The state likelihood is evaluated by using multiple cameras and multiple classifiers. Each of the classifiers is trained for detecting human heads that are facing in a particular direction. Among these classifiers, the most suitable one is selected adaptively by considering each hypothesis and known camera position. This selection of classifier allows us to employ additional classifiers without increasing computational cost.

After establishing the human head tracking technique, I extend it to a more practical people tracking system. In a real environment, it is necessary to track multiple people and to deal with appearance/disappearance of people including occlusions caused by people's interactions. To cope with these inherent problems, I propose a method for multiple people tracking using a mixture particle filter framework incorporating laser range scanners to improve the robustness and accuracy of tracking. In particular, people's appearance/disappearance is captured based on the information from laser range scanners. Each of the proposal distributions of the mixture particle filter is constructed by a mixture model that incorporates information from an optical flow and measurements from a laser range scanner. This novel tracking framework enables the incorporation of information from a different sensing modality.

To track people successfully in the whole area, it is necessary to establish correspondences between people captured by different cameras and to estimate a person's trajectory even in unobserved areas.

To establish correspondences between people, we can consider a space-time cue and an appearance cue. A space-time cue is based on the concept that each camera is capturing a part of real space in real time. For example, a person cannot be captured by multiple cameras observing different areas simultaneously, and we can suppose the person's travel time between two different observation areas. An appearance cue is also the concept that observations of the same person in two different cameras are supposed to be similar in appearance. Graph theory is used to find observation pairs of the same person from a variety of combinations. In particular, referring the method proposed by Javed et al., a directed graph is constructed as a node in an observation of one camera, an arc

is a hypothesis of correspondence of two observations, and a weight of an arc is the likelihood that derives from a space-time cue and an appearance cue. Because a directed graph can be converted into a bipartite graph, the pairs of observations are found by calculating maximum matching of the weighted bipartite graph.

Finally, to estimate a person's trajectory in the whole area, an interpolation of trajectories in unobserved areas is indispensable. Though Rahimi proposed the method based on a MAP estimation framework by using a motion model and an observation model, the estimated trajectory is run through walls because he did not consider obstacles. Therefore I propose a method incorporating an environment model into a MAP estimation framework. In particular, a person's trajectory is estimated by optimizing an evaluation function that is derived from a motion model, an observation model, and an environment model.

In this work, I propose novel methods for stable and accurate tracking of people's heads and integrate the techniques to estimate the trajectories in the whole area, including unobserved areas. These techniques and framework of my work can contribute to research recognizing human activities in a higher abstraction level such as intention understanding.

A14. 描画ロボット: 視覚に基づく高レベルプランニング

ルチャスラック ミティ

Robot Painter: High-Level Planning Based on Visual Perception By Ruchanurucks Miti

Recently, many areas of research on humanoid robots have been studied, such as motion control, man-machine interfaces, artificial intelligence (AI), and so on. Among them many research projects have tried to create artist robots, with the common objective of exploring new sensing, artificial intelligence, and manipulation techniques.

This research explores new vision and manipulation techniques through painting tasks. The ultimate goal is to create a robot painter that has capabilities similar to human artists.

Consider the vision part, the key problems of 2D/3D object segmentation, color perception, orientation mapping, geometry edge processing are what our method can directly address.

This research focuses, first, on effective 2D segmentation scheme using local and global classifiers. Our proposed method can effectively deal with a foreground cut, multiple cuts, and cut before matting. Then it is shown how to exploit normal stereo cameras to roughly extract the object automatically, based on 3D background subtraction and other vision techniques, and then use our 2D segmentation to extract the object area correctly.

The robot tries to understand color distribution of the object to select the best set of colors to use. Normally, clustering colors face the problem that it tends to produce colors with low

contrast. We solve this problem by incorporating two clustering methods: maximum distance clustering and K-means.

Then, in order to draw brush strokes meaningfully, the robot senses the orientation of the object. To interpolate the orientation for the whole object, the global orientation that exploits radial basis function to generate an orientation similar in style to Van Gogh, is applied.

Furthermore, some human artists usually use edges to enhance his/her paintings. Technically, many researches use gradient information to represent edges of objects. However, this would be affected from the color information on the surface. Hence, we decide to use 3D geometry edges as an input. It will be described how to extract 2D edges from 3D model. Then, the 2D edges are processed into brush strokes.

We then show how to apply these methods to high-level manipulation using a robot platform that consists of two arms and multi-fingered hands. The robot also has a stereo vision system. Based on the derived information, the robot then performs a visual feedback drawing. First, it detects a brush and grabs it using cameras and force sensors. Second, a position of the brush tip is calculated using principal component analysis (PCA). Third, it then draws and compares the canvas with the picture produced by the stereo cameras.

Finally, as the trajectories planned by the robot may not be realized on the real robot platform since its physical limitations, this research presents a method to filter and optimize trajectories targeting offline and online applications. All physical attributes, namely angle, collision, velocity, and dynamic force, are considered as a set of constraints to be met and represented as B-spline coefficients, making the limits guaranteed.

Many of the proposed methods will be shown to outperform the current methods in the sense of correctness and minimal user interaction, and it does so in a reasonable computation time.

Semantic concepts of objects do not occur in isolation and there is always a context to the co-occurrence of objects and backgrounds in a video scene. It is believed that it can be beneficial to model this context. In this work, a block-based background classification engine is used to recognize the backgrounds where the objects appear in the video. To extract similar backgrounds from the video, a model image, which is a template representing the feature of the background and serves as the background model, is selected from keyframes. Each model image is inspected to find the closest match based on the similarity measure between the model image and the target keyframe. On the other hand, a probabilistic Bayesian network is used to model the context between objects and backgrounds, and to demonstrate how this leads to an improvement in the performance of object query and annotation.

In the case of model matching, a fuzzy mode similarity measure is proposed to adaptively calibrate the feature matching criterion based on the illumination instability. We first use an information-theoretic measure as a quantitative measure of the information distribution within an image. This

measure is further extended to the video case and used to quantitatively represent the lighting condition of each single scene. The illumination instability of the video is thus measured by calculating the instability of the features extracted from the extended measure. Based on this information-theoretic illumination instability measure, characterizing the similarity between the model regions and the retrieved keyframes becomes two issues, one being model distribution prediction and the other being similarity measure according to the degree of lighting changes and the shape of model distribution.

We store 15 videos with total of 15,708 keyframes to generate experiments for examining the performance of the proposed approaches. In case of one video, the total processing time is 655.2 minutes, less than 11 hours. From the experimental results illustrated in the manuscript of this thesis, it is demonstrated that the proposed instability measure successfully reflects the relationship that the performance of color-based video system decreases as the lighting condition of the object video becomes unstable. The experimental result of semantic object model matching, fuzzy mode similarity measure and context relationship network (CRN) demonstrates significant improvement in performance of semantic object extraction by using CRN than without using it. Furthermore, the retrieval performance is improved by the fuzzy mode similarity measure. Compared to conventional approaches, the proposed system greatly holds down the indexing cost of content provider.

As the result, we build up a semantic content database, which stores video content metadata and the operations that manipulate such kind of metadata. Based on this database and the corresponding operations, the proposed system generates a general video management and utilization framework to provide a great potential environment for development of interactive multimedia applications. In this thesis, two novel practical applications are constructed and implemented to show the practicability of the proposed semantic content generation support system. Following BS digital broadcasting from 2001, the terrestrial digital broadcasting started on Dec. 1 of 2003 in Japan, and the analogue broadcasting will be ended in 2011. Against this background the necessities of semantic video indexing system and interactive multimedia application increase rapidly. We believe that our research will contribute greatly to the related fields.

A15. テキストからの感情センシングのための解析的アプローチ

モスタファ アル マスム シェック

An Analytical Approach for Affect Sensing from Text By Mostafa Al Masum Shaik

Studying the relationship between natural language and affective information as well as assessing the underpinned affective meaning of natural language are becoming crucial for improving human computer interaction. The area of such interactive applications is numerous and varied, ranging from

categorizing newsgroup flame and augmenting search engine responses to analysis of public opinion trends towards a particular fact or entity and customer feedback. Text is not only an important medium to describe facts and events, but also to effectively communicate information about the writer's positive or negative sentiment underlying an opinion, or to express an affective or emotional state, such as happy, fearful, surprised, and so on. We consider sentiment assessment and emotion sensing from text as two different problems. Classifying the tone of the communication as generally positive or negative is considered as the task of sentiment assessment and recognition of particular emotion(s) being expressed is the task of emotion sensing. Therefore, the thesis first presents an analytical approach to sentiment assessment, i.e., the recognition of negative or positive valence of a sentence and then explains how a well-founded emotion model has been implemented for recognition of emotions. For the purpose of sentiment assessment from text, we perform semantic dependency analysis on the semantic verb frame(s) of each sentence, and then apply a set of rules to each dependency relation to calculate the contextual valence of the words used in the sentence. By employing a domain-independent, rule-based approach our system is able to automatically identify sentence-level sentiment. A linguistic tool called 'SenseNet' has been developed to recognize sentiments in text, and to visualize the detected sentiments. We conducted several experiments with a variety of datasets containing data from different domains. The obtained results indicate significant performance gains over existing state-of-the-art approaches. Emotions expressed in natural language are very often expressed in subtle and complex ways, presenting challenges which may not be easily addressed by simple text categorization approaches such as 'n-gram' or 'keyword identification' approaches. Numerous approaches have already been employed to "sense" affective information from text; but none of those ever employed the OCC emotion model ? an influential theory of the cognitive and appraisal structure of emotion. The OCC model derives twenty-two emotion types and two cognitive states as consequences of several cognitive variables. This thesis therefore describes how to relate cognitive variables of the emotion model to linguistic components in text, in order to achieve emotion recognition for a much larger set of emotions than handled in comparable approaches. In particular, we provide tailored rules for textural emotion recognition, which are inspired by the rules of the OCC emotion model. Hereby, we clarify how text components can be mapped to specific values of the cognitive variables of the emotion model. The resulting linguistics-based rule set for the OCC emotion types and cognitive states allow us to determine a broad class of emotions conveyed by text.

This thesis is composed of seven chapters and two appendices, which provide background to this research, describe the core methodologies, demonstrate results of this work, describe the developed applications, and enlist pseudo codes of the approach discussed. The contents of each chapter are outlined below.

* Chapter one: This part is a general introduction to the topic. Since the research topic is multi-disciplinary, first the contribution and background knowledge obtained from different knowledge domains are discussed. Then the core features of this research are pointed out.

* Chapter two: In this chapter, the current state of the art approaches for sentiment analysis from texts have been discussed by pointing to the limitations of those. Finally, our approach is explained from the viewpoint of considering the previously ignored topics for the task of sentiment analysis of text.

* Chapter three: This chapter explains the core approach of this research. How different lexical resources have been developed and then employing several rules how an input text can be considered as an analytical model have been explained with examples. Our developed application, SenseNet, assesses an input text numerically in order to know whether the input text carries a negative or positive sense. The implementation detail of SenseNet is discussed in this chapter.

* Chapter four: This chapter contains experimental results for different standard datasets for the task of sentiment analysis. Different types of system evaluation are done and the chapter concluded with a discussion on obtained results and failure analysis.

* Chapter five: Though all emotions can be seen as positive or negative, this chapter extends the idea of recognizing more fine-grained named emotions (e.g., happy, sad, anger etc.). Towards this point how a well-founded emotion model (i.e., OCC emotion model taken from Cognitive Psychology) can be implemented in linguistic realm has been discussed. This is completely a new contribution that came out of this research.

* Chapter six: Grounding the developed theories and methodologies several applications are developed. In this chapter the developed applications are discussed in terms of their architectures, functional steps and graphical user interfaces.

* Chapter seven: This chapter contains summary and conclusions of the studies in sentiment and affect sensing from text.

* Appendix A: It contains the pseudo code of the algorithm for sentiment sensing from text.

* Appendix B: It contains the detail experimental result of one of the datasets.

A16. 意味的關係と興味に準じる交流に基づく物語生成法

アルトゥロ ナカソネ

A Storytelling Model based on Semantic Relations and Interest Interaction By Arturo Nakasone

In a general sense, stories are defined as unique sequences of events, mental states, or happenings involving human beings as characters or actors. Any properly constructed story always aims to deliver a particular message to its audience, and the

content of this message is commonly conveyed through discrete pieces of information, referred to as events, so that users can assimilate the story in a more convenient and orderly way. Nevertheless, a story is not only defined by its content, but also by the manner this content is presented. Even though the information that defines the content of a story can be fixed, several different “told stories” may arise depending on how such information is sequenced. Storytelling is, in other words, the process by which content is conveyed to the audience in order to maximize not only its attention, but also its understanding and eagerness, and researchers have created extremely complex applications to enhance not only the manner a story can be told, but also the manner users can enforce their preferences in content presentation through interaction.

In this context, interactive storytelling (IS) models, either implicitly or explicitly, have had to deal with three major aspects in their implementations, regardless of their technology: (1) how to define events, i.e. the pieces of information that constitutes the content of any story, (2) how to present events, i.e. the algorithm that is used to convey this content to the user, and (3) how the user is to interact with the story, i.e. the variables that the user can modify in order to change the presentation of the events in content or in order. The majority of IS implementations encode in their definition of story event timing information (the range of time specified in terms of the story timeline in which the event must be presented) and interaction variables associated with that predefined timing. This approach is convenient for story presentation, but presents several restrictions in terms of story understanding if events are not adequately organized, and story dynamism since it leaves story algorithms with little or no manipulation ability to arrange the events taking into consideration the narrative appeal to the user. In this thesis, I present ISRST (Interactive Storytelling Model using RST), my proposal for a storytelling model based on the organization of generally defined events using a subset of rhetorical relations proposed by the Rhetorical Structure Theory (RST) and the application of narrative principles and user interaction through interest to generate appealing stories.

The thesis document is composed by eight chapters, which provide the background and starting point for my research, description of the storytelling conceptual framework, and the demonstration of the results of my work. The contents of each chapter are outline below.

* Introduction: This chapter is the introduction of my thesis, in which I describe the essential concepts of a story and give proper fundamentals for the value and approach of my work. It also describes the structure of this thesis.

* Storytelling Application Models: This chapter describes the current state of the art in storytelling applications organized by the way these applications contribute to the field in terms of event sequencing and event interaction, two keys aspects for any storytelling model.

* Attributes for a Generalized Semantic Storytelling Model: This chapter details the model attributes that were considered

in order to have a generalized storytelling model and why they are needed.

* The Role of User Interest in the Storytelling Process: This chapter details the role of the user's interest in the storytelling process, its definition and principles regarding its relation with the story itself. It also describes how it is calculated in my model and the assertiveness of this calculation compared to other well known methods.

* The ISRST Semantic Ontology Model: This chapter describes ISRST, the application I developed, by emphasizing its design components (story ontology, narrative functionality, interest calculation, and story generation)

* The ISRST Application ? Implementing on the Web: This chapter describes the web implementation of ISRST.

* ISRST Story Testing and Analysis: This chapter describes the analysis' results of ISRST by using two real stories with different objectives. I present the details of the construction of each story and the interest data I collected so far.

* Conclusions and Future Research Directions: This chapter states the conclusions of the research work, highlighting discussions about each component of the model and future work that may contribute to enhance the present version.

Appropriately selected features give the application a solid base as a storytelling framework and flexibility in story implementation, including:

* The utilization of OWL class structures to define major story components. Although the current functionality is limited to object searching and attribute extraction, the use of this semantic tool gives ISRST the possibility to further encapsulate the model by implementing more complex reasoning inferences involving already implemented classes and real time parameters. In addition, OWL provides to the story author a well-known standard way to create and implement his or her stories.

* The construction of complex multimedia content using a flexible script language called the Event Specification Language (ESL). ESL provides not only the way to personalize this content, but also a useful way to synchronize it to enhance a story's presentational effects.

* The ease of web deployment by implementing the whole application in Java.

* The implementation of a true unobtrusive interaction model through the use of interest, which not only is the most important factor in any user interaction paradigm, but also can be extrapolated to other well known types of interaction methods, such as menu selection, gamepad manipulation, command processing, action perception, etc.

A17. トラップされた励起子ポラリトンの凝縮体と励起状態

宇都宮 聖子

Condensation of Confined Exciton-Polaritons and Their Excitations By Shoko Utsunomiya

When we use existing search engines, we enter only a few

terms to form a query. Even if we use effective query terms, e.g., proper nouns and technical terms, such a short query is likely to be ambiguous. As a result, we often have to select the documents of interest from a large number of retrieved documents, which may have a wide variety of content. I propose a method for supporting query refinement by using term clusters of topical terms extracted from a retrieved set of documents.

Bose-Einstein condensation (BEC) is generally defined as a macroscopic occupation of a single-particle quantum state, a phenomenon often referred to as off-diagonal long-range order due to non-vanishing off-diagonal components of the one-body density. Since the theoretical prediction of BEC in an ideal gas of non-interacting bosons by Einstein in 1925, BEC in dilute atomic gases has been long-awaited and finally demonstrated by two experimental groups in 1995. In the past decade, a new solid state system called exciton-polaritons, which are half-matter, half-light quasiparticles in semiconductor microcavities, has attracted considerable attention as a new candidate of Bose Einstein condensate in solid state systems.

Bose-Einstein condensation was theoretically predicted in Einstein's 1925 paper, based upon the Bose's statistical description of quanta of light in 1924. However, Einstein's prediction had been neglected for more than ten years, since BEC was regarded as not much more than a theoretical anecdote. The discovery of superfluidity in liquid ^4He by Kapitza and by Allen and Misener in 1938 stimulated the interest in BEC physics. The hypothesis of the connection between superfluidity and BEC by London motivated the theoretical study of BEC. Shortly after that, Tisza used the notion of BEC in his two-fluid hydrodynamics model in 1938, which describes the co-existence of thermal and condensate phases in the fluid. In 1941, Landau noticed that liquid could be described in terms of weakly interacting particles rather than non-interacting particles. This phenomenological description of a superfluid assumes a relatively simple excitation energy spectrum for two kinds of quasiparticles: phonons and rotons. A quantum field-theoretical formulation by Bogoliubov in 1947 established a microscopic theory for weakly interacting Bose gases, which yielded directly the phonon-like excitation spectrum. Cohen and Feynman suggested that the excitation spectrum could be observed by thermal neutron scattering experiments. However, the observed excitation spectrum agreed only qualitatively due to strong particle-particle interaction of liquid helium. In 1995, the experimental group of Cornil and Wieman at Boulder and that of Ketterle at MIT succeeded in reaching critical temperatures and densities required to observe BEC in dilute atomic gases with different cooling techniques. Experimental verification of the Bogoliubov theory only came with that long-awaited BEC of weakly interacting particles.

The exciton-polariton in a semiconductor microcavity is a promising solid state system for studying the dynamical condensation phenomena in solids. Since its effective mass is eight orders of magnitude smaller than the atomic hydrogen mass and four orders of magnitude lighter than the exciton

mass, the critical temperature of polariton BEC transition is expected to be up to room temperature. Furthermore the experimental set up is rather compact and simple compared to that of cold atoms or liquid helium. Meanwhile, the exciton BEC was theoretically predicted in 1965, but it has never realized because of notorious problems inherent to solid state systems, that is a relatively short lifetime, dissociation of excitons at high densities by screening, Auger recombination and phase space filling and localization of excitons due to disorder and inhomogeneous potential.

Recent experimental progress with exciton polaritons demonstrated several promising signatures for polariton condensation, such as quantum degeneracy at nonequilibrium condition, polariton bunching effect at condensation threshold, long spatial coherence and finally quantum degeneracy at equilibrium condition. Those experimental results are good smoking guns but not sufficient to convince the scientific community with the occurrence of BEC. This is mainly because the exciton-polariton system is a dynamical system due to its short lifetime and a complicated system due to its solid state environment. The particle-particle interaction, which is in the intermediate coupling regime between strongly interacting superfluid ^4He and weakly interacting dilute atomic gas in the case of polariton, and peculiar excitation spectra are keys for understanding BEC and superfluidity. In this thesis the five distinct signatures of the polariton-polariton interaction are studied: In this thesis the five distinct signatures of the polariton-polariton interaction are studied: (1) blue shift of the condensate energy U due to repulsive interaction among condensate polaritons, (2) expanding condensate size with polariton density due to the same origin, (3) increasing position-momentum uncertainty product to above the Heisenberg limit, (4) phonon-like dispersion of excitations at small momentum region blue shift of particle-like excitation energy $2U$ at large momentum regime due to the interaction between the condensate and thermally excited particles.

For the observation of BEC, we used circular traps to induce the effective potential barrier for polaritons by depositing the thin metal film, which modulate the effective photon field in a microcavity and increase a resonant energy of a cavity photon field and also lower polariton energy. When energetic polaritons are injected near a trap, those polaritons are cooled by collision with lattice and eventually confined in a trap made of a hole of metal film, where the lower polariton energy is $\sim 200\text{meV}$ lower than that in the surrounding area. Trapped polaritons condense into nearly a single-transverse mode and features a position-momentum uncertainty product close to the Heisenberg limit.

We showed the quantitative agreement of Bogoliubov theory and experimentally observed excitation spectra which stem from the condensate of polaritons in traps. We confirmed that excitation spectra of trapped polariton condensate agrees with inhomogeneous and homogeneous model of Bogoliubov excitation near $|k| = 1$ at different densities. In both the phonon-like regime $|k| < 1$ and the free particle regime at $|k| > 1$, the experimental results agree well

with the universal curve. We also investigated polarization dependence of condensation and excitation spectra and confirmed the excitation part has the same polarization as the condensate.

As for the first important experimental result in this thesis, for the observation of condensate, we showed the quantitative agreement of Bogoliubov theory and experimentally observed excitation spectra which stem from the condensate of polaritons in traps. In both the phonon-like regime and the free particle regime at $|k| > 1$, the experimental results agree well with the universal curve. We also investigated polarization dependence of condensation and excitation spectra and confirmed the excitation part has the same polarization as the condensate.

As the second important result is that we observed that 1D arrayed polariton shows the condensates spectra, which is normally obtained at the ground state energy, at excited state energy with “ π -phase” modulation between adjacent sites. The wave function of the condensate plays a role as an order parameter, whose phase is essential in characterizing the coherence and superfluid phenomena. The long-range spatial coherence leads to the existence of phase-locked multiple condensates in an array of superfluid helium, superconducting Josephson junctions, or atomic BECs. Under certain circumstances, a quantum phase difference of π is predicted to develop among weakly coupled Josephson junctions. Such a meta-stable π -state was discovered in a weak link of superfluid ^3He , which is characterized by a ‘p-wave’ order parameter. Possible existence of such a π -state in weakly coupled atomic BECs has also been proposed, but remains undiscovered. We observed the spontaneous buildup of inphase (‘zero-state’) and antiphase (‘ π -state’) ‘superfluid’ states in an exciton-polariton condensate array connected by weak periodic potential barriers as shown. These states reflect the band structure of the one-dimensional polariton array and the dynamic characteristics of meta-stable exciton-polariton condensates.

A18. 無線マルチホップネットワークにおける自律分散経路制御に関する研究

寺田 真介

A Study on Autonomous Distributed Routing Protocol for Wireless Multi-hop Networks By Shinsuke Terada

In recent years, technologies of wireless communication have been developed and various kinds of mobile nodes have been equipped with wireless devices. As a result, great deal of attention is attracted to ad hoc network, which is a multi-hop wireless network without any fixed network infrastructure such as a base station. In the ad hoc network, even when two mobile nodes cannot directly communicate due to radiowave transmission ranges, the communication between them can be established by the assistance of other cooperative nodes that relay packets. Routing protocol is thus a important technique in ad hoc networks where the every mobile

node must relay communications with autonomous and decentralized manner.

This paper focuses unicast using application such as web and mail and multicast for effective data distribution. As a result, this paper proposes novel routing protocols for the realization of transmission increasing quality and efficient. The availability of the proposed methods is clarified by computer simulation.

A19. ネットワークの援用によるGPS性能向上に関する研究

劉 智星

GPS Performance Improvements by Utilizing Networks By Liu Zhixing

The usage of the GPS has become nearly ubiquitous in recent years. This is driving for new challenges such as high precision, high-sensitivity and fast positioning for GPS performance. Nowadays our society is evolving to a ubiquitous network society. Various kinds of networks exist in our life. In this thesis, we proposed two kinds of system to improve GPS performance with the help of network. First, we suggested differential GPS correction data dissemination via geostationary satellite communication link and Internet for high accuracy Differential GPS. Then, we proposed a fast acquisition scheme based on timing-synchronized 3G (third generation) cellular network for high-sensitivity Assisted GPS receiver.

Differential GPS was proposed for the applications of high precision measurement, land survey and so on. In a Differential system, how to transmit the correction data from reference station to the user is extremely significant. We proposed geostationary satellite communication link and Internet as new type data link. The geostationary satellite communication link has merits as follows: First, satellite communication can cover wide area and unlimited number of user can receive signals with their receivers; second, 64kbps data transmission rate is available. A transmission system is suggested and a DGPS positioning experiment is carried out via geostationary satellite communication link. The experiment results are evaluated. One other kind network we chose as data link is Internet. The Internet covers the entire world and if the user has an IP, he can connect to Internet easily. Because bi-direction communication is possible, the user has flexibility of selecting reference station, correction data type and so on. However, the most critical characteristic of Internet is latency, which will have a great effect to the differential GPS positioning accuracy. We measured the GPS correction data transfer latency via Internet. Furthermore, we evaluated of the static positioning results of the Internet-based GPS positioning system.

Satellite communication line is appropriate for network-based RTK-GPS data dissemination to provide wide-area RTK-GPS service. It is possible for network-based RTK-GPS positioning system to provide the precise positions to mass users via the

QZSS in Japan. In the other hand, Internet can help construct ground-based differential information distribution and provide various kinds of services corresponding to user's requirements, such as precision request, their link bandwidth, and environment.

A function of automatic location identification from an emergency call (E911) requires integrating positioning services in cellular communication networks. AGPS technology makes indoor positioning possible by using the assistant information transmitted from the assisting server. Sensitivity during acquisition is critical to a receiver. It is well known that 50 bps navigation data cause a bit polarity transition. To obtain highly sensitivity, the first problem is how to wipe off navigation data. In the signal acquisition process, the conventional receiver has to search 1023 chips for each satellite and 6 kHz Doppler frequency shift for a sky search. The second problem is how to narrow the search space to get fast positioning response.

To wipe off the navigation message, we need the navigation message sequence from the server and to align the start time with the received signal bits. The external sub-millisecond time synchronization is essentially needed to find start time. In a 3G cellular network, there are two time synchronization standards: CDMA2000 and TD-SCDMA have accuracy less than 10 microseconds. Thus we suggest wiping off navigation data referring to the precise time provided by timing-synchronized network. During acquisition, there is a two-dimensional search in C/A code and carrier frequency directions. The C/A code search can be performed nearby navigation data bit start time. To reduce the carrier frequency search range, the conventional receiver store almanac data in memory. However, the old almanac data causes frequency error. For a cell phone, it is inefficient to store almanac locally. Thus, we want to predict Doppler frequency shift at the server and send short information to the user. The user can determine his optimum search space just with simple calculation.

We analyze the proposed system's main errors. The simulations proved feasibility and efficiency of our method. The real data received from GPS front-end was used to verify the validation of the scheme. If the estimated arrival time error of navigation data is within 20 microseconds, the processing gain loss in acquisition is so trivial that will not affect the acquisition correlation peak determination. We wiped off navigation data successfully and enabled long-time coherent integration. Thus the sensitivity is finally improved. On the other hand, the C/A code phase can be obtained by searching within only 20 code phases, which is 96% reduction of code searching space. In the fast Doppler frequency search method, we gave optimum adjustable frequency search range to different server-user distance.

To conclude our research, by utilizing various communication networks, firstly, we tried high precision positioning network construction; then we proposed acquisition scheme for AGPS receiver to provide high sensitivity and fast positioning service. We believe that high performance GPS will bring us more convenient in the future.

A20. シーケンスパターンマイニングの高速アルゴリズムに関する研究

楊 征路

Fast Algorithms for Sequential Pattern Mining By Zhenglu Yang

Sequential pattern mining is very important because it is the basis of many applications. Although there has been a great deal of effort on sequential pattern mining in recent years, its performance is still far from satisfactory because of two main challenges: large search spaces and the ineffectiveness in handling dense data sets. To offer a solution to the above challenges, we have proposed a series of novel algorithms, called the LAsT Position INduction (LAPIN) sequential pattern mining, which is based on the simple idea that the last position of an item, α , is the key to judging whether or not a frequent k -length sequential pattern can be extended to be a frequent $(k+1)$ -length pattern by appending the item α to it. LAPIN can largely reduce the search space during the mining process, and is very effective in mining dense data sets. Our performance study demonstrates that LAPIN outperforms PrefixSpan and SPADE by up to an order of magnitude on long pattern dense data sets.

However, we found that the improvement is at the price of much memory consuming when building the list of item's last position because LAPIN uses a bitmap strategy. We aim to obtain an efficient and balanced pattern mining algorithm with low memory consuming and thus, we proposed an improved algorithm which makes good use of not only the position of item but also the intermediate value (support value) of k -length pattern when finding $(k+1)$ -length pattern. The experiments demonstrated that our improved algorithm performs the best in limited resource environments.

Ayres et al. claimed that SPAM is very efficient for long pattern mining and it can outperform PrefixSpan by up to an order of magnitude. Our experiments show that, although SPAM can handle long patterns in dense data sets, it is limited in the length of long patterns it can handle, and its high speed comes at a price of large space consumption. We proposed a new algorithm named LAPIN_SPAM, which combines the idea of LAPIN and SPAM. The experiments demonstrated that LAPIN_SPAM significantly outperforms the original SPAM, and is the best under unlimited resource assumption.

The WWW provides a simple yet effective media for users to search, browse, and retrieve information in the Web. Web log mining is a promising tool to study user behaviors, which could further benefit web-site designers with better organization and services. Although there are many existing systems that can be used to analyze the traversal path of web-site visitors, their performance is still far from satisfactory. In this thesis, we propose our effective Web log mining system based on the efficient sequential mining algorithm, LAPIN_WEB, an extension of previous LAPIN algorithm to extract user access patterns from traversal path in Web logs. Our experimental results and performance studies demonstrate that LAPIN WEB is very efficient and outperforms

well-known PrefixSpan by up to an order of magnitude on real Web log datasets. Moreover, we also implement a visualization tool to help interpret mining results as well as predict users' future requests.

Due to the importance of skyline query in many applications, it has been attracted much attention recently. Given an N -dimensional dataset D , a point p is said to dominate another point q if p is better than q in at least one dimension and equal to or better than q in the remaining dimensions. In this thesis, we generalize this problem that, users are more interested in whom these dominated points are. We find the interrelated connection between sequential pattern mining and the dominant relationship. Based on this discovery, we propose efficient algorithms to answer the general dominant relationship queries. Extensive experiments illustrate the effectiveness and efficiency of our methods.

A21. ウェブディレクトリを用いた人名の曖昧性解消に関する研究

ヴー クァンミン

A Study on Name Disambiguation Using Web Directories By Vu Quang Minh

In the current World Wide Web, information is increasing explosively.

To search for valuable information from this huge database are increasing needs from users. Search engines are playing as gateways for users to acquire useful information. Among requests of users to search engines, a certain amount of requests are to search for information related to people. However, since a personal name is often shared by several people, search results for a personal name query tend to contain documents relevant to several people.

In our research, we tried to disambiguate names of people in the results from search engines. We proposed to use web directories as additional information to improve the disambiguation performance.

We used information from web directories to improve the extraction of contexts related to people in documents and to improve the name disambiguation performance. We carried experiments with several well known web directories to disambiguate real documents containing ambiguous names. The experiment results showed that our approaches extracted contexts of people effectively and performed better than other approaches that used the vector space model method and the named entity recognition method.

A22. 屋外環境下における大規模拡散反射物体の表面色推定

川上 玲

Surface Color Estimation of Large Scale Diffuse Objects Under Outdoor Environment By Rei Kawakami

Digital three-dimensional models created by the computer

vision and graphics technique are becoming widely used in a variety of scenes. Specifically, modeling cultural heritage objects have attracted a lot of attention, since such objects are worth preserving and the data can be utilized for restoration when an object faces the crisis of collapse. Automation for creating 3D models have therefore attracted many interest, since currently, most models are created by manual operation; it causes the significant increase of the cost.

To model an accurate appearance of an object, the object's shape and surface reflectance properties are required. Acquiring shape information has been facilitated by the development of sensors and the progress of data processing algorithms, while acquiring surface reflectance properties remains a challenge, specifically with outdoor objects.

This paper targets a large-scale object such as an architectural structure under outdoor environment. The size of target objects is up to around 100m by 100m by 50m. Regarding such a huge object, measuring the surface properties becomes a challenge. The appearance of an object can be modeled by mapping image textures to the known shape of the object. To achieve the consistent colors between image textures, the effect of illumination has to be removed, before mapping them, by the surface color estimation and surface reflectance estimation techniques.

Two methods that calculate a surface color by a pixel-based operation are presented. Most previous methods assume uniform illumination in a scene, while this is not always true in images with shadows or with curved objects. The methods enable pixel-based operation by utilizing the illumination change. Two models of illumination colors that we introduce make a surface color to be uniquely determined from two pixel values. First, the paper propose a method that uses blackbody radiation. It analyzes the stability and practicality of the method. Then, a more practical method that can perform robust estimation is proposed, which uses a statistical model derived from outdoor illumination data. The robust estimation is realized by introducing the plausible range of outdoor illumination colors.

In practical situation, surface reflectance would be required for relighting purpose. A method is presented to estimate surface reflectance from spherical images with known shape information. Spherical images have nearly 360 degree field of view; it captures the target objects and surrounding illumination at one shot. Owing to that, neither specific apparatus nor calibration of exposure times, apertures and camera gain factors is needed. Furthermore, geometric calibration between an image and shape information tends to be robust owing to the characteristic of a spherical camera. Measurement and data-processing cost will be decreased by the method compared to previous methods that need elaborate procedures. This is critical specifically for large-scale objects.

The main contribution of this thesis is that the author has proposed three methods that estimate surface properties of an object. It can be summarized by the three following points: First, the research provides insights of the stability and practicality on pixel-based surface color estimation. Second, a

pixel-based method for surface color estimation has been developed that is robust and accurate even for real outdoor objects. None of the conventional methods can perform a pixel-based operation with higher accuracy than the proposed method, so far as the author's knowledge. Third, an efficient method has been developed that estimates surface reflectance of large-scale objects under outdoor environment. The proposed techniques would form the foundation of developing a system that models the appearance of a large-scale object under outdoor environment.

The character agents use eye movement information to facilitate empathy-relevant reasoning and behavior. Eye Information is used to monitor user's attention and interests, to personalize the agent behaviors, and for exchanging information of different learners. The system reacts to multiple users' eye information in real-time and the empathic character agents owned by each learner exchange learner's information to help to form the online learning community.

In the system, the learner's facial information, voice information, as well as mouse movement, is obtained in real-time and the character agents give the feedback to learners based on these kinds of information. Each type of the data is a modular which makes the system easy to integrate and update. The system provides the platform for communicating and exchanging the information during the learners' learning process. The interface is customizable.

Based on these measures, the interface infers the focus of attention of the learner and responds accordingly with affective and instructional behaviors. The thesis will also report on the usability test results concerning how users respond to the empathic functions and interact with other learners using the character agents.

電子工学専攻

A23. 声調核モデルに基づくニューラルネットワークを用いた標準中国語連続音声の声調認識

王 曉東

Neural-Network-based Tone Recognition of Continuous Speech of Standard Chinese Using Tone Nucleus Model By WANG Xiao-Dong

In tonal languages, tones are used to distinguish lexical meaning of words. Meanwhile, tonal information is helpful to detect higher level prosody information. Due to this distinct function of tones and the possible assistance from prosody information which can be further detected using tonal information, tone recognition is desirable when constructing the automatic standard Chinese speech recognition system, thus attracted many researchers in the past decades. These studies can be generally divided into two directions: embedded approaches and explicit approaches, i.e. approaches done as an integral part of or in parallel to the existing ASR framework. According to the technologies, efforts of explicit approaches,

as the mainstream direction, were continuously made along two lines. One line is to construct appropriate statistical tonal models and classifiers, while the other is to make reasonable prosody models in order to overcome difficulties due to substantial F0 variations.

In this work, we adopted the Tone Nucleus Model, which points out that as a portion of syllabic F0 contour tone nucleus contains crucial information for tone perception and recognition, to suppress great effect from neighboring tones, called tonal co-articulation. This model can not only provide a clear linguistic meaning for the F0 normalization process, but also shows explicit potentials for detecting intonation structure. On the other hand, Multi-Layer Perceptron (MLP), one kind of Neural Network (NN) approaches, was used to easily incorporate heterogeneous features, such as category feature and segment duration, which are important for tone recognition. Via integrating these two efficient methods, our proposal can exploit the above advantages to achieve better performance in tone recognition of continuous speech of standard Chinese.

To realize this proposal, firstly we present an efficient algorithm to automatically extract tone nucleus, which is a portion of syllabic F0 contour and contains crucial information for tone recognition. High performance of tone nucleus extraction was confirmed by the inspection on results of 50 utterances. With the assistance of this algorithm, input features were calculated, most of which are related to tone nuclei. As for the MLP tone classifier, one hidden layer was exploited to make the construction clearer and effective enough based on the universal approximation theorem for neural networks.

In order to evaluate the proposed system, comparative experiments were implemented both in the speaker dependent and independent tone recognition. In speaker dependent case, the system with MLP tone classifier and feature extraction from whole syllabic voiced part was constructed as the first baseline. Meanwhile, the second baseline is the system with HMM tone classifier and Tone Nucleus model, i.e. features extraction from tone nucleus (a portion of syllabic voiced part), reported in previous work. The same speech corpus was used in the reported work and thus results are comparative. Therefore, among these three systems, comparison was carried out. In speaker independent experiments, 20-fold cross-validation was used to avoid the selection of training and testing sets affecting the result, and global mean feature normalization was preliminarily exploited to reduce the features varying with speakers. Then performance comparison of speaker independent tone recognition was implemented between the first baseline system and proposed system.

From the results of baseline systems and proposed system in speaker dependent and independent experiments we can see,

(1) In speaker dependent experiment, the proposed approach achieved an absolute error reduction of 1.3% compared to the 1st baseline, equal to a relative error reduction of 9.2%. In speaker independent experiment, absolute error reduction of 0.5% was also obtained by proposed approach. The difference of the two systems lies in whether calculating

the features from the whole syllabic voiced part or tone nucleus. The better performance indicates that tone nuclei do keep important and robust discriminating features for the tone recognition.

(2) In speaker dependent experiment, the proposed approach got an absolute error reduction of 1.7% compared to the 2nd baseline, corresponding to relative improvement of 11.7%. The better performance can be attributed to the use of MLP and the two more kinds of features: segmental durations and syllable positions in the sentence. But they are difficult to be exploited in an HMM based approach.

However, some problems still exist in proposed tone recognition system. One of them is the feature normalization in speaker independent case, resulting in relatively much difference in performance (about 10%) between speaker dependent and independent statuses.

To solve this issue, three feature normalization approaches were proposed for speaker independent tone recognition, which are Shifting-Window feature normalization, Cumulative Distribution Function matching based on quantile histogram equalization and normalization inside syllabic voiced part, marked as SW, CDF and InSyl respectively in this thesis.

With regard to evaluation of these normalization approaches, previous speaker independent tone recognition based on global mean normalization was taken as baseline for comparison, marked as MSD+G. The comparative experiments among this baseline, proposed approaches and hybrid of proposed approaches are implemented. From the results of these comparisons, we can conclude that each of these feature normalization approaches is significantly effective for speaker independent tone recognition. The best performance was achieved by the hybrid approach via combining MSD, SW and InSyl together. Through this hybrid approach, the difference of average error rate between speaker independent and dependent tone recognition was reduced from 10.4% to 3.9%.

A24. 3次元ビデオ処理:分節化、要約、補間、編集 徐建鋒

Time-Varying Mesh Processing for Segmentation, Summarization, Interpolation, and Composition By Jianfeng Xu

Time-Varying Mesh (TVM), which is composed of a sequence of mesh models, captures the realistic and dynamic scene of the real world including a human's shape and appearance from multiple synchronized videos. This thesis is to propose key techniques of TVM processing including motion segmentation, summarization, frame interpolation, and motion composition. There are many challenges in the TVM data. For instance, the raw data in mesh models are in low level without any semantic information, which causes the semantic gap. Because each frame is generated independently in the generating system, the topology and the number of vertices may vary frame by frame, which causes correspondence information is difficult to obtain. There is some noise that comes from the generating system, which requires the proposed algorithms are robust to noise.

Because the topology in different frames may change, many existing algorithms cannot be employed directly. Another issue is the efficiency to deal with the huge data that come from TVM.

Management of TVM is essential to use the contents efficiently especially when the contents become very huge. Fundamental techniques are proposed to manage and re-use the TVM data. For example, a similarity measure is necessary in many applications like retrieval, which is useful in TVM management. If a TVM sequence is segmented into single motions, it will become much easier to process further. And summarization of a long sequence is helpful to reduce the viewing time. We also propose an editing system to re-organize the frames for a new purpose. Frame interpolation is an important method to generate new frames from the original frames. By these techniques, it is possible to manage and re-use the TVM data efficiently.

Similarity measure is a powerful tool to reflect the motion degree in a TVM sequence, which is the base of motion segmentation, summarization, and composition. Three types of similarity measures are proposed based on statistical methods such as histogram and mutual information. Those statistical methods are very suitable for huge and noisy data. By analyzing the similarity measures, a TVM sequence is segmented into single motions, which is the pre-requisite of our other algorithms including summarization and motion composition. Two approaches are proposed for two different types of motions in TVM sequences, namely, periodic motions and non-periodic motions. Our experimental results demonstrate high precision and recall are achieved.

Summarization of a TVM sequence is necessary in those applications with limited storage, bandwidth, and other resources. For this purpose, we propose an efficient scheme to extract key frames in each single motion or shot. However, it is conflict to summarize a sequence compactly and completely. Therefore, we consider the trade-off between the rate and distortion in our cost function. Unlike many algorithms in 2D video, it is not required to decide the key frame number in advance in our scheme, which is more friendly to the user.

Currently, one serious problem of TVM is that it is time-consuming and expensive to generate TVM sequences. Therefore, it is necessary to re-use the original data to create new sequences. An editing system is presented for this purpose. A motion graph, which includes all the motions in the database, is defined and constructed considering the smoothness of transitions between motions. The user selects some desired motions from the motion database. Then, an optimized path is searched between every two desired motions by a modified Dijkstra algorithm. The edited sequence is rather smooth.

In this thesis, an approach is presented for frame interpolation in TVM in high level, which is very challenging due to the absence of semantic information in mesh models. A semantic human model is employed to estimate the motion vectors of the object. The mid-frames are interpolated linearly by the estimated motion vectors. Our experimental results demonstrate the effectiveness of the approach. This technique

can be applied in many areas such as frame rate up-conversion and motion blending, and can support the motion analysis in high level.

The proposed algorithms in this thesis are key techniques in managing and re-usage of TVM data, which involve not only low level analysis but also high level analysis in mesh models.

A25. Si-MOSトランジスタ2次元電子系の移動度とエネルギー緩和機構に関する研究

朴 敬花

Mobilities and Energy Relaxation Mechanisms of Two-Dimensional Electrons in Si Metal-Oxide-Semiconductor Field-Effect Transistors By Kyung-Hwa Park

The decision making of the agents has an influence each other, and they piles up to a population characteristic. I observe the behavior of an agent and the population characteristics to get knowledge with respect to an emergence phenomenon. In addition, the proposed agent models help us to investigate the influence of the spatial structure on learning of an agent and the utility of estimating ability of intention of an opponent in this study.

We have investigated systematically mobilities and energy relaxation mechanisms of two-dimensional electrons in silicon metal-oxide-semiconductor field-effect transistors on the following three major points.

(1) Strong temperature dependence of mobility in Si inversion layer; scattering mechanisms and screening effect

We have investigated systematically mobilities of two-dimensional electrons as functions of temperature and electron density in n-type conventional Si metal-oxide-semiconductor field-effect transistors (Si MOSFETs) with high mobility, $\mu \approx 1549 \sim 18,000 \text{ cm}^2/\text{Vs}$. It is found that at temperatures below 10 K the observed mobilities significantly decrease with temperature in low electron density, $N_s < 1.6 \times 10^{12} \text{ cm}^{-2}$. The measured mobilities are compared with theoretical calculations for scattering by ionized impurity scattering, acoustic phonon scattering, and interface roughness scattering, by also taking screening effect into account. It is found that the strong temperature dependence of mobility was governed by reduction of screening effect and due to the fact that the electron system becomes easily non-degenerate with increasing temperature. It is in good quantitative agreement between theory and experiment with few adjustable parameters.

(2) Energy heating in Si inversion layer; deformation potential constant of conduction band in Si.

We have investigated the heating process of two-dimensional electrons in conventional n-type Si metal-oxide-semiconductor field-effect transistors (Si MOSFETs) by analyzing the amplitudes of Shubnikov-de Haas oscillations at low temperatures. It is found that the observed carrier heating behavior is well explained by the energy relaxation due to acoustic phonon emission via deformation

potential coupling. From detailed analysis, we have determined the deformation potential constant of the conduction band in Si to be 12 ± 2 eV, which is larger than commonly accepted value 9 eV for bulk Si.

(3) Effective mass enhancement of Si MOSFETs with thin gate oxide; effects of thin gate oxide.

We have investigated the electron effective mass, m^* , in Si-MOSFETs with thin gate oxide, using the temperature dependence of Shubnikov-de Haas (SdH) oscillations. The effective mass of n-type Si MOSFETs with thin gate oxide is significantly heavier than bulk one. It shows the enhancement whose m^* is $0.23 \pm 0.01 m_0$. Furthermore m^* increases with decreasing N_s in the low carrier density region, which might be caused by Coulomb drag effect. Interlayer Coulomb coupling between electron channel and positive charges in gate electrode creates a fractional drag force.

A26. 室温動作シリコン単電子トランジスタとその応用 宮地 幸祐

Study on Applications of Room-Temperature Operating Silicon Single-Electron Transistors By Kousuke Miyaji

For the past 30 years, the size of a metal-oxide-semiconductor field-effect-transistor (MOSFET) in very-large-scale integrated circuits (VLSI) continued to scale down for higher integration and higher performance. As the gate length of MOSFETs has reached down to sub-50 nm, unprecedented technical issues have become prominent to proceed scaling of the MOSFETs.

Silicon single-electron transistor/single-hole transistor (SET/SHT) is one of the most promising devices for VLSI in silicon nanotechnology; the technology that seeks new function in nano structures. Although its operation principle is different from conventional MOSFETs, its fabrication process is very similar to them. Hence, it is expected that SETs/SHTs can be easily combined with CMOS VLSI and realize high functional, ultra-low power, and ultra-high density circuits. Owing to the intensive researches on SETs/SHTs, process techniques for SETs/SHTs to operate at room temperature have been established. In such room-temperature operating SETs/SHTs, strong quantum effect has become pronounced and started to affect the transport characteristics. However, basic analysis and enhancement of the device performance are still required for room-temperature-operating SETs/SHTs to be used in actual VLSI circuits.

In this dissertation, characteristics of the room-temperature-operating SETs/SHTs are analyzed and their advantages are fully enhanced aiming at the actual VLSI circuit applications. The feasibilities of the proposed methods are evaluated by simulations and measurements.

In the first half of the Chapter 2, characteristics of the SETs/SHTs is introduced starting from the fundamentals of the SET/SHT physics. Coulomb blockade oscillation and other important current characteristics in SET/SHT are derived from

the classical physics. For the systems that quantum mechanical effects matters, quantum level spacings should be taken into account. Also, it is shown that the dot size must be small and ensure single-electron/hole addition energy is much larger than thermal energy for SET/SHT operation. In silicon (semiconductor) SETs/SHTs, quantum effects play important roles in their transport characteristics. NDC is supposed to be the most promising quantum effects to be utilized in novel high function circuits. In the second half, some fabrication methods of the room-temperature operating SETs/SHTs are discussed. Ultra-narrow channel MOSFETs is introduced as the best method in terms of room-temperature operation. The mechanism of the formation of the tunnel barriers and quantum dots are explained. Channel potential fluctuation in undulated ultra-narrow channel by lithography, wet etching and thermal oxidation processes are the dominant origins.

In Chapter 3, a compact analytical SET/SHT model considering the discrete quantum energy levels is proposed and developed. The model is expressed in closed-form and there is no need of numerical calculation. It successfully reproduces NDC characteristics and non-periodic Coulomb oscillations due to the finite quantum level spacings. It also shows that the accuracy is comparable to the conventional full master equation method and fits well to the measured data. The model is incorporated into the HSPICE simulation, and basic NDC circuit applications are demonstrated. The proposed analytical model is promising to provide suitable environments for designing CMOS-combined room-temperature-operating highly-functional SET circuits.

In Chapter 4, the relationship between the FWHM of the NDC and voltage gain is focused for the first time and it is found by the experiments and calculations that high gain SETs/SHTs show small FWHM in NDC. Low drain-dot coupling in the high gain SETs/SHTs is considered to be the most important factor. This result indicates that characteristics of the NDC are able to design by the basic capacitance parameters of the SETs/SHTs. From the viewpoint of applications, high-gain SETs/SHTs have great advantage to NDC circuits as well as to the standard logic circuits.

In Chapter 5, FWHM of Coulomb blockade peak is modulated in a SHT at room temperature by varying substrate capacitance through changing the substrate condition from depletion to accumulation (inversion) in a thin BOX SOI substrate. The results are also quantitatively supported by the low temperature measurements in another fabricated SHT. The electrical control of the sharpness of the Coulomb blockade peak creates great opportunity for adding further functionality to the present SETs/SHTs, such as application to the novel analog pattern matching device. Also, the guide lines to increase the proposed effects for practical use are discussed.

In conclusion, proposed model, analysis, and application are promising to maximize the advantages of room-temperature operating SETs/SHTs combined with the scaled MOSFETs in future VLSI system.

A27. 高精度 3次元モデルベース動画取得のための複数視点システム

谷内出 悠介

Multiple-Viewpoint Range-Finding System for Accurate Three-Dimensional Model-Based Movie Acquisition

By Yusuke Yachide

This thesis focuses on the multiple-viewpoint range-finding system for an accurate three-dimensional(3-D) model-based movie acquisition. The present systems are designed for meeting the components as the "real-time", "high-speed", "high-accuracy", "3-D model(3-D data of targets include less occlusion)". High-speed control, computation and high-accuracy parameter acquisition of an imaging system are the keys on 3-D model based movie acquisition.

Chapter 2 shows the comparison of features on various 3-D measurement methods for the realization of the 3-D imaging system meeting the four components. 3-D measurement speed and accuracy on the various methods are evaluated. 3-D measurement methods are categorized in passive and active methods for the evaluation and comparison. And also, the performance of the speed and accuracy are evaluated in the device level such as the CCD device and CMOS device.

Chapter 3 presents the evaluation of the various calibration methods for the "high-accuracy" 3-D measurement. The calibration methods, which are categorized in camera and projector, are compared and evaluate. We present the summary of the calibration method on the 3-D measurement accuracy with various 3-D measurement methods described in chapter 2.

Chapter 4 proposes the multiple-viewpoint system for the 3-D model-based movie acquisition. The light-section-method based on a range finder, consists of a camera and projector, are placed at multiple viewpoints for the 3-D model-based movie acquisition. We employ the time-division light-projection technique to prevent light interference from multiple range finders. And we use the smart image sensor with VGA(640x480) pixel resolution for high-speed high-accuracy 3-D imaging. The present system achieves 2.5mm of maximum error by measuring a plane placed at 1200mm. The capability of the system is 3-D model-based movie acquisition with video-rate.

Chapter 5 presents the evaluation result toward the decision of calibration parameters which are needed for high-accuracy 3-D range finding. We analyze the error factor of the 3-D measurement which depends on 3-D imaging system. We evaluate the parameter about the error of the distortion and displacement in 3-D space. Therefore, the major calibration parameter can be employed using the evaluation results.

Chapter 6 proposed the triangulation-based calibration method using spheres for multiple-viewpoint system. The proposed method calibrates the various parameters to fit measured 3-D data to surfaces each of spheres. A sphere is feasible for the calibration target since the projection shapes are similar in arbitrary viewpoint. In the present method, the many calibration points for the high-accuracy calibration are

easily obtained by measuring spheres, which contributes to prevent the calibration cost. And also, the proposed method calibrates the 3-D space flexibility to the measurement range and environment. We calibrate the translation and rotation parameters utilizing the sphere center positions from multiple viewpoints in case of the extension of multiple-viewpoint calibration. We achieved the high-accuracy result of the average error of 0.42 mm by calibrating the volume of 400x400 mm at the distance of 400~700 mm. And we evaluate the displacement and distortion in 3-D spaces.

Chapter 7 presents the standalone 3-D measurement system aiming for the parallel control, high-speed computation, and display of the multiple rangefinders. The huge amount of the data processing is required for the 3-D model-based movie acquisition using multiple image sensors with high-pixel resolution. And it is necessary to control a sensor and to transfer data in multiple-viewpoint system. Therefore, it is not appropriate to process such huge data in multiple-viewpoint system with a standard PC. We develop the standalone 3-D measurement system with the FPGA-based 3-D computational engine for parallel sensor controlling and high-speed 3-D computation. Moreover, we implement the bus and graphic controller to the same FPGA, which contributes to carry out a series of the 3-D measurement including 3-D data acquisition, computation, and display without a PC. The performance of the 3-D engine is 7.2 GOPS which is enough to measure 3-D positions with over 1Mega pixel resolution sensor such as SXGA(1280x1050) pixel resolution.

The present system with the hardware controlling, processing and proposed calibration method efficiently achieves the multiple-viewpoint range-finding system which meeting four components of "real-time", "high-speed", "high-accuracy" and "3-D model". The 3-D model-based movie acquisition will significant contributes to realize advanced 3-D imaging system using 3-D information flexibility and interactively and become a driving force of future applications with high-quality 3-D imaging.

Appendix reports the wavelength identification sensor for future applications. LSI process technology has recently improved, which directly contributes metal line spaces equal to or shorter than optical wavelength. A narrow single slit is formed by the top most metal layer above the photo-transistor array in the proposed sensor. Incident light is diffracted by the single slit where the wavelength of incident light is equal or longer than the slit width. The wavelength is identified by utilizing a dependency of the diffraction angle on wavelength. The present sensor is fabricated by a monolithic process. The sensor can identify the wavelength of 475nm~785nm within 10 % error.

A28. 位相情報を積極的に利用した超音波イメージング

西野 智弘

Phase-Information-based Ultrasonic Imaging

By Tomohiro Nishino

The ultrasonic pulse echo method is commonly used in three-dimensional shape measurement to generate a digital elevation map (DEM). However, because the transmitted wave has a certain beam width determined by diffraction, the backscattered wave often interferes with itself, resulting in wave-amplitude attenuation and wave-shape distortion in the echo. The generated dark speckles caused by interference largely deteriorate the quality of the DEM. In this research, we propose four proposals for solving the problem described below.

First, we propose to measure the complex-amplitude value of the backscattered wave, instead of the pulse arrival time. Then we unwrap the phase map, which contains contour information, to generate a DEM. We name this scheme the complex-amplitude method. Results with the complex-amplitude method are more precise than those with the pulse echo method.

Because the phase value represents intrinsically the height of an object, the phase field should be conservative except for 2π jump. However, in the complex-amplitude method, we face to another problem of the so-called singular points (SPs) caused by interference. SPs mean rotation points included in the phase map, and need to be removed or mitigated because they make the elevation field nonconservative.

In our secondary stage, we eliminate the SPs by a compensation process, which updates a set of four values at a SP by replacing them with estimated values using the complex-valued Markov random field (CMRF) model. This process moves SPs to cause combinations of positive and negative SPs, resulting in their disappearance. We apply this compensation for all the SPs to obtain a distortion-reduced phase map, where we expect a less number of SPs. By repeating this process, we get a final restored phase map. SP elimination is an effective solution for speckle noise reduction. In total, our technique can compensate the data distorted by interference, and yield a highly accurate DEM. Experimental results demonstrate that the signal-to-noise ratios of the DEM generated by our method are higher than those obtained by the pulse echo method or a complex-amplitude method without the CMRF compensation.

In third suggestion, we apply a novel phase unwrapping method because conventional ones generate deteriorated DEMs, which have many unnatural cliffs in the areas with many SPs. In contrast, our proposed method, the singularity-spreading phase unwrapping (SSPU) method, yields high-quality DEMs, which look natural over the whole image with no cliffs. In the process, the SSPU spreads the singularity at SPs around them so that an SP is gently connected to an opposite-rotation SP existing in its vicinity, and the both SPs are canceled out. At the same time, singularity of isolated SPs also attenuates by itself. Though each spreading of an SP is isotropic, the total compensation after iteration settles not isotropically but adaptively reflecting the SP distribution. Experiments demonstrate that the signal-to-noise ratios of the DEMs generated by our method are higher than those obtained by a conventional phase

unwrapping method.

Forth proposal realizes an adaptive beamforming for maximizing ultrasonic array performance. In general, the performance of an ultrasonic array is worse than the theoretical one calculated with the phased array principle, because actual ultrasonic arrays have some detrimental effects such as grating lobe radiation, array shading and cross coupling. We maximize the array performance by controlling adaptively the carrier phase values fed to respective emitters of the array by using the hill-climbing (HC) method so that the received signal at a desired direction is maximized. In experiments, we construct an ultrasonic phased array, and control the radiation direction horizontally. We demonstrate a successful beamforming with our adaptive technique. The learning curve presents a monotonic improvement in the directivity, which suggests a high applicability of the HC method in array performance maximization.

In this research, we suggest high applicability of phase-information-based methods in ultrasonic imaging.

A29. オンチップ電源システムに向けた電源回路技術 鬼塚 浩平

Circuit Technologies for On-Chip Power Supply Systems By Kohei Onizuka

This thesis proposes lowpower, high performance and high functionality power supply circuits and architectures toward on-chip distributed power supply systems which are suitable for current and future LSI's.

The thesis is organized into 7 chapters. The first chapter includes motivation and goal of this thesis. On-chip distributed power supply system is valuable for both the power integrity issue and multiple power supply to several types of chips and circuit blocks integrated in a package. In the background, there is a fact that the optimum power supply voltage differs between different types of function blocks and they are not suppressed as technology scales down. In a distributed power supply system, power is supplied from outside the package using one high voltage and it is converted to required lower supply voltages using DC-DC converters at the vicinity of the load circuits. By doing so, the total input current for one package and power line noise issue caused by parasitic resistances and inductances are reduced.

Chapter 2 introduces three types of conventional on-chip step-down DC-DC converters. The first one is a linear regulator which is useful for on-chip implementations and suitable for applications which require low voltage ripple. Linear regulators however, have low power efficiencies when the voltage conversion ratio is low. The second one is a buck converter which performs higher power efficiency compared with the linear regulator, instead of the area overhead caused by the output LC filter and the implementation complexity. The third one is a switched capacitor DC-DC converter which is suitable for low current applications. Switched capacitor converters need an external circuit such as a linear regulator

for voltage regulation. Both the operation principles and research trends on these three types of DC-DC converters are introduced in this chapter.

Chapter 3 proposes novel implementation methodologies of on-chip buck converter for higher power efficiency and lower cost. By implementing passive and active elements of a buck converter on chips or interposers in different technologies and connecting them with each other through metal bumps and vias, power and cost effective implementations are achievable. Especially two chips implementation and two chips plus one interposer implementation are discussed in this thesis. Moreover, how to implement the switching elements which are tolerant of high input voltage is discussed. By using high tolerance voltage I/O transistors, the number of cascaded transistors can be reduced instead of over all power efficiency reduction. The optimum implementation method mixing different types of transistors for higher power efficiency and smaller area is discussed as well in this chapter.

Maintaining the supply voltage in time domain according to the required performance of the load circuit is another important aspect of power supplies especially in case of lowpower digital circuits. Chapter 4 describes the methodologies to quickly change and settle the output voltage of on-chip DC-DC converters. In case of linear regulators, voltage hopping acceleration up to ns-order of transition time is available by putting large transistors named VDD-hopping accelerators in parallel with the load circuit and shorting them so quickly. By applying analog mirror delay circuit, the accelerator can be controlled robustly independent of the size of the acceleration transistors, load current and load capacitance. In case of buck converters, there occurs voltage ringing issue caused by the output LC filter when the output voltage is changed quickly by the VDD-hopping accelerator. Solutions of this problem are discussed as well in the later half of this chapter. Proper timing control is one of the keys to successfully accelerate the output voltage hopping of a buck converter.

In chapter 5, a power supply circuit which performs a collaborative operation of a linear regulator and a buck converter is presented. The circuit settles the output voltage much faster than a conventional single mode buck converter, with assistance by a linear regulator put in parallel, while it achieves high steady-state power efficiencies equal to those of conventional buck converters. Proper control of the linear regulator and the buck converter achieves a smooth wake-up. The power supply works as power gating circuit for leakage current reduction of the load circuit as well.

On the other hand, inter chip wireless communication technologies using inductive or capacitive coupling are investigated aiming at lowpower and high-speed communications between stacked chips in SIP's in recent years. The communication performance basically depends on the chip-to-chip distance, and the bonding wires for power supply lines prevent them to get close with each other. By transmitting not only the signal but also the power between chips, both low assembly cost and higher communication performance are

achievable. Circuit techniques and design methodology using inductive coupling for chip-to-chip wireless power transmission are presented in chapter 6.

Finally, the thesis concludes in chapter 7.

A30. 文書画像中の手書き文字と活字文字の判別

小山 純平

Distinction between handwritten and machine-printed characters in document images

By Junpei Koyama

We discuss techniques for distinction between handwritten characters and machine-printed characters in document images. The distinction gives us a lot of advantages. One typical advantage is automatic selection of optical character recognition (OCR) engines, which is performed by hand now. Existing distinction methods mainly use typographical features of characters or text lines. These methods commonly need to extract characters or text lines from documents, as preprocessing. However, if a document has overlapping line drawings or connections among characters, such as cursive handwriting, the complete extraction is difficult. To solve the problem, we pay attention to human vision system. Human beings can distinguish handwritten and machine-printed characters without the extraction. They use textural information as one hint for the distinction. Some researches construct such human vision models and conduct distinction of letter types of documents. However, they didn't perform distinction of characters in local regions. In this paper, we propose a spectrum-based local fluctuation evaluation method for distinction between handwritten characters and machine-printed characters, which is applicable also to mixed character images and with no need to extract characters and text lines from documents.

Our method refers to human vision system. Early vision cortex perceives spatial frequencies and their orientation in each local region, and integrates the information to analyze texture. Similarly, we transform local regions in document images into power spectrum and obtain textural information. It enables us to evaluate local regions without considering positions of characters and text lines. The second is that we detect fluctuations caused by handwriting. Line segments of machine-printed characters are arranged and drawn orderly, but those of handwritten characters are not in order because they have fluctuations by nature. We quantify and utilize the fluctuations for the distinction.

As a first step, we paid attention to line segments in horizontal and vertical direction since many types of characters have such line segments. Line segments of machine-printed characters are absolutely horizontal or vertical. They induce absolutely horizontal or vertical point sequences which have large power in two-dimensional coordinate of frequency domain. For descriptive purpose, we call such point sequence as principal axis. On the other hand, the line segments of handwritten characters are not absolutely horizontal or vertical because they have fluctuations caused by handwriting.

Therefore, the principal lines have slant and blur. We regarded the power off the horizontal and vertical axes in the power spectrum as the fluctuation. We defined a specific feature value to evaluate the fluctuation power. We first conducted an experiment using single character images. The result shows that the method provides effective feature values for the distinction. Then we apply the method on document images. The result shows that our method provides useful feature values for the distinction without extracting characters and text lines.

Next, we advance the spectrum-based local fluctuation evaluation method. We handle more orientation as well as horizontal and vertical orientation. The extended method consists of two steps. First step is a learning step. We transform character images into frequency domain and extract feature values which well represent orientations of line segments of characters. Then we employ multilayer perceptron to learn the patterns of feature values. It learns two points. One is machine-printed characters have limited patterns of line segments. The other is that those of handwritten characters are innumerable since they have fluctuations. Second step is a distinction step. We extract local regions of a document and obtain feature values in the same way in the learning step. We obtain likelihood of handwritten characters by using the trained multilayer perceptron. The results show our method can distinguish handwritten and machine-printed characters with no need to extract characters or text lines.

In addition, we show an optical character recognition system with automatic selection of proper engines. Considering actual use of the proposed method, we distinguish handwritten and machine-printed characters and utilize the distinction results to recognize the characters. We discuss the proposed system based on the recognition results.

Finally, I conclude my paper. In this paper, I handle distinction between handwritten and machine-printed characters. I propose a spectrum-based local fluctuation evaluation method. The method gives us two advantages. One is release from extraction of characters and text lines, and the other is distinction of characters in local regions. Our method is inspired by human vision system. Elucidation of human vision system sophisticates our method, and the method will contribute in a wide range of areas.

A31. フォトルミネッセンスを用いた SiC 結晶中の構造欠陥の評価

星乃 紀博

Characterization of Structural Defects in SiC Crystals by Photoluminescence Spectroscopy and Topography By Norihiro Hoshino

The effective use of the energy resources is pressing need for a measure against the energy and environment problems. Economizing on the electric power during its conversion and control is also essential to counter these problems. Silicon

carbide (SiC) has the potential for high-power, high-temperature, high-frequency devices. Although SiC wafers are available by the advances in bulk crystal and epitaxial growth technologies, further improvements are necessary for the practical use of SiC devices. Therefore, a nondestructive, rapid, and high-detective characterization of SiC crystals is eagerly sought after for the analysis of the structural defects, which affects the device performance. Photoluminescence (PL) is an effective tool for these requirements. In this paper, we characterized the structural defects in SiC by PL spectroscopy and topography. Since the basal plane dislocations and stacking faults (SFs) are recently reported to affect the current characteristic and long-term reliability of the SiC devices, the characterization of these defects is especially important.

The degradation of the forward current characteristic in 4H-SiC bipolar devices is reported to be caused by the extended defects which expand from a basal plane dislocation to a single Shockley SFs (SSFs) during forward current injection. We investigated the expansion of the SSFs in 4H-SiC off-axis (0001) and on-axis (11-20) epitaxial layers under high-intensity scanning laser beam during room temperature photoluminescence mapping, which is similar to the degradation of pin diodes. The on-axis (11-20) epitaxial wafers are expected for the switching devices due to its high channel mobility. However, etching/optical microscopy using KOH solution was hardly applicable to the (11-20) epitaxial layer because of the chemical property of the surface. Therefore, other techniques are sought for the crystalline characterization of the (11-20) crystals. We confirmed that the emission lines around 2.9 eV, which were observed in the epitaxial layers after high-intensity scanning laser beam, agreed with the SSF-related emission lines from the degraded pin diodes. In the off-axis (0001) epitaxial layer, the SSF-related intensity patterns induced by scanning high-intensity laser beam were classified into two types. The first one was a triangular pattern and the second a pattern which expanded in accordance with the motion of the scanning laser beam. The origins of the SSFs responsible for both patterns are presumably due to the preexisting basal plane dislocations and the dislocation-loops on the basal plane in the epitaxial layer, respectively. On the other hand, most of the SSF-expansion in the on-axis (11-20) epitaxial layers was similar to the second type in the (0001) epitaxial layer. We, therefore, suggest that the dislocation-loops, which were located close to the surface, were dominant nucleation sites of the SSFs in the (11-20) epitaxial layers.

Various type SFs are reported to be observed in 4H-SiC bulk substrates and epitaxial layers, such as SSFs, double Shockley SFs and in-grown SFs during epitaxial growth (E-IGSFs). For the first time, we succeed in the nondestructive detection of in-grown type SFs during bulk crystal growth (B-IGSFs) in off-axis 4H-SiC bulk substrates and epitaxial layers by room-temperature PL mapping. Although the B-IGSF related emission is observed near SSF-related emission at 2.9 eV, the shape and behavior of these PL intensity patterns are quite

different: The former forms a bar-shaped pattern and does not expand under the high-intensity laser excitation, and the latter is the triangular or rhombic pattern which expands by the carrier recombination during the high-intensity laser excitation and forward current injection. The use of a deep-UV light excitation is essential to detect the B-IGSF related pattern in the bulk substrates because of its shallow penetration depth. A bar-shaped pattern agreed well with the etch-pit pattern due to the B-IGSFs in the bulk substrate. The expansion length of the bar pattern from a bulk substrate to an epitaxial layer corresponded to the projected width of the basal plane in the epitaxial layer. These results allowed us to analyze the B-IGSFs propagated from the bulk substrate to the epitaxial layer. The origin of the B-IGSF was determined as the intrinsic Frank SF by PL mapping and high-resolution transmission electron microscopy.

We demonstrated the rapid and nondestructive observation of micropipes and threading dislocations in SiC wafers by full-wafer PL imaging under below-gap excitation. The use of visible light emitting diode arrays as an excitation source is effective to the simplification of an optical system and the light excitation covering the whole wafer. We were able to observe the defect-related intensity patterns similar to those obtained by a conventional laser-scanning PL mapping. The measurement time of the PL imaging was more than fifty times faster than that of the PL mapping.

In summary, we investigated the behavior of the SSFs depending on the scanning laser beam and characterized the dominant nucleation site of the SSFs in the epitaxial layers. Also, the nondestructive analysis of the B-IGSFs in the bulk substrates, which has heretofore been quite difficult, and the propagation of the B-IGSFs from the bulk substrate to the epitaxial layer were demonstrated. We succeed in the rapid and distinctive observation of the structural defects by full wafer PL imaging with the below-gap excitation.

A32. フォトルミネッセンスイメージングを用いた太陽電池用半導体基板の品質評価に関する研究 杉本 広紀

Analysis of semiconductor wafers for solar cells by photoluminescence imaging **By Hiroki Sugimoto**

Photovoltaic energy is attracting much attention as a clean and sustainable energy, and the production of solar cells is expanding extensively. Multicrystalline Si (mc-Si) solar cells have become the dominant product due to their advantages of high-efficiency and low-cost. However, the present wafer quality of mc-Si cells is still poor, and the photovoltaic industry is now requiring further high quality mc-Si wafers to fabricate much higher-efficiency cells. Under these circumstances, characterizing the electrical property of the wafers is essential to fabricate high quality wafers. Especially in the mc-Si wafers, spatially resolved monitoring is indispensable for improving their quality because there are numerous defects.

The purposes of this work were to investigate the defects which decrease the mc-Si cell performance and to develop the useful technique for examining the wafer quality. Photoluminescence (PL) technique is known to be one of the most sensitive techniques for characterizing defects and impurities in semiconductors. In this work, we applied the PL technique to characterizing the wafer quality.

Firstly, we investigated distributions of band-edge PL intensity in mc-Si wafers by the highly spatially resolved PL mapping. We confirmed that the distributions of PL intensity had a great correlation with those of the electrical property such as the minority carrier diffusion length and lifetime. Due to the highly spatial resolution of PL mapping, dark-line defect patterns were recognized in the low quality regions.

PL mapping tomography was performed to determine the three dimensional structures of the defects, and concluded that defects of the rapidly solidified wafers had intermittent plane structures, and those of the slowly solidified wafers had cylindrical structures extending to the crystalline growth direction.

The origins of the dark-line defects were analyzed by the electron backscatter diffraction pattern (EBSP) measurement and the etch-pit observation in addition to the PL mapping. Comparison between the PL and the EBSP crystallographic orientation mapping showed that the dark-line defects were ascribable to the small angle grain boundaries. Optical micrograph of the etch-pits clearly showed that dislocation clusters existed at the dark-line patterns. Low-temperature PL spectroscopy was also used to disclose the origins of the defects, and the dislocation-related lines (D lines) were observed only from the defect regions. The generation of the D lines was reported to relate to the transition metal contamination. These findings confirmed that the dark-line defects were the metal contaminated dislocation clusters which were ascribable to the small angle grain boundaries. In addition, we also performed room temperature PL spectroscopy, and the deep-level emission associated with oxygen precipitation was observed from the defect regions. The result concluded that the dislocation clusters were decorated with not only heavy metal but also oxygen impurities.

Secondarily, we developed a new diagnostic technique called PL imaging for characterizing wafer quality. PL imaging was demonstrated to be an extremely fast and highly spatially-resolved technique for characterizing the mc-Si solar cells and wafers with surface passivation layer. The measurement time and spatial resolution of PL imaging were a few thousand times faster and tens of times higher than those of conventional methods. PL imaging was a contactless measurement and did not require a device structure. Therefore, we believe that it is suitable for an inline monitoring tool at any processing stage of the mc-Si solar cells.

Thirdly, we found that a surface recombination became a big problem for characterizing non-passivated wafers. The surface recombination prolonged the measurement time, and

disturbed the accurate measurement of the bulk property. Therefore, I applied the immersion in HF solution to the PL imaging for restricting the surface recombination. Highly spatially resolved PL images of non-passivated wafers were obtained within 1 s by the present technique. We confirmed that the PL intensity from the HF-dipped wafers increased two orders of magnitude higher than that from wafers without the HF immersion. We also examined the effects of the HF concentration on the surface property, and concluded that 5% HF etching was the most appropriate surface treatment.

The present technique was also applied to quantitative analysis of wafer quality. By using singlecrystalline Si wafers whose lifetime and resistivity were known as the references, the qualitative PL image was converted to the quantitative lifetime mapping.

Finally, we applied PL imaging to characterizing InGaP/GaAs/Ge triple-junction solar cells and CuInGaSe solar cells as well as mc-Si solar cells. PL imaging with multiple wavelength excitations allowed me to characterize respective layers of these solar cells. We also found the present technique was applicable to clarify the effects of shunt resistance and series resistance on the cell performance.

In summary, we disclosed the origin and the structure of defects which decrease the solar cell performance, and realized the rapid and spatially resolved monitoring tool which is applicable to any processing stage of various solar cells.

A33. III-V/MnAs 複合構造および III-V 族ベース強磁性半導体の作製と物性に関する研究

横山 正史

Fabrication and properties of III-V/MnAs hybrid structures and III-V based ferromagnetic semiconductors

By Masafumi Yokoyama

This thesis presents the studies on the fabrication and fundamental properties of nanostructure materials for semiconductor spin-based electronics; MnAs thin films, III-V:MnAs granular thin films, and III-V quaternary alloy ferromagnetic semiconductor $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ thin films.

A variety of materials and structures for semiconductor spin-based electronics have been investigated for decades. For example, III-V ferromagnetic semiconductors, such as $(\text{Ga}_{1-x}\text{Mn}_x)\text{As}$ and $(\text{In}_{1-x}\text{Mn}_x)\text{As}$, are potential candidates, but their Curie temperatures are much lower than room temperature. On the other hand, spinodal decomposition which is often observed in wide-gap-semiconductor based diluted magnetic semiconductors and diluted magnetic oxides, such as GaN:Mn and ZnO:Co, has recently generated much attention, because it can lead to high Curie temperature, but such materials have some difficulties for device applications. In this thesis, we have fabricated and investigated the properties of ferromagnetic materials which have high Curie temperature and excellent compatibility with III-V semiconductor devices.

First, the growth and fundamental properties of ferromagnetic

MnAs thin films on InP substrates are described. We have successfully grown the MnAs thin films on InP(001) substrates by molecular beam epitaxy (MBE), and characterized the structural and magnetic properties. The epitaxial orientation was as follows: MnAs (1100) //InP(001), MnAs[0001]//InP $[110]$, and MnAs $[1120]$ //InP $[110]$. The easy magnetization axis was in-plane and along the MnAs $[1120]$ direction. The Curie temperature was 321 K. We also succeeded in the growth of MnAs thin films on $\text{In}_{0.65}\text{Ga}_{0.35}\text{As}_{0.75}\text{P}_{0.25}$ layers in the same manner. Excellent compatibility of MnAs with InP based materials is demonstrated.

Next, the fabrication and fundamental properties of the III-V:MnAs granular thin films, where MnAs nanoclusters are embedded in a host III-V semiconductor matrix, are described. Generally, overgrowth of a semiconductor layer on a ferromagnetic layer is very difficult because of the difference in crystal structure between ferromagnets and semiconductors. However, a semiconductor layer can be easily grown on a III-V:MnAs granular layer, and this is one of the advantages of the granular thin films. We fabricated GaAs:MnAs granular thin films with MnAs nanoclusters of NiAs-type crystal structure, by annealing $(\text{Ga}_{1-x}\text{Mn}_x)\text{As}$ films at 600°C. GaAs:MnAs granular thin films showed a large magneto-optical effect and a large magnetoresistance change (>600%) at room temperature. Furthermore, by annealing $(\text{Ga}_{1-x}\text{Mn}_x)\text{As}$ around 500°C, we also fabricated GaAs:MnAs granular thin films with MnAs nanoclusters of zinc-blende(ZB)-type crystal structure. The Curie temperature of the GaAs:MnAs granular thin films with ZB-type MnAs nanoclusters was 360 K.

We also succeed in fabricating $(\text{In}_y\text{Ga}_{1-y})\text{As}:\text{MnAs}$ and $(\text{In}_y\text{Al}_{1-y})\text{As}:\text{MnAs}$ granular thin films, which are compatible with InP. These III-V:MnAs granular thin films showed a large magneto-optical effect at room temperature. Adding to the unique fundamental properties, the III-V:MnAs granular thin films were well compatible with both GaAs and InP based III-V semiconductors. Furthermore, we applied the $(\text{In}_y\text{Ga}_{1-y})\text{As}:\text{MnAs}$ and $(\text{In}_y\text{Al}_{1-y})\text{As}:\text{MnAs}$ granular thin films to a magneto-optical device operating at room-temperature, that is, a semiconductor waveguide-type optical isolator based on the nonreciprocal loss effect. We integrated the III-V:MnAs granular layers into semiconductor optical amplifier, and observed the optical absorption based on the nonreciprocal loss shift.

Finally, the fabrication and the fundamental properties of III-V quaternary alloy ferromagnetic semiconductor $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ thin films are presented. In particular, their magnetic anisotropy was investigated. We found that the compressively strained $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ thin films showed uniaxial magnetic anisotropy along the $[110]$ direction by using planar Hall effect measurements. We controlled the magnetic anisotropy of $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ by changing the In content and thus the strain in the ferromagnetic films. A series of the $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ thin films were grown by MBE with various In content (y) of 0.38 – 0.54 and

with Mn content (x) of 0.12. As y increased, that is, the compressive strain becomes dominant over the tensile strain, the easy magnetization axis changed to an in-plane direction from the perpendicular direction. The relationship between the strain and magnetic anisotropy in $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ well agreed with that in other III-V ferromagnetic semiconductors ($(\text{Ga}_{1-x}\text{Mn}_x)\text{As}$ and $(\text{In}_{1-x}\text{Mn}_x)\text{As}$). Additionally, we found that the perpendicular component of the magnetic anisotropy is increase by low-temperature annealing, probably because of the reduction of the interstitial Mn atoms. Moreover, we grew the $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ thin films with high x of up to 0.40. When the thickness of $[(\text{In}_y\text{Ga}_{1-y})_{1-x}\text{Mn}_x]\text{As}$ thin films was below 10 nm, the Curie temperature was around 100 K. On the other hand, the thickness was above 10 nm, especially at a thickness of 100 nm and $x = 0.40$, the Curie temperature was above the room temperature, though the origin of high temperature ferromagnetism needs to be further investigated.

A34. システムレベル設計記述に対する効率的な形式的等価性検証手法に関する研究

松本 剛史

Efficient Formal Equivalence Checking Methods for System-Level Design Descriptions By Takeshi Matsumoto

Due to the great advance of semiconductor technology, the integration of VLSI (Very Large Scale Integration) circuits has been increased for many years, which results in the increase of the design periods. One solution to improve the design productivity is introducing system-level design as a starting point of SoC design. In the most hardware designs, designers start designing from RTL (Register Transfer Level). In RTL, the function executed by combinational circuits for each clock cycle and the hardware resources (for example, adder and multiplier) to execute the function are decided. On the other hand, in system level, the (partial) execution order of the behaviors and the functional units consisting of many memory elements and combinational circuits (for example, filter and inverse discrete cosine transform) to execute the behaviors are decided. Therefore, we can say that system level design is more abstract than RTL design in terms of time and hardware resources. Since SoCs usually implement a system consisting of both hardware and software, it is preferable to use a single design language to describe designs. To satisfy this need, C language or C-based design language is used in system level design, which enables to design both hardware and software seamlessly.

Currently, system-level design is not completely automated by tools. That is, before the final design descriptions that can be processed by behavioral synthesizers and compilers are generated, a number of refinements, changes, and optimizations of design descriptions are carried out by designers. Therefore, it is very important to check the equivalence of the design descriptions when they are modified. This is because, if the bugs inserted in system level are found in the later design steps, for example in RTL or in gate-level, a

lot of time and cost will be spent to debug. Therefore, equivalence checking of system-level designs is studied.

In system-level design, there are few formal verification methods that are used widely in industry, and simulation plays a main role to verify designs. This is because large system-level designs cannot be solved by formal methods in practical periods. At the same time, however, simulation has also a serious problem in feeding good test patterns when a design is very large. Currently, state-of-the-art formal verification methods can solve one module of system-level design, which is corresponding to the size that can be synthesized by behavioral synthesizers. If our proposed methods can check the equivalence of two large design consisting of several modules, it can be said that the scalability of formal methods is much improved.

One powerful method to check the equivalence is applying symbolic simulation to both of the designs under verification with generating equivalence classes of variables and expressions. This approach does not need any test patterns, hence, can be classified as formal verification. However, it cannot be applied to large designs since the run time of symbolic simulation increases exponentially to the design sizes. To realize efficient equivalence checking of large system-level design descriptions, in this thesis, several verification methods are proposed.

The proposed verification methods utilize the difference between the design descriptions. In practical, system-level design is proceeded by gradually refining designs step by step. Therefore, the difference between designs of one refinement step is expected to be relatively small. The basic idea of the proposed method is that we can reduce the computation effort of equivalence checking utilizing the difference.

An efficient equivalence checking method using difference is proposed. In the method, symbolic simulation is applied only to the related portions to the difference, while it is applied from the start to the end of each path in the previous method. For each difference between the designs under verification, equivalence checking based on symbolic simulation is performed first only for the difference. If all differences can be proved to be equivalent, the result of the verification is equivalent. When a difference cannot be proved to be equivalent, the verification is repeated extending the verification areas until the equivalence is proved. The extension of the verification areas is carried out along data and control dependence. This local checking approach results in that the equivalence can be proved with small computation effort even if the design itself is very large.

When verifying designs including parallel behaviors, it is impossible to apply equivalence checking to all possible schedulings, since the number of schedulings increases exponentially to the design size. To solve the problem, a sequentialization method is proposed. Given a design description with parallel behaviors, the method generates an equivalent design description without parallel behaviors. In the method, two statements that can be executed in parallel and dependent to each other are checked whether or not the

execution orders of them is always the same. If the statements are always executed in the same order due to synchronization, they can be sequentialized into an equivalent two sequential statements. Otherwise, they cannot be sequentialized, since the executions of the statements may occur different results depending the execution orders. Using this sequentialization method, equivalence checking of two parallel behaviors can be reduced to equivalence checking of only a pair of two sequential behaviors, instead of checking many pairs of all possible scheduling.

When symbolic simulation is applied to loops, they are unrolled to avoid the execution paths with infinite length. This results in the increase of verification time especially when the number of unrolling is large. As a solution of the problem, an equivalence checking method of loops without loop unrolling is proposed. It identifies the symbolic values of loop iterators that are required to compute an arbitrary index of the output arrays. After the required symbolic values of the iterators are extracted, symbolic simulation is applied only to the values for equivalence checking. As a result, the number of statements to be symbolically executed does not increase even if the number of iterations is actually large. The several experiments conducted in this thesis confirm that the proposed methods enable to verify the equivalence of large system-level designs between practical design refinements.

A35. 光ファイバ中の誘導ブリルアン散乱の特性評価 —光ファイバ神経網における歪と温度の分離測定 の検討—

鄒 衛文

Characterization of Stimulated Brillouin Scattering in Optical Fibers —Study on Discrimination of Strain and Temperature in Fiber Optic Nerve Systems—

By Weiwen Zou

Owing to the advantageous correlation-domain continuous-wave-based technique, fiber optic nerve system of either Brillouin optical correlation-domain analysis (BOCDA) or reflectometry (BOCDR), rather than Brillouin optical time-domain analysis (BOTDA) and reflectometry BOTDR, has been theoretically investigated and experimentally realized to provide outstanding performances in diagnosis of fully-distributed strain or temperature disturbances with an extremely-high spatial resolution of from tens of centimeters to several millimeters along the whole fiber under test (FUT). Regardless the ability of how short segment can be diagnosed, either BOCDA/R or BOTDA/R via measurement of a single parameter (i.e., Brillouin frequency shift, BFS) is unable to distinguish the response to strain from the response to temperature. The target of this dissertation is to study discriminative measurement and simultaneous sensing of strain and temperature in fiber optic nerve systems.

First of all, a great amount of work has been focused on

investigating and clarifying the feasibility/possibility of discriminative sensing by utilizing different acoustic resonance peaks in a newly-proposed fiber structure, a w-shaped triple-layer optical fiber with high-delta core and F-doped inner cladding (F-HDF).

For this purpose, we proposed a modal analysis based on two-dimensional (2-D) finite element method for evaluating the Brillouin gain spectra (BGS) in optical fibers with 2-D complicated geometry and/or 2-D arbitrary refractive-index profile. Our analyzed examples, a standard single-mode optical fiber (SMF) and a PANDA-type polarization-maintaining fiber (PANDA-PMF) drawn from the same design of the optical core, are in good agreement with the experimental results. The experimental arrangements for both SMF and PANDA-PMF were respectively modified from the traditional pump-probe scheme by taking use of a single-sideband modulator (SSBM), high-bit A/D data acquisition and rather-high probe power to improve the measurement accuracy within 0.05 MHz-0.10 MHz. The merits of our proposed modal analysis and the improved experimental arrangement of BGS characterization has been manifested and validated by investigating optical fibers drawn from the same preform but under different tensions.

To study w-shaped triple-layer F-HDF optical fibers, a preliminary measurement and a systematic acoustic modal analysis were both undertaken. We found experimentally that multiple acoustic resonance peaks with wide neighboring frequency spacing have different dependences on strain and temperature, especially between the fundamental L01 mode and the highest L04 mode since they feel the largest difference of germanium dopants from fluorine dopants. This material difference is estimated to be useful to enhance discriminative performances because the fundamental L01 mode and a L03 mode can be separated into germanium core and the F-doped inner-cladding region while with comparable gain (-5 dB) by using proper fiber designing.

Strain and temperature dependences of Brillouin resonance frequencies in GeO₂-doped optical fibers and F-doped optical fibers have been respectively investigated to clarify the physical nature of the silica materials lying behind the discriminative measurement. Our results show that either strain dependence or temperature dependence is significantly originated from the nonlinearity of Young's modulus of silica materials, and that germanium dopants decrease the nonlinearity of Young's modulus while fluorine dopants increase the nonlinearity. Furthermore, we found that the fabrication conditions, such as draw tension, can increase the difference of strain and temperature dependences, which provides a more degree of freedom for fiber designing to enhance the discriminative measurement.

On the other hands, when analyzed the BGS in PANDA-PMF, it was proved that, in the process of stimulated Brillouin scattering in PANDA-PMF, the acoustic wave generated by the counter-propagating pump-probe light waves along each principal polarization has the same displacement distribution along the fiber's cross section. This fact indicates that the

acoustic wave generated and intensified by x-polarized light waves can be used as an acoustic grating to diffract a y-polarized light wave if it has a birefringence-determined wavelength/frequency deviation from the x-polarized pump light. We have experimentally characterized the frequency deviation with a precision as high as ~ 4 MHz, which corresponds to a birefringence accuracy of $\sim 3 \times 10^{-8}$.

Strain and temperature disturbances influence linearly the birefringence but in a far different behavior from their influences to the BFS. For example, strain increases while temperature decreases the birefringence. We proposed to utilize the characteristics as a novel technique to discriminate the response to strain from that to temperature by use of the PANDA-PMF. Our experimental results show that simultaneous measurements of the BFS and the birefringence-induced frequency deviation can provide an extremely-high reproducible accuracy of 3-4 microstrain and 0.02-0.03 degree

A36. 論理 LSI における放射線起因ソフトエラーの測定手法に関する研究

川 善光

A Study on Measurement Method of Radiation-Induced Soft Errors in Logic LSIs By Yoshimitsu Yanagawa

A radiation-induced soft error is becoming a dominant reliability failure mode in advanced logic LSIs. It is critical to eliminate or mitigate the radiation-induced soft errors in the logic LSIs. The goal of this work is to develop a method of measuring the radiation-induced soft errors in the logic LSIs. For the purpose, firstly, we have developed an on-chip pulse-width-measurement circuit and performed irradiation tests to measure the widths of single event transients (SETs) which originate in the combinational logic cells. Then, we have developed a new soft-error measuring scan flip-flop (FF) and proposed an irradiation test method to evaluate soft-error-rates (SERs) in the logic LSIs. The validity of the proposed scan FF has been demonstrated by an irradiation test.

This paper consists of 6 chapters.

Chapter 1 is an introduction and describes the purpose of this work and how the rest of the paper is organized.

Chapter 2 gives the basics of a radiation and its interaction with semiconductors. Then, the mechanisms of how the soft errors occur are shown. The radiation-induced soft errors are classified into two types: single event upset (SEU) soft errors and SET soft errors. Here, the SEU soft errors means the upset caused by a direct ion hit to the FF, while the SET soft error means the upset caused by latching a radiation-induced transient pulse that originates in the combinational logic cells. Different hardening techniques are necessary to mitigate the SEU and SET soft errors, and these techniques usually have large implementation costs. Several hardening techniques are introduced, and their efficacies and costs are discussed. The conclusion of this chapter is that, to develop cost-effective radiation-hardened logic LSIs, it is desirable to identify the

SEU- and SET-vulnerable circuit-nodes in the logic LSIs and implement appropriate hardening techniques to the nodes.

Chapter 3 describes an SET-pulse-width measurement. The SET pulse width draws much attention because its value is often used as a critical parameter in designing SET-mitigating techniques. However, it is not easy to measure the pulse width because the pulse is too short to observe from the outside of the chip, and also its generation is spatially and temporally random. Therefore, we have designed an on-chip self-triggering mechanism to measure the SET-pulse widths. The mechanism enables us to capture SET pulses as many as possible and measure their widths directly. A test chip was fabricated, and irradiation tests were performed. A nickel (Ni) and a krypton (Kr) ions were irradiated with a linear energy transfer (LET) of 40 MeV-cm²/mg to evaluate SET pulses in a space environment. The results showed that the widths of the SET pulses distributed under constant-LET of 40 MeV-cm²/mg. The maximum width of SET-pulses originated in the NOT and NOR logic cells were 0.9 ns and 1.2 ns, respectively. The most frequently observed widths of SET-pulses were 0.5 ns (NOT) and 0.7-0.8 ns (NOR). Based on the test results, the design consideration for the SET-mitigation techniques is given.

Chapter 4 describes a new soft-error measuring scan FF and a measurement method of the SERs in the logic LSIs. The scan FF proposed here was designed based on conventional scan architecture which enables us to investigate the states of each FF. The proposed scan FF can detect and capture both SEU and SET soft errors during an irradiation test. We can read the errors out using the scan architecture to calculate both SEU-soft-error rate (SER_SEU) and SET-soft-error rate (SER_SET). The FF has two irradiation test modes: SEU mode and SET mode. In the SEU mode, only SEU soft errors can be captured by the FF, and thus SER_SEU is measured at each FF. On the other hand, in the SET mode, both SEU and SET soft errors can be captured by the FF, and thus SER_SEU + SER_SET is measured at each FF. Subtracting these two results, we can separately obtain SER_SEU and SER_SET at each FF. This chapter finally discusses the benefits of the proposed test method.

Chapter 5 shows irradiation test results to demonstrate the validity of the proposed scan FF. For the demonstration, we fabricated a test chip which consisted of the proposed scan FFs and several logic cell chains that were connected to the input of each scan FF. The test chip was irradiated by Kr ions with an LET of 40 MeV-cm²/mg. The results show that, in the SEU mode, the SER at each scan FF was almost the same. On the other hand, in the SET mode, the SER measured at each scan FF increased depending on the length of the logic chain connected to each scan FF. These results show that the proposed scan FF works properly. This chapter also shows the result of cell level implementation cost estimation. Compared to the conventional scan FF, the cost increased 29% in area, 5% in delay and 21% in power. It means that we can implement the proposed scan FF at reasonable costs. Based on these results, this chapter concludes that the proposed method

is valid for the SER measurement in the logic LSIs.

Chapter 6 concludes this paper.

A37. 柔軟な動画像認識システムのための動きフィールド特徴ベクトル表現

早川 仁

Feature Vector Representation Algorithms for Motion Fields in Flexible Moving Image Recognition Systems

By Hitoshi Hayakawa

Today, microprocessors contain hundreds of millions of transistors thanks to the exponential progress in semiconductor technology and they perform more than billion operations in a second. Despite the enormous computational power of microprocessors, recognizing objects which is commonly carried out in real time by humans is extremely difficult problem for computers. The concept of associative systems is one of possible solutions for the problem. In the system, recognition is carried out by associative operations which find out most similar events in the past experiences to the input. Real-time hardware recognition system implementing the concept using state-of-the-art semiconductor technology has been proposed. In the system, key issues are feature extraction algorithms and associative processing hardware. The former extract features from input and represent them in the form accommodating to hardware. The latter performs associative operations using those features. On this background, feature vector representation algorithms of moving images and an associative processor architecture have been developed for moving image recognition in the present work.

For the first step of feature representation of moving images, a motion field generation algorithm based on block matching of edge-flag histograms has been developed in the present work. Use of edge flags instead of pixel intensities has made the algorithm robust against illumination changes. In order to detect local motions of interest effectively, a new adaptive frame interval adjustment scheme has been introduced in which only the edge flags due to local motions present in the frame are accumulated and utilized in block matching. These edge flags are projected onto x and y axes to generate histograms and the motion in x and y directions are determined by histogram matching. As a result, the computational cost for best match search has been substantially reduced. A vector representation of the motion field is also proposed and has been applied to preliminary motion recognition experiments using Hidden Markov Models (HMMs). The advantage of the proposed method over the simple optical flow has been demonstrated.

Next, an algorithm of generating a single feature vector representation from a sequence of motion fields has been developed for gesture perception. Four directional motion components in a motion field are projected onto x- and y-axes perpendicular to respective directions and four histograms are generated. Then the time evolution of such histograms are integrated by spatiotemporal projection and summarized in the

form of a single vector that represents the motion history of the image in a scene. Gesture perception is carried out by a simple template matching using such motion-field sequence vector. In order to make it robust against the translation of images in a frame and speed variations of motions, three techniques have been introduced in template matching: normalization, smoothing and shifting. The spatiotemporal compensation scheme has also been developed to avoid the adverse effect due to the variations in location and size of motions in both spatial and temporal domains. Preliminary gesture perception experiments using the vector representation developed in the present work have been carried out and the effectiveness of the algorithm has been demonstrated.

For the recognition system of moving images, associative operation is an essential operation. To construct flexible recognition systems, regular central processing unit (CPU) like operations are also required in addition to the associative operation. Since the functions of conventional associative processors are dedicated to the associative operation, CPU-like operations need be carried out in external processors and total performance is forced to be degraded. Multiple associative processing is needed in flexible recognition system which executes multiple recognitions and integrates the results. However, conventional associative processor could perform multiple associative operations in a single chip at one time. To solve the problem, new processor architecture for a multiple-instruction-stream multiple-data-stream (MIMD) associative processor has been proposed. The processor employs an architecture that enables seamless switching from associative operations to arithmetic operations. The MIMD element is convertible to a regular CPU while maintaining its high performance as an associative processor. Three key technologies have been developed to generate the MIMD element: associative-operation-and-arithmetic-operation switchable calculation units, a versatile register control scheme within the MIMD element for flexible operations, and a short instruction set for minimizing the memory size for program storage. The feasibility of the architecture has been verified by the implementation. The effectiveness of the architecture has been confirmed in the performance estimation of an association-based face detection algorithm.

In this research, the motion-field based feature representations of moving images has been developed and successfully applied for simple gesture recognition for moving image recognition systems. The general-purpose-processing and associative-processing switchable MIMD associative processor architecture has been also proposed for flexible recognition systems. These technologies enable us to build a real-time flexible moving recognition hardware system and have made a certain contribution to human-like information processing systems.

A38. 新しいIV族強磁性半導体 $\text{Ge}_{1-x}\text{Fex}$ 薄膜の研究: エピタキシャル成長、結晶構造、磁性、およびヘテロ構造

周藤 悠介

**A New Group-IV Ferromagnetic Semiconductor
Ge_{1-x}Fe_x: Epitaxial Growth, Crystal Structure,
Magnetic Properties, and Heterostructures Systems
By Yusuke Shuto**

Si-based spintronics will lead to a new progress beyond the conventional Si technology, because spin degrees of freedom provide new and unimaginable functionalities in well-established Si devices and systems. Here, injection and detection of spin-polarized current in actively-controlled channels are indispensable fundamental operations to obtain new functionalities in Si-based spintronic devices such as spin MOSFETs. Group-IV ferromagnetic semiconductors have many advantages to achieve these operations in comparison with commonly-used ferromagnetic metals, because they can be grown on Si platform with atomically flat and abrupt interfaces, they are compatible with Si device processes, and the conductivity mismatch problem does not have to be considered. Thus, group-IV ferromagnetic semiconductors are promising for emerging Si-technology-based spintronic devices.

Ferromagnetic semiconductors have been given simultaneously dual advantages of the semiconductor properties and the magnetic properties. Fundamental properties of “intrinsic” ferromagnetic semiconductors have been investigated in III-V-based ferromagnetic semiconductors Ga_{1-x}Mn_xAs and In_{1-x}Mn_xAs. The magnetic ions were substituted for the lattice sites of host semiconductors keeping the single crystal structure of the type of hosts, and as a result, the band structure of ferromagnetic semiconductors reflects that of hosts. Ferromagnetic ordering is induced by the s,p-d exchange interactions, not by the intermetallic precipitates. The s,p-d exchange interactions provide unique properties such as large magneto-optical effects induced by spin-splitting of the band-edge, and controllability of their magnetism by varying the hole density. When a new candidate material is fabricated, investigation of these fundamental characters is indispensable to test whether it is an intrinsic ferromagnetic semiconductor or not.

The first successful growth of group-IV ferromagnetic semiconductor was reported by Park et al. They demonstrated the control of ferromagnetic ordering in gated Ge_{1-x}Mn_x films by applying an electric field. Although this result implied that Ge_{1-x}Mn_x had the behavior of intrinsic ferromagnetic semiconductors, the investigation of fundamental properties was not enough. Then controversy arose over the origin of the ferromagnetism in epitaxial Ge_{1-x}Mn_x films, since some reports suggested that the Ge₂Mn nanocolumn structures, the intermetallic Mn₅Ge₃, and amorphous Ge_{1-y}Mn_y clusters were easily formed in epitaxial Ge_{1-x}Mn_x films.

In this thesis, Fe was chosen as magnetic dopants in place of commonly used Mn atoms. Fe-doped Ge (Ge_{1-x}Fe_x) films have been grown on Ge(001) and Si(001) substrates by low-temperature molecular beam epitaxy (LT-MBE) and thoroughly investigated their crystal structure and magnetic properties. Furthermore, by studying group-IV magnetic

heterostructures, possibility of using Ge_{1-x}Fe_x films in actual spintronic devices is explored.

At first, Ge_{1-x}Fe_x films were epitaxially grown on Ge(001) substrates by low-temperature molecular beam epitaxy (LT-MBE). During growth, the surface morphology of the samples was monitored by in-situ reflection high energy electron diffraction (RHEED) observations. RHEED patterns of the samples showed the diffraction pattern of the diamond-type lattice structure without extra spots caused by the formation of Fe-Ge precipitates. Detailed crystallographic analyses were carried out by transmission electron microscopy (TEM), transmission electron diffraction (TED), energy dispersive X-ray spectroscopy (EDX), and X-ray diffraction spectroscopy (XRD) observations. Epitaxially-grown Ge_{1-x}Fe_x films on Ge(001) substrates maintained the diamond-type lattice structure including the fluctuation of Fe distribution and tiny stacking fault defects without any other ferromagnetic Fe-Ge precipitates, when they were grown at the substrate temperature (TS) of less than 200 °C. The lattice constant (along the growth direction) evaluated from XRD spectra of the samples linearly decreased with increasing the Fe content (x) up to 13.0% and was saturated at x more than 13.0%. This behavior indicates that Fe atoms were substituted for the lattice sites of host Ge up to at least x = 13.0%. Magneto-optical measurements were carried out by magnetic circular dichroism (MCD) technique. The MCD spectra of Ge_{1-x}Fe_x films reflected the band structure of host Ge and the MCD peak at the critical point (especially E₁ transition energy) was largely enhanced by Fe doping, although broad offset-like MCD signals were observed. This indicates that the band-edge spin-splitting was induced by the s,p-d exchange interactions as described above. Magnetic field dependence of MCD intensity at any photon energies including E₁ and other points exhibited clear ferromagnetic hysteresis loops, and these shapes were identical with one another, indicating that the MCD spectral features and ferromagnetic ordering of the samples came from a magnetically-homogeneous single ferromagnetic phase, without any other ferromagnetic Fe-Ge precipitates. The Curie temperature (TC) of the Ge_{1-x}Fe_x films on Ge(001) evaluated from the temperature dependence of MCD hysteresis loops linearly increased with increasing x up to 13.0%, and was saturated at x more than 13.0%. The behavior of TC had a good correlation with the behavior of lattice constant as a function of x. This correlation indicates that TC increases in proportion to the number of substitutional Fe atoms, and that the crystal structure and the magnetic properties of Ge_{1-x}Fe_x films on Ge(001) have linear relation with each other, which is one of the essentials for intrinsic ferromagnetic semiconductors. All the results presented here confirm that epitaxial Ge_{1-x}Fe_x films on Ge(001) are “intrinsic” ferromagnetic semiconductor.

Next, Ge_{1-x}Fe_x films were epitaxially grown at TS = 200 °C on Si(001) substrates by LT-MBE. To establish the epitaxial growth of Ge_{1-x}Fe_x films on Si is the next important step for realizing group-IV-based spintronic devices integrated

into Si CMOS platform. In-situ RHEED during growth showed only the diffraction pattern of the diamond-type lattice structure. Crystallographic analyses revealed that the crystal quality of the Ge_{1-x}Fe_x layer was deteriorated including not only the fluctuation of Fe distribution and tiny stacking fault defects as well as the films on Ge(001) but also threading dislocations induced by large lattice mismatch between Ge_{1-x}Fe_x and Si, although there were no formation of intermetallic Fe-Ge precipitates within Ge_{1-x}Fe_x layer. The lattice constant (along the growth direction) evaluated from XRD spectra linearly decreased with increasing *x* up to 13.0% and was saturated at *x* more than 13.0%. MCD measurements indicate a largely enhancement of MCD peak intensity at E₁, a magnetically-homogeneous single origin of their ferromagnetism, linear increase of TC depending on *x*, and good correlation between TC and the lattice constant. All the results of Ge_{1-x}Fe_x films on Si(001) were consistent with the case of Ge_{1-x}Fe_x films on Ge(001), confirming that epitaxial Ge_{1-x}Fe_x films on Si(001) are also intrinsic ferromagnetic semiconductor. Furthermore, magneto-transport properties were examined in the Ge_{1-x}Fe_x films on Si(001). Anomalous Hall effects (AHE) with ferromagnetic hysteresis loops was clearly observed at the temperature lower than TC evaluated from MCD, and the shapes of AHE was consistent with those of MCD. This means that anomalous Hall effect and MCD measurements detected the same ferromagnetic phase, that is, the intrinsic ferromagnetic semiconductor phase.

Finally, the observation of tunneling magneto-resistance (TMR) effect was attempted in tri-layer magnetic tunnel junction (MTJ) structures with ferromagnetic Ge_{1-x}Fe_x films as ferromagnetic electrode. TMR-like behaviors were observed at low temperature (~3K) in the tri-layer structure of top Fe / Si_{0.2}Ge_{0.8} barrier / bottom Ge_{1-x}Fe_x (*x* = 13.0%), although TMR changed negatively and these TMR ratio were very low (~ 0.3%). This behavior indicated that Ge_{1-x}Fe_x films can actually function as a spin injector and detector in Si-technology-based spintronic devices.

A39. 時間分解テラヘルツ分光法を用いた高電界下バルク GaAs 中のフェムト秒キャリアダイナミクスに関する研究

朱 亦鳴

Femtosecond Carrier Dynamics in Bulk GaAs under High Electric Fields Investigated by Time Domain Terahertz Spectroscopy
By YiMing Zhu

Taking advantage of a novel experimental method, i.e., time domain terahertz (THz) spectroscopy, invaluable information on nonequilibrium carrier transport in bulk GaAs has been obtained. In this study, we focused ourselves particularly on the following three subjects;

We have investigated femtosecond acceleration of carriers in bulk GaAs subjected to very high electric fields, *F*, by time domain THz spectroscopy. It is found that the initial acceleration signal in THz emission waveform, $\square E_{\text{THz}}$, which

corresponds to the acceleration of electrons in \square valley gradually saturates and starts decreasing for *F* > 50 kV/cm. This result suggests that the effective acceleration mass of electrons significantly increases with increasing *F*. The mass enhancement is most likely due to strong band mixing under very high electric fields.

Furthermore, the transient velocity of carriers in bulk GaAs has been obtained from the time domain THz traces. Surprisingly, it is found that the initial velocity of carriers does not start from zero at the time of photoexcitation, which is far from the expectation from a semiclassical picture. Possible origins of this surprising behavior are discussed.

Finally, we have investigated the gain due to intervalley transfer under high electric fields, which is of practical importance for its exploitation in microwave oscillators. The energy density spectra under step-function-like electric fields in THz range have been obtained by using the Fourier transformation of the time domain THz traces. From the energy density spectra, the cutoff frequencies for negative energy density (i.e., gain) in bulk GaAs have been determined. The cutoff frequency gradually increases with increasing electric field, *F*, for *F* < 50 kV/cm, saturates and reaches 1 THz (300 K) for *F* > 50 kV/cm. Furthermore, from the temperature dependence of the cutoff frequency, we found that it is governed by the energy relaxation process of electrons from L to \square valley via successive optical phonon emission.

The present insights on the nonstationary carrier transport contribute to better understanding of device physics in existing high speed electron devices and, furthermore, to new design of novel THz oscillators.

基盤情報学専攻

A40. TDMA ベース無線アドホックネットワークにおける最大帯域タイムスロット割り当て

李 建平

Time Slot Assignment for Maximum Bandwidth in Slotted Wireless Ad Hoc Networks
By Jianping Li

A wireless ad hoc network is a distributed and autonomous system composed of nodes connected by wireless links. These nodes communicate with each other over the wireless medium without the intervention of centralized access points or base stations, and each of them acts as both as a router and as a host. The wireless ad hoc network offers unique benefits and versatility for certain environments and certain applications, therefore it is considered as one of the most promising terminal networks in future communications.

Slotted wireless ad hoc networks are drawing more and more attention because of their advantage of QoS(Quality of Service) support for multimedia applications owing to their collision-free packet transmission. Thus, I put my research emphasis on slotted wireless ad hoc networks.

Bandwidth must be firstly met when multimedia data are

transported from one end to another end in slotted wireless ad hoc networks.

Bandwidth requirement is more difficult to meet in wireless ad hoc networks than in other types of networks, and providing enough bandwidth for multimedia applications is a critical and challenging problem in wireless ad hoc networks because of multihop, mutual radio interference and lack of central coordination.

My research addresses the following three challenging problems about the bandwidth support for multimedia applications in wireless ad hoc networks.

Problem 1: How much is the bandwidth of a given route in a wireless ad hoc network?

Problem 2: How to assign the time slots in order to get the maximum bandwidth of a given route in a slotted wireless ad hoc network?

Problem 3: How to select a route of maximum bandwidth for a pair of source node and destination node?

In Section 1, research background, motivation, objective and my contributions are introduced briefly.

Sections from 2 to 7 address the above three problems essentially.

Section 2 addresses Problem 1, that is, how much is the bandwidth of a given route in a wireless ad hoc network. Bandwidth formulae for a route considering mutual interference in wireless ad hoc networks are derived, and these formulae are proved by induction.

Sections from 3 to 6 address Problem 2, that is, how to assign the time slots in order to get the maximum bandwidth of a given route in a slotted wireless ad hoc network.

In Section 3, I formulate the time slot assignment for maximum bandwidth of a route in a slotted wireless ad hoc network as an MIP problem, and showed some numerical examples on the optimal solution by making use of a tool named GLPK.

Though optimal time slot assignment for maximum bandwidth can be obtained by MIP method, it takes too much time to complete the time slot assignment when a slotted wireless ad hoc network becomes large, which leads to the infeasibility of MIP method in practice.

Therefore, in Section 4, I propose an approximate algorithm of SAGO, by which more available bandwidth of a route is obtained than the conventional approximate methods and much less time is consumed than MIP method. Furthermore, the bandwidth by SAGO is in general close to that by MIP method.

Moreover, in Section 5, I extend SAGO to CDMA/TDMA ad hoc networks, which are another kind of networks focused because of QoS support. I propose SAP algorithm by which more available bandwidth can be obtained than conventional approximate solutions and much less time is consumed than the optimal method in a CDMA/TDMA ad hoc network.

The above time slot assignments for deriving bandwidth of a route for a new flow do not take account of the directions of radio wave transmission on each link of the route. However, if the directions in each link are considered, then the possibility

of time slot assignment becomes much larger.

Thus, in Section 6, I propose direction-aware time slot assignment for slotted wireless ad hoc network. The proposed assignment is different from the existing methods in the following aspects: a) consideration of link directions during time slot assignment; b) largest bandwidth to be achieved; c) feasibility in a resource limited ad hoc network because of its fast assignment. Moreover, the effectiveness of the proposal is confirmed by some simulation results.

Section 7 addresses Problem 3, that is, how to select a route of maximum bandwidth for a pair of source node and destination node?

In Section 7, a bandwidth-aware routing protocol is proposed in order to rapidly find a route of maximum bandwidth for a flow from a source node to a destination node in a slotted wireless ad hoc network.

Section 8 concludes the dissertation and presents the future work.

Moreover, the above research results can also be used for QoS-routing, admission control, load balancing, etc. And it will be a great contribution to end-to-end QoS support research in wireless ad hoc networks.

A41. 広域センシングのための映像処理

味八木 崇

Video processing for wide area sensing

By Takashi Miyaki

This paper proposes video processing schemes for wide area sensing application that supports our secure daily life using information technology. Concern about digital security is increasing. In today's ubiquitous computing environments, it is important to achieve flexible and reliable personal identification and tracking performance for media processing framework used by security application. Existing approaches do not provide easy to use personal identification or reliable pedestrian tracking scheme which is able to apply in wide area environment. In this paper, two schemes: view-based ID sensing and wide area pedestrian tracking by sensor fusion, are described.

For identification issue, a framework, "object-based anonymous ID", used for simple personal identification is proposed. The basic concept of this framework is to use commonplace objects, such as hand-written symbols on a paper, as keys to identification. As this system requires little private information from users, as required in other identification systems, this framework will be able to build a system with minimum invasion of privacy. For this purpose, a scale invariant feature transform algorithm is applied to extract image features that are robust to rotation and scaling of the objects and general image processing on GPUs for fast feature extraction.

When we wish to obtain services anonymously, tickets or specific tags (e.g., RF-ID, bar codes, etc.) are used in most circumstances with conventional frameworks. This paper presents a novel framework for personal identification with

simple ID generation and a recognition scheme based on image feature analysis. Using only image features to recognize users, the system does not need any specific devices such as RF-IDs or ID readers. Our approach also aims at simple digital security enhancement. Unlike biometrics, no personal information strongly correlated with the user is needed. This makes the system simple and acceptable. A prototype system is developed for personal identification in a ubiquitous environment. In this system, users are required to draw symbols on a piece of white paper of a specified size for their IDs. The system recognizes the drawings and the image features are matched with those in the database for identification. A scale-invariant local feature detector, based on scale-space image analysis, is used to calculate the similarity of each keypoints. Note that any personal object can replace the drawings. We have developed a proof-of-concept system and demonstrated a very promising identification performance with a realistic False Acceptance Ratio (FAR) and False Rejection Ratio (FRR), respectively.

Object tracking with multiple cameras is another fundamental problem in wide-area surveillance application, but it has difficulties to achieve accurate and stable performance because of disjoint shot areas or initial object identification problems. This paper proposes a novel object tracking method which jointly uses estimated location information of the target derived from a set of Wi-Fi signal strength values with video images from cameras. Different from the conventional approaches which use another kind of sensors (e.g., global positioning system (GPS), pressure sensors on the floors, laser-range scanners, etc.), our approach can cover wider areas both indoor and outdoor with lower cost. Particle filter is applied to combine those two different kinds of sensory input to achieve tracking the target in a stable performance. Wi-Fi observation model is involved in a conventional visual particle filtering scheme to evaluate importance weights of each particle.

Possible location information of the target is estimated from a set of received signal strength identifier (RSSI) values of beacon packets from Wi-Fi access points (APs) around the targets. The client scans signal strength from multiple APs and matches the data with location database which has a set of estimated location of APs. As client-side does not need processing power, small mobile terminals such as Wi-Fi enabled mobile phones or PDAs are enough to estimate location of the user. In RSSI models, only the beacon packets are needed for RSSI scanning, thus clients do not need to be able to connect with the networks and all the APs around the targets can be used as positioning infrastructure. It works both indoor and outdoor, and estimated accuracy is often comparable with that of existing positioning systems. With this Wi-Fi location estimation, particle filtering is applied to achieve tracking the target from video images. In this way, very efficient and accurate tracking quality is achieved. Our experimental results demonstrated that the target was successfully identified and tracked in a wide area. Such a system can be used for a lot of applications such as networked

“keep an eye on” system for children to sustain the security of the street.

These studies contribute to improve reliability and usability of video processing systems which are used in wide area applications. Moreover, the knowledge disclosed by this paper suggests the establishment of fundamental methodology of future media processing systems.

A42. 分布推定に基づく確率的関数進化アルゴリズム

長谷川 禎彦

Probabilistic Function Evolution based on Estimation of Distribution By Yoshihiko Hasegawa

The thesis deals with the probabilistic function evolution based on estimation of distribution.

Evolutionary algorithms (EAs) are optimization methods and are based on a concept of natural evolution. Recently, growing interests have been observed on applying estimation of distribution techniques to EAs (EDAs). EAs basically generate individuals from distribution of promising solutions. Since the distribution is unknown, EDAs assume a set of parametric models. EDAs select a model which gives the maximum posterior probability from the set, and estimate parameters. Solution candidates are generated from the estimated models. EDAs are reported to be more powerful than classical EAs in some problems. Although EDAs based on fixed length linear array have hitherto been proposed (GA-EDA), in recent years, EDA approach has been applied to tree structures which can handle programs and functions (GP-EDA). In the thesis, I propose two new GP-EDAs: POLE (Program Optimization with Linkage Estimation) and PAGE (Programming with Annotated Grammar Estimation).

POLE is based on a prototype tree based method. Since GA and GP have much in common, research on prototype tree based GP-EDA has taken advantage of many of the techniques devised in GA-EDA. However, due to the differences between GA and GP, there arises a critical problem in the simple application of GA-EDA techniques to GP: Because GP uses many symbols during the search, the number of possible symbols at each node becomes very large. When the number of possible symbols is large, the size of conditional probability tables (CPT), which express the quantitative relationships between nodes, also becomes large. As a result, many samples are required to construct the Bayesian network. POLE employs a special chromosome called the expanded parse tree, which significantly reduces the size of the Conditional Probability Table (CPT). POLE employs Bayesian network for a probabilistic model to grasp the interactions between nodes. POLE estimates Bayesian networks from promising solutions and new individuals are generated from estimated Bayesian networks. By using Bayesian network, interactions among nodes can be taken into account. The present approach is applied to three distinct computational experiments and the effectiveness of this new approach for dealing with deceptive problems is demonstrated. POLE shows superior results

compared to simple GP and other GP-EDAs.

The second approach PAGE is based on the probabilistic context free grammar (PCFG). The conventional PCFG adopts the context freedom assumption that the probabilities of production rules do not depend on the ascendant nodes or sibling nodes. The basic GP-EDAs based on the PCFG just estimate parameters (production rule probabilities) and generate the programs using the parameters. Although the independence assumption makes the statistical estimation easier, the conventional PCFG basically cannot take into account the interactions among nodes. Thus it is not suitable for estimating the sub-functions or sub-routines in tree structured functions, because these functions often have strong interactions among nodes. In order to weaken the independence assumption in PCFG, annotations have been proposed in the natural language processing (NLP). Although PCFG is a widely used model in GP-EDAs, it is not able to estimate the building blocks from promising solutions. I propose new program evolution algorithms based on PCFG with latent annotations (PCFG-LA) which weaken the context freedom assumption. PCFG-LA is a very rich model proposed in NLP, which assumes that all the annotations which are features attached to non-terminals are hidden. I think GP-EDA using PCFG-LA is more powerful than GP-EDA using other simpler PCFG models. A model learning of PAGE is done with EM algorithm (PAGE-EM) which is also used in the original PCFG-LA and variational Bayes (PAGE-VB). Although EM algorithm estimates parameters in the latent variable models, EM algorithm cannot select the best model. On the other hand, variational Bayes estimates the posterior distribution of parameters and it can also select the best model. PAGE-VB not only estimates parameters (hyper-parameters) but also estimates the model complexity from the promising solutions. Computational experiments on two subjects (the royal tree problem and the DMAX problem) demonstrate that our new approaches (PAGE-EM and PAGE-VB) are highly effective compared to prior approaches including the conventional GP.

A43. ゲーム知識を表現する語彙の棋譜データからの自動獲得

三輪 誠

AAutomatic acquisition of vocabularies for representing game knowledge from game records By Makoto Miwa

Computer games has been researched as test-beds for artificial intelligence research for over half a century. Most researchers have bended their minds to make stronger players and many strong players in many games have been implemented as the results of their long-term efforts. Search algorithms have been generalized and made more efficient. More and more knowledge of the specific targeted games has been incorporated to the computer players: the knowledge to produce accurate evaluation functions, knowledge databases telling which moves are better than which, and knowledge to make the search more efficient.

The knowledge is frequently extracted with machine learning methods from game data, such as records of played games and results of search made by computers. With games complicated enough, exactly the same game situations would not appear frequently. Therefore, extracted knowledge should be represented in an abstract form by a suitable vocabulary that can represent the situations in an effective manner. The vocabulary should be selected to fully express the knowledge. If the vocabulary is not sufficiently rich, some parts of the extracted information may not be expressed. On the other hand, a vocabulary with too much complexity and/or redundancy may make knowledge extraction and their application more difficult.

In most computer game players, the vocabularies to express game situations are selected by hand through the developers' experiences of the games. Extraction of knowledge based on a hand-selected vocabulary may have the following three problems. Firstly, selection of an appropriate vocabulary is difficult because they may have limited knowledge and experiences on the game which may be insufficient and/or biased. They may not be aware of knowledge that cannot be represented in the chosen vocabulary, or they may not be able to find a vocabulary that can express the knowledge more efficiently. Secondly, the selection may be subjective and its rationale may not be clear. This may lead to the problem that the knowledge extraction methods may not be applicable to other games, not to mention problems other than games. This inapplicability is one of the most severe obstacles in the computer game research is facing. Finally, learning games empirically requires a large amount of examples. Most of the successful methods used a large amount of examples and only few succeeded with relatively small examples. A large amount of examples can be acquired from past game records or self-match records. However, most of the useful machine learning methods are not easily applicable to very large amount of data because of their high computational costs.

In this thesis, widely applicable methods to acquire the knowledge representation vocabularies automatically from game records are proposed. The acquired vocabularies are not biased because the acquisition is based on objective criteria that also are acquired from the game records. The vocabularies are constructed on basic vocabularies of primitives which can be easily and almost automatically constructed on the game rules, and thus are easily applicable to a wide variety of games. Unnecessary or duplicated information are eliminated by representing the examples using acquired vocabularies. This elimination eases treatment of a large amount of data.

The methods acquire the vocabularies by combining basic vocabularies based on their co-occurrence relations in game records. There are mainly two kinds of co-occurrence in game records, and two methods are proposed

based on each kind of co-occurrence. One method is an extension of move categorization based on successive moves which is time-series co-occurrence. The other is automatic acquisition of evaluation features for evaluation functions based on two or more features appearing in the same position which

is spatial co-occurrence.

For extending move categories, the proposed method decomposes move categories based on move sequence in game records. This method is applied to a computer shogi player "Gekisashi", which categorizes moves depending on the role of moves in their positions, which in turn is used to control tree search depth. Using the player's move categories and strong players' 47,321 game records, a player using decomposed move categories is implemented. The new player solved more of

the problems in the "find next move" set successfully than the originally, and is proven to be stronger than original player. For automatically acquiring features for evaluation functions, a fast and scalable method to automatically generate game position features based on game records is proposed. This method treats two-class problems

which is widely applicable to many types of games. Evaluation feature are built as conjunctions of the simplest features representing positions. These features are selected based on two measures: frequency and conditional mutual information. This method is applied to 200,000 Othello game positions. The proposed selection method is found to be effective, showing much better results than when simple features are used. This generation method can be parallelized easily and it is shown to be able to treat large scale problems by converting these selection algorithms into incremental selection algorithms.

The evaluation results of the proposed methods show that the acquisition of vocabularies is essential and effective, and can be automated. The proposed methods need little domain knowledge or any other existing knowledge, can treat large amounts of data, and resolve some problems in acquiring suitable vocabularies. Therefore, the methods can be applied to a wide variety of games and also can help reusing successful game-specific methods to different games.

A44. 母語話者と学習者の日本語朗読音声に現れる韻律的特徴

平野 宏子

PROSODIC FEATURES OF JAPANESE SENTENCES READ ALOUD BY NATIVE AND NON-NATIVE SPEAKERS

By Hiroko Hirano

When learning to speak a non-native language, acquiring appropriate prosody is as important as saying segmentals. Controlling F0 patterns in a way is the key to naturalness for Japanese as a pitch-accent language. However, scant attention has been paid to comparing native and non-native F0 patterns. Particularly in the case of learning Japanese as a foreign or second language, instructor-led classroom instruction often omits prosodic training, partly due to a lack of instructor knowledge ("can't teach what you can't see in print"), a reliance on language universals ("learners will figure it out somehow because all languages have similar prosody"), and paucity of pronunciation courseware ("prosody belongs to the

performing arts"). Non-native prosodic disfluencies yield utterances that are sometimes subjectively referred to as "choppy", "disjoint", or "harsh". Exactly how native and non-native prosody differ remains unknown. I suggest a systematic method for analyzing and comparing native and non-native F0 patterns within and across phrases. Eventually, I hope the method can be used to develop prosody courseware, and to automatically determine F0 errors so that learners can receive corrective feedback from a computerized tutor.

Chinese learners comprise over two-thirds of learners of Japanese as a second language. In my initial work, I examined F0 patterns of Japanese declarative sentences read aloud by native and Mandarin Chinese speakers. I analyzed changes of per-phrase F0 ranges in the utterances with the parameters of normalized F0 maximum, median, and minimum values, and showed the differences of patterns according to degree of prosody acquisition which was found by the scores from the native speakers' perceptual evaluation. Japanese speakers express syntactic and semantic cohesion by using smooth, hump-shaped F0 contours, and, for each phrase, adjusting F0 maxima and ranges. Chinese speakers are unable to acoustically convey intonational phrase groups due to their inflexible, invariable F0 ranges within phrases, and abrupt step-shaped F0 contours. Their relatively high F0 and wide ranges and steep drops of F0 especially at the end of the utterances might be perceived as harsh, strong or rude. Chinese speakers need to learn how to gradually raise and lower F0 such that they match native speaker patterns, and to adequately control F0 ranges.

I continued my work in capturing essential differences between native and non-native prosody by quantitatively analyzing F0 patterns using a F0 contour generation process model that divides pitch into global sentence intonation and local word accent. Compared to native speakers of Japanese, Chinese speakers exhibit the following characteristics: (1) higher baseline F0, (2) over-generated phrase and accent commands, (3) uniform magnitude of phrase and accent commands, and (4) possible negative accent commands. These characteristics may be subjectively perceived as: (1)-(3) tinny speech and L1 markers, (2)-(3) lack of sentential focus and decomposed prosodic phrases and words requiring mental consolidation for listeners, (4) abrupt utterance terminations possibly misconstrued as emphatic or rude. These difficulties might arise from tonal and syllable-timed interference, which can be overcome by prosodic control and planning.

A45. モバイルディスプレイを用いた直感的なヒューマンロボットインタラクションに関する研究

細井 一弘

Mobile Display Based Manipulation for Human-Robot Interaction

By Kazuhiro Hosoi

In this dissertation, we propose the Mobile Display based Manipulation (MDM) technique for manipulating simple robots such as automotive cleaning robots. By capturing images of robots with a camera-attached mobile display and

moving it in a three-dimensional space, a user can easily and intuitively manipulate the robots. In order to verify the validity and effects of the MDM technique, we developed two prototype systems using a handheld display and a projection display. User studies of these systems indicated that the proposed technique worked well for supporting users' intuitive manipulations. This paper also describes several issues to be investigated in the future work.

A46. ライフ・アダプティブ・コンピューティング：モバイル／ユビキタス時代における計算機システムのパーソナライゼーションに関する研究

竹内 雄一郎

Life Adaptive Computing: Personalization of Computer Systems in the Mobile/Ubiquitous Age By Yuichiro Takeuchi

Life Adaptive systems take the user's "life" as input. They adapt, morph, and evolve into forms that ideally fit the user.

In this dissertation I propose "Life Adaptive Computing", a new concept regarding how we humans interact with computers. Its general idea is to endow computer systems with the ability to deepen their user understandings through observing various details of the user's "life", and automatically adapt themselves to individual preferences, tendencies, and lifestyles. Even seemingly trivial daily activities - shopping, shooting photos, tying shoelaces, etc. - can serve as cues into a person's inner qualities. Just as humans gradually form a deep mutual understanding through each other's actions and words, Life Adaptive applications evolve toward optimal user experience, through careful observations of the user's daily life.

Today we are witnessing an age of unprecedented progress in computer technology. The continuous tide of ever more powerful, compact, and inexpensive computational hardware has made a solid impact on the relationships between humans and computers, giving rise to new HCI (Human-Computer Interaction) concepts such as Ubiquitous Computing, Wearable Computing, Context-Aware

Computing, etc. Life Adaptive Computing can be thought of as a yet another new HCI concept enabled by technical advances, with an impact comparable to the concepts listed above.

This dissertation first provides a series of discussions, with the ultimate goal of establishing the basic conceptual framework of Life Adaptive Computing. In particular, emphasis is placed on extracting and articulating the common features present in the fundamental structures of Life Adaptive applications. A good conceptual framework should allow engineers/designers to easily integrate the concept into future application developments.

Next, two examples of Life Adaptive applications are given, to offer a glimpse into the vast real-world possibilities of the concept.

The first application is CityVoyager, an intelligent city guide system whose chief function is to recommend shops to users based on their past GPS location records. The recommendation

procedure involves a newly developed place learning algorithm which can efficiently construct a list of each user's frequented shops. The list is then sent through the widely-proven collaborative filtering algorithm, to provide recommendations. CityVoyager is also equipped with an intuitive "metal detector" interface, which allows users to find recommended shops in the same way a metal detector would be used to detect metal objects. Evaluation tests have been conducted at Daikanyama, a popular shopping district inside Tokyo, whose results validate the effectiveness of CityVoyager's overall approach.

The second application is TimeWarp, an automatic video summarization system which adapts to each user's preferences by looking at his/her personal photo library. Nowadays, it is common practice for people to keep thousands of photos in their PCs, taken using their digital cameras. TimeWarp estimates preferences on video summarization, by learning the contents of these libraries through the use of image classification techniques. For example, if a user's library contains many photos of "cats", video summarization will be performed in a way that emphasizes sections showing "cats". TimeWarp has been implemented as a desktop application for Mac OS X, and evaluation results prove the system's ability to offer powerful video summarization.

In addition to detailed descriptions about their functions, the design processes of these applications will also be examined in detail, to demonstrate how using the conceptual framework can assist developers in initial designs of Life Adaptive applications.

Further topics discussed in the thesis include some extreme future possibilities of Life Adaptive applications, and the proposal of a general design principle to appropriately deal with privacy issues. On the whole, this dissertation should provide readers with a clear vision of what can be accomplished with Life Adaptive Computing, including even its limitations and potential risks.

A47. ユビキタスネットワーク環境における時間制約型プロアクティブサービス発見機構に関する研究

プピレフ パベル

Time-bounded Proactive Service Discovery in Ubiquitous Networks By Pavel Poupyrev

This dissertation describes the design and development of a system to support a new type of service discovery in ubiquitous networks. The new type of service discovery, called "proximate discovery" is discovery by mobile users of ubiquitous resources within close range of their motion path. Typical application scenarios include detecting friends who are passing nearby, picking up sale advertisements from shops as you walk through an arcade, meeting strangers in the street who have useful goods to exchange, and browsing at a large exhibition.

The requirements of these scenarios cannot be met by

existing technologies. In general, they can be divided in two categories: 1) systems that are based on infrastructure (infrastructure-based systems) and 2) systems that are not based on infrastructure (infrastructure-less systems). Systems built using cellular networks represent infrastructure-based wireless solutions. Because of low location detection resolution and large cost of increasing network capacity to handle large numbers of mobile resources, these solutions are inappropriate for realization of our application scenarios. The known wireless tag technologies that can be used for infrastructure-less service discovery include: Bluetooth and RFID-systems. However, these solutions are also inappropriate for realizing the described scenarios. Bluetooth devices have to organize themselves into networks before any content discovery can occur that slows down the discovery time of ubiquitous resources. RFID tags provide only device id which provides little information directly about an item, and would require continual access to global server database to discover contents.

We propose a new type of service discovery system to support proximate discovery. The core requirements are ubiquitous service descriptions, mobile operation, proactive discovery, physical accessibility and user-centric operations. To support the first requirement, we define a method for explicit description of services in terms of attributes. The mobility requirement postulates that a user should be able to discover services advertised by both mobile users and mobile objects. To support this requirement, we use a dedicated short-range wireless discovery device. To support proactive discovery, we designed algorithms for continuous advertisement and discovery. To support physical accessibility requirement that needs short-range discovery, we proposed to use short-range wireless communications which allows discovering services within short distance of a few meter. Finally, we aim at providing a user-centric service discovery system for an average user who should be able to easily manage advertising and discovering. To support this, we proposed a service format data management which allows a user to select a suitable service data format for discovery as well as create and share new service data formats. The combination of described core requirements and their realization represents an original service discovery system.

In addition to the proposed discovery system, we researched and evaluated solutions to enhance performance of the system. Two crucial components of the system which significantly affect the wireless service discovery performance are a data packet size minimization mechanism and a time-bounded wireless media access control (MAC) protocol.

The data packet size minimization is important because in order to transmit larger number of advertisements without degradation in discovery time performance wireless discovery devices have to use small data packets. We described three methods for data packet size minimization which are a local id replication, a data separation and a data indexing. We showed that only data separation and data indexing methods are suitable for our system because they do not rely on network

infrastructure during wireless discovery. We provided thorough analysis and showed that these two methods achieve data packet reduction of three times compared to transmission of service descriptions without minimization, and two times compared to a standard data compression method.

Another component that significantly affects discovery time performance and power consumption is a wireless MAC protocol. We described the design and evaluation of a new wireless MAC protocol that achieves reliable and economical service advertisement given the required discovery time-bound in a distributed wireless network. The proposed protocol achieves a given discovery time using the lowest possible transmission rates that results in lower power consumption since nodes transmit fewer packets.

Finally, we described a prototype implementation of the service discovery system which includes software for a server, a client device and a wireless discovery device as well as hardware implementation of the wireless discovery device. The wireless discovery device has compact size, low power consumption, multi-user interface support, and adjustable discovery range. We developed software which allows an average user to easily configure a wireless discovery device for advertisements or discovery.

In summary, the dissertation describes a complete solution for a new type of service discovery in ubiquitous networks. We described the design of the proposed system and described optimization of system components to achieve superior discovery time performance. In addition, we described a prototype implementation of the proposed system including software and hardware components.

B. 大学院修士課程論文リスト

Masters' Dissertations

電気工学専攻

氏名	論文題目	Name	Title
チャンタナカ ジョンフン プリーダー	変動通信遅れの補償制御による インターネットを介したバイラ テラル遠隔微細作業システム	Chantanakajornfung Preeda	Internet-based Bilateral Tele-Micromanipulation System with Time-varying Delay Compensation Control
渡邊 浩行	MEMS 搬送システムを用いた形 状によるソーティングのための ニューラルネットワークの回路 化手法	Hiroyuki Watanabe	Neural Network Circuit Integration for Shape-based Sorting by MEMS Conveyance System
小池 卓志	電気二重層キャパシタと DD モ ータを搭載した小型電気自動車 のエネルギー分析と車両運動制 御	Takashi Koike	Energy Analysis and Motion Stabilization using high performance Electric Vehicle powered by Electric Double Layer Capacitors
大西 祐介	筋電信号を用いた車椅子のパワ ーアシスト制御	Yuusuke Oonishi	A New Control Method for Power-assisted Wheelchair based on the Surface Myoelectric Signal
関田 航	系統信頼度マージンを考慮した 地域間連系線 ATC 計算手法に関 する研究	Ko Sekita	A New Evaluation Method of Available Transfer Capability of Tie Lines between Control Areas Considering Power Supply Reliability Margins
安井 遼	高感度複屈折測定を利用した絶 縁材料診断	Ryo Yasui	Insulating material diagnosis based on sensitive birefringence measurement
林 純也	マイクロギャップ中における沿 面放電現象	Junya Hayashi	Surface Discharge Phenomena in Micro Gap
波田 隆	気中数十 cm 級ギャップにおけ るスパークオーバモデルの作成	Takashi Hada	Development of Sparkover Model for Tens of cm-Class Air Gaps
奈良 雅文	マルコフ決定モデルに基づく収 益の期待値と分散を考慮した発 電事業者の最適入札戦略	Masafumi Nara	Optimum Bidding Strategy of Power Producer on the Basis of Markov Decision Model Considering Both Expected Value and Variance of Its Profit
倉持 晃	大気圧非熱平衡プラズマによる 低濃度揮発性有機化合物の分解 -触媒とリアクタの位置関係につ いての検討-	Hikaru Kuramochi	Decomposition of Dilute Volatile Organic Compounds in the Air by the Nonthermal Plasma -Positioning effects of the Catalyst Related with the Plasma-
川路 浩平	知能化空間における人と物の関 係を観測するシステム	Kouhei Kawaji	Intelligent Space Based Human-Object Relations Observation System
王 親和	屋内環境における超音波を用い た複数対象物の同時位置計測手 法	Wang Qinhe	Ultrasonic Based Simultaneous Localization of Multiple Targets in Indoor Environments
矢田 尚	エネルギーの視点からの物質フ ロー分析	Takashi Yada	Material Flow Analysis from the Viewpoint of Energy

桃原 千尋	レーザ誘起蛍光法を用いた大気圧パルスコロナ放電中の準安定準位 N ₂ (A)の挙動観測	Chihiro Toubaru	Identification of metastable N ₂ (A) behavior in atmospheric pressure pulsed corona discharge by using laser-induced fluorescence
速水 智章	能動手法を用いた逆転磁場配位の電流緩和現象の実験的検証	Tomoaki Hayamizu	Active Experimental Study of Current-Profile Relaxations of Field-Reversed Configuration
馬 文静	フローティングゲート MOS 技術を用いたアナログ機能回路	Ma Wenjing	Analog Functional Circuits Employing Floating-Gate MOS Technology
大屋 慎次	マイクログリッドの制御可能電源による系統需給制御への貢献に関する研究	Shinji Oya	A Fundamental Study on Contribution of Controllable Distributed Generators in Microgrid to Power System Frequency Control
布 洋平	高光電変換効率 CMOS イメージセンサのためのフォトダイオード・パターン設計	Yohei Nuno	Design of photodiode patterns for high optical-efficiency CMOS image sensors
濱口 洋平	微細孔垂直内壁測定用光ファイバ内蔵型先端可撓マイクロプローブの作製と評価	Yohei Hamaguchi	Fabrication and evaluation of the optical fiber integrated end warping probe for vertical inner profile of micro structures
西村 崇	高温超電導ケーブルにおける PPLP バットギャップ内の部分放電特性	Takashi Nishimura	Partial Discharge Characteristics of PPLP Butt Gaps in High Temperature Superconducting Cable
太田 泰友	フォトニック結晶ナノ共振器の作製と光電子相互作用制御に関する研究	Yasutomo Ota	Fabrication of Photonic Crystal Nanocavities and Manipulation of Electron Photon Interaction
山根 大輔	導波路/アクチュエータ間のレイヤ分離設計技術による RF-MEMS スイッチ	Daisuke Yamane	An RF-MEMS switch by waveguide/actuator layer-separation designing technique
大和久 崇	不確実な状況下における分散電源のオプション価値分析	Takashi Owaku	A Study on the Option Value of Distributed Generators under Uncertain Situations
鈴木 武海	一定むだ時間を考慮したデュアルサンプリングレートオブザーバの提案と汎用カメラの画像情報に基づくリニア同期モータの状態フィードバック制御	Takeomi Suzuki	A Dual-Sampling-Rate Observer That Considers Dead Time and Feedback Control of a Linear Synchronous Motor - Using Position Signals Provided by a Multi-purpose Camera -
高橋 功	誘電体バリア放電時の沿面ストリーマ進展現象	Isao Takahashi	Surface Streamer Propagation on Dielectric Barrier
武田 敏信	急峻方形波印加時における CF ₃ I のガス中および沿面 V-t 特性	Toshinobu Takeda	V-t characteristics of CF ₃ I gas in gaseous space and on dielectric surface under steep front square pulse voltage application
西川 勝也	マイクログリッドの設計・構築のための解析・評価法の基礎検討	Katsuya NISHIKAWA	Fundamental Research on Analysis and Evaluation Methods for Design and Construction of Microgrid
鈴木 公三	銀シース BSCCO 線材を用いた動作開始電流値調整可能な配電系統用限流器の基礎検討	Kozo Suzuki	Fundamental considerations of an SFCL with adjustable trigger current level for distribution lines by use of Ag sheathed BSCCO wire

原 和弘	列車運行乱れ時の因果律を考慮した乗客流推定に基づく運転整理システムにおける整理案の効率的評価・適用法	Kazuhiro Hara	Efficient Algorithms for Evaluating and Implementing Rescheduling Plans for Train Rescheduling System using Simulations of Passenger Flow Considering the Causality During Disordered Operation
高木 隆志	有効・無効電力注入による電力系統過渡安定度向上効果の比較に関する基礎検討	Takashi Takagi	Comparative Study on Improvement of Power System Transient Stability by Injecting Active/Reactive Power
齋藤 悠也	水素-空気混合気の放電着火過程における OH ラジカル密度および温度の二次元分布計測	Yuya Saito	Two Dimensional Measurement of OH Radical Density and Temperature in Spark Ignited Hydrogen-Air Mixture
鳥巢 大輔	印刷技術による MEMS 黒板型ディスプレイの製作	Daisuke Tosu	Fabrication of MEMS Blackboard Type Display by Printing Technology
中山 啓之	フォトルミネッセンス法を用いた CuIn(S,Se) ₂ 太陽電池の評価	Nakayama Hiroyuki	Photoluminescence Characterization of CuIn(S,Se) ₂ Solar Cells

電子情報学専攻

氏名	論文題目	Name	Title
中尾 一貴	PC クラスタを用いた大規模距離データの並列統合	Kazutaka Nakao	A parallel method for integrating a large number of range images with PC clusters.
センデハス サマノ バ デ イム ヘフテ	時間情報を用いた Eメールの分類	Vadim Jefte Zendejas Samano	Using Time in Email Classification
ネビアロス カヤ アレナ	AffectIM : テキストからのルールに基づく感情抽出を用いるアバター付きインスタントメッセージング・システム	Alena Neviarouskaya	AffectIM: An Avatar-based Instant Messaging System Employing Rule-based Affect Sensing from Text
オラナット セーラッタ ナシャイクン	電子タグを用いた測位基盤における位置同定とプライバシーに関する研究	Oranat Sangratanachaikul h	Localization and Privacy Issues in RFID-Based Reference Point Systems
島田 健太	ノードのモビリティを利用したロバストなジオキャストプロトコルに関する研究	Shimada Kenta	A Study on Robust Geocast Protocol Using Node Mobility
北田 亘	識別子の特徴を考慮した識別子利用暗号の拡張に関する研究	Wataru Kitada	A Study on the Enhancement of Encryption Schemes with Identifiers Regarding Their Properties
堀口 研一	運転状況を考慮した脇見推定手法	Kenichi Horiguchi	Detection of Inattentive Driving by Fusing Multiple Observation Cues
近藤 雄飛	カテゴリ共起を考慮した物体認識手法	Yuhi Kondo	Using the Co-occurrence of Multiple Categories for Object Recognition
松田 隆宏	衝突困難ハッシュ関数を用いない電子署名に関する研究	Takahiro Matsuda	A Study on Digital Signatures without Collision Resistant Hash Functions
肥後 智昭	二色性反射モデルに基づく反射の解析	Tomoaki Higo	Reflection Analysis Based on Dichromatic Reflection Model

辻下 卓見	制約付クラスタリングを用いた適合性フィードバックに関する研究	Takumi Tsujishita	Relevance feedback using constrained clustering
倉沢 央	文書情報を利用した P2P 情報検索の効率化に関する研究	Hisashi Kurasawa	A Study to Improve Peer-to-Peer Information Retrieval Schemes Using Document Features
木間 俊宏	画像センサを用いた路車間協調システムに関する研究	Konoma Toshihiro	A Study on Vehicle Infrastructure Interaction based on Image Sensing Technology
Pierre Devautou	分散された内部コンフィギュレーション・メモリ・アクセス・ポートを持つ	Pierre Devautou	分散された内部コンフィギュレーション・メモリ・アクセス・ポートを持つ
蔣 声宇	相互作用のあるボース・アインシュタイン凝縮に関する研究	Jiang Shengyu	Study of Bose-Einstein condensation in an interacting bose gas
木村 翔	可視光通信プロジェクタを用いた映像とのインタラクションに関する研究	Sho Kimura	A Study on Interaction with Projected Images using Pixel-Level Visible Light Communication Projector
岡嶋 穰	語の出現予測によるテキスト分類のための複合素性の獲得	Yuzuru Okajima	Compound Feature Extraction for Text Categorization based on Term Occurrence Prediction
陳 ルル	影を伴う映像からの教師無し多様体学習による形状復元	Lulu Chen	Manifold-Based Photometric Stereo with Cast Shadows
楠戸 健一郎	2次元格子系における金属—モット絶縁体相転移に関する研究	Kenichiro Kusudo	A study for the metal Mott insulator transition in 2DEG lattice system
グエン フォン ヴ	ネットワークコーディングによる無線メッシュネットワークの効率向上に関する研究	Nguyen Vu Phong	A Study on Efficiency Improvement of Wireless Mesh Networks using Network Coding
廣瀬 健一郎	動作時信号遷移監視に基づく遅延補償フリップフロップの研究	Kenichiro Hirose	Delay-Adaptation Flip-Flops Featuring In-Situ Signal-Transient Monitoring
ファン ティラン アン	補助鍵を用いた鍵隔離公開鍵暗号方式	Phan Thi Lan Anh	Using Auxiliary Helper Key in Key Insulated Public Key Encryption
デゲル エルハン	EMD に基づく閾値操作による低歪み雑音除去	Erhan Deger	Noise-Thresholding with Empirical Mode Decomposition for Low Distortion Speech Enhancement
蔡 昌	勾配方向のフローに基づく対象の動きの検出	Cai Ting	Motion Detection Using Gradient Direction Flow
落合 秀也	広域センサネットワークの運用構造と多属性検索の実現	Hideya Ochiai	Operating Architecture and Multi-Attribute Search for Wide Area Sensor Networks
一林 宏憲	逆 Dualflow アーキテクチャ	ICHIBAYASHI Hironori	Anti-Dualflow Architectureh
関谷 岳史	ヘテロな分散環境用 make の実装と大規模自然言語処理ワークフローの実行	Takeshi Sekiya	Implementation of Make for Heterogeneous Distributed Environments and Execution of Large-scale Workflow of Natural Language Processing
渡辺 憲一	プロセッサ・シミュレータ「鬼斬式」の設計と実装	Kenichi Watanabe	The Design and Implementation of Processor Simulator "Onikiri2"
唐門 準	社会ネットワークマイニングのためのネットワーク構造を用いた属性生成に関する研究	Jun Karamon	A Study on Generating Network-based Features for Mining Social Networks

亙理 靖展	ツインテール・アーキテクチャにおけるハーフパンプ FU アレイ	Yasuhiro Watari	Half-pumped FU array of Twin-tail Architecture
塩谷 亮太	回路面積指向レジスタ・キャッシュ	Ryota Shioya	Area-Oriented Register Cache
フェレイラ レボルダオ、 アントニオ ルイ	涛立成分分析と音声区間検出による雑音除去	Antonio Rui Ferreira Rebordao	An adaptive Speech Denoising System based on ICA with Voice Activity Detection
中田 貴之	対象の値動きの方向性に着目した経済時系列予測へのサポートベクターマシンの応用に関する研究	Takayuki Nakata	Research regarding the Application of Support Vector Machines to Predict the Direction of Price Changes in Economic Time Series
平井 遙	データベース問合せ処理を意識したディスクアレイ省電力化に関する研究	Haruka Hirai	A Study on Power Saving Methods of Disk Arrays for Database Systems
蓑津 真一郎	ロボット・プレゼンテーションエージェントの音声インタラクティブ性向上の研究	Minotsu Shinichiro	A Study on the Improvement in Voice Interactivity for Robot and Presentation Agent
木村 英雄	アドホックネットワークにおける位置情報を用いたルーティング手法に関する研究	Hideo Kimura	A Study on Routing Method using Location Information for Ad Hoc Networks
篠田 知宏	番組検索音声対話システムにおけるユーザの知識を考慮した応答生成	Tomohiro Shinoda	Generation of reply using user's knowledge in spoken dialogue system of TV-program retrieval
賈 洪光	災害時の非接続アドホック・ネットワーク環境におけるコンテンツ・デリバリ・アーキテクチャ	Hongguang Jia	Contents delivery architecture for disconnected adhoc networks in disaster case
ナジャンド アリ	文節境界を利用した統計的言語モデルの改良と話し言葉コーパスへの適用	Ali Najand	Improvement of Statistical Language Modeling Using Bunsetsu Boundaries with its Application to Corpus of Spontaneous Japanese
福島 健一	日本語固有表現抽出におけるコーパスから自動獲得した知識の利用	Ken'ichi Fukushima	Use of Knowledge Automatically Acquired from Corpora in Japanese Named Entity Recognition
勝沼 聡	SWIFT: 文字列ごとの情報フロー追跡手法	Satoshi Katsunuma	SWIFT: String-Wise Information Flow Tracking
ナリノ メン ドザ ホアン パブロ	条件付き確率場による音声認識のための音響モデルの改良	Juan Pablo Narino Mendoza	Improvements to acoustic modeling using hidden conditional random fields for automatic speech recognition
天野 翔	さまざまな実物体をユーザインタフェースに転用するための動的ひずみ計測応用システムの研究	Sho Amano	A Study on Application System of Dynamic Strain Measurement for Utilizing Real Objects as User Interfaces
西村 康孝	アドホックネットワークにおけるスループット改善に関するMACプロトコルの研究	Nishimura Yasutaka	A Study on MAC Protocol for Throughput Improvement in Ad Hoc Network
吉田 慎一郎	言語横断的な Web ニュース記事の関連付け	Shinichiro Yoshida	Cross-Lingual Linking of Web News Articles

高橋 慧	分散環境での Stable なブロードキャストアルゴリズムの提案と実装	Kei Takahashi	A Stable Broadcast Algorithm for Distributed Environments and Its Implementation
三輪 周作	学習者の音声で矯正フィードバックする英語発音教育システム	Shusaku Miwa	A CALL system for English pronunciation training with corrective feedback inh
坂本 祥吾	並列計算の通信パターン設計を支援する, より高速なトポロジ推定	Shogo Sakamoto	A Faster Topology Inference for Supporting Communication Pattern Design of Parallel Computing
稲垣 貴彦	話し言葉音声認識における韻律的特徴を用いたフィルター検出	Takahiko Inagaki	Detection of filled pauses using prosodic features in spontaneous speech recognition
王 智勇	ラベルスイッチングを用いたコンテンツ指向フォワーディング手法の提案と実装	Zhiyong Wang	Contents Based Forwarding Using Label Switching
上田 健介	適応的なインテグラルフォトグラフィによる自由視点画像合成に向けた可変焦点レンズアレイの研究	Kensuke Ueda	A Study on Variable Focus Lens Array for Free-Viewpoint Image Synthesis Based on Adaptive Integral Photography
鄭 容朱	ウェブスパムの境界抽出手法に関する研究	Chung Young joo	A Study of Methods for Extracting the Boundaries of Web Spam

電子工学専攻

氏名	論文題目	Name	Title
陳 雋	画像の特徴表現を生成するパルス結合ニューラルネットワークのアナログ VLSI 実装	Jun Chen	An Analog VLSI Implementation of Pulse-Coupled Neural Networks for Image Feature Generation
清水 俊匡	AIN/GaN 量子井戸サブバンド間遷移全光スイッチの低パワー動作に向けた導波路の改善	Toshimasa Shimizu	Improvement of Waveguide Structure for Low-Power Operation of AIN/GaN Quantum-Wells Intersubband-Transition All-Optical Switch
勝井 秀一	光照射 STM による InAs 細線構造での光誘起信号の選択的測定	Shuichi Katsui	Selective Measurements of Photo-induced Signals on InAs Wire Structures by STM under Light Illumination
中邨 勉	柔軟構造を有する人工衛星の高速姿勢変更のための制御手法	Tsutomu Nakamura	Feedback-Based Control Design for Agile Satellite with Flexible Structures
金森 毅	方向性画像エッジ情報を用いた手指状態認識システム	Takeshi Kanamori	A Hand Posture Recognition System Based on Directional Edge Information
ファン ハイ ディン ミン	整数線形計画法によるキャラクタプロジェクション電子ビーム直接描画技術のショット最適化	Pham Hai Dinh Minh	Shot minimization for Character Projection Electron Beam Direct Writing based on Integer Linear Programming
出浦 桃子	III/V 族化合物半導体 MOVPE における界面急峻化に向けた表面 in situ 観察と速度過程解析	Momoko Deura	In situ surface observation and kinetic analysis for abrupt hetero-interfaces in MOVPE of III/V compound semiconductors
安藤 大介	システムレベル設計記述に対する記述誤り発見と性能見積りのための静的解析手法	Daisuke Ando	Static Analysis Methods for Design Error Detection and Performance Estimation of System-Level Designs

田中 俊輔	近接場光顕微鏡による量子ドット間の単一光子励起移動の観測	Shunsuke Tanaka	Observation of Single-Photon Excitation Energy Transfer between Quantum Dots using the Near-Field Microscope
ラデンアマド ダムリ	アンテナ素子間の結合効果を利用する高効率アレイアンテナの研究	Damri Radenamad	Research on highly efficient array antennas using coupling effect between antenna elements
ジャーネル バシチ	電流モードピクセル回路による背景光除去機能付 CMOS イメージセンサ	Caner Basci	CMOS Image Sensor For Ambient Light Suppression by means of Current-Mode Pixel Circuit
王 瑤	室内マルチオブジェクトに対応した空間的位置同定 LSI に関する研究	YAO WANG	A Study on Indoor Multi-Object Position Identification LSI
石川 悠司	オートマトンのグラフ探索に基づく実用的オンチップ通信プロトコル変換器合成手法	Yuji Ishikawa	Synthesis of practical transducer for on-chip communication protocols based on graph exploration of protocol automata
松本 忠久	ケルビンプローブフォース顕微鏡での局所電位計測における操作性・信頼性の向上に関する研究	Tadahisa Matsumoto	Study on Improvements in Operation Performance and Reliability of Kelvin Probe Force Microscopy for Local Potential Measurements
荻原 崇	フォトルミネッセンス法によるシリコン結晶の高濃度不純物定量に関する研究	Takashi Ogihara	Study on the Photoluminescence Method for Quantitative Analysis of High Concentration of Impurities in Si
高橋 啓介	三次元構造トランジスタにおける基板バイアス効果の検討	Keisuke Takahashi	Study of Body Effect in Transistor with Three-Dimensional Structure
丁 亨洙	ナノフォトニックデバイス開発のための ZnO 量子ドットの合成および量子ドット間エネルギー移動の観察	Hyungsu Jeong	Synthesis of ZnO Quantum Dots and Observation of Energy Transfer for Development of Nanophotonic Devices
宮本 喜生	超広帯域インパルス無線通信用送信回路の低消費電力化	Yoshio Miyamoto	Low Power Ultra-Wide-Band Impulse Radio Transmitter VLSI Circuits
新山 太郎	電源電圧 0.3V に向けた超低消費電力ロジック LSI に関する研究	Taro Niiyama	Research on Ultra Low Power Logic VLSI Circuits Design toward 0.3V Power Supply Voltage
垂水 規泰	ビスマス系エルビウムドーパファイバ/導波路を用いたレーザに関する研究	Noriyasu Tarumi	Research on Lasers using Bismuth-Based Erbium-Doped Fiber/Waveguide
李 蓮福	既存設計の再利用を考慮した SoC の仕様記述手法と上位設計方法論	Yeonbok Lee	Specification Description and High-level Design Methodology of SoC Considering Design Reuse
金間 泰樹	伸張歪多重量子井戸をもちいた偏波無依存多モード干渉双安定半導体レーザーによる全光フリップフロップの研究	Yasuki Kanema	Study on Polarization-Insensitive MMI-BLD All-Optical Flip-Flop with Tensile-Strained MQW Structure
金 雄鉉	連想プロセッサによる三次元データモデリング手法	WoongHyeon KIM	3D Data Modeling Method for Associative Processor
田辺 聡	GOI(Ge-On-Insulator)pMOSFET チャネルにおける正孔輸送特性の評価	Satoshi Tanabe	Hole transport properties in GOI(Ge-On-Insulator)pMOSFET

栗原 健一郎	光学的パターン転写工程におけるばらつきを考慮したセルの歩留り評価手法	Kenichiro Kurihara	Yield Modeling of CMOS Cell Layout for Optical Lithography Considering Process Variation
高野 恭弥	ワイヤレスセンサネットワーク用極低消費電力 CMOS 無線回路に関する研究	Kyoya Takano	Study on Ultra Low Power CMOS Wireless Circuit for Wireless Sensor Networks
高橋 祐二	不純物を導入したシリコン微結晶を有するナノクリスタルメモリの特性評価	Yuji Takahashi	Characterization of Nanocrystal Memory with Impurity doped Silicon Nanocrystals
竹中 聡	二重障壁共鳴トンネル構造を用いた高感度光検出	Satoshi Takenaka	High-sensitivity photodetection using double barrier resonant tunneling structures
広瀬 展明	水および水溶液のテラヘルツ分光手法に関する研究	Nobuaki Hirose	High-sensitivity photodetection using double barrier resonant tunneling structures
山城 遼	レーダ位相画像からの三次元形状推定のための位相アンラッピングと位相特異点除去手法に関する研究	Ryo Yamaki	A study on phase unwrapping and phase singularity elimination for geometry estimation from radar interferograms
都木 宏之	単一量子ドットの光電流分光測定とコヒーレント制御の研究	Hiroyuki Takagi	Photocurrent Spectroscopy and Coherent Control in Single Quantum Dot
山本 巧	ナノフォトニックデバイスの為の金微粒子を用いた InAs 量子ドットの光学特性制御	Takumi Yamamoto	Control of Optical Properties of InAs Quantum Dots Using Au Particles for Nanophotonic Devices
金 時煥	差分方向性エッジ画像に基づく物体追跡のための VLSI ハードウェア・アルゴリズム	Sihwan Kim	A VLSI Hardware-Compatible Algorithm for Object Tracking Based on Differential Directional-Edge Images
宮坂 啓	低電圧微小ギャップ静電気放電特性	Hiraku Miyasaka	Electrostatic Discharge Characteristics between Small Gap with Small Voltage Difference
馬 奕涛	K-means 学習プロセッサシステムのためのマルチチップアーキテクチャ	Yitao Ma	A Multiple-Chip Architecture for K-means Learning Processor Systems
原田 智之	強磁性金属 MnAs からのシリコン MOS 反転層へのスピン注入とその電氣的検出	Tomoyuki Harada	Electrical detection of carrier spin injected into a Si MOS inversion layer from ferromagnetic MnAs
朴 鐘臣	可動ゲートを導入したシリコン極狭細線型 MOSFET および室温動作単電子トランジスタに関する研究	Park Chongsin	Silicon MOSFET and single-electron transistors with movable gate electrode
小西 正俊	光波コヒーレンス関数の合成法による光リフレクトメトリの高性能化とセンシング応用	Masatoshi Konishi	Improvement and sensing application of optical coherence domain reflectometry by synthesis of optical coherence function
梶原 康嗣	光波コヒーレンス関数の合成法による長尺ファイバブラッググレーティングのブラッグ波長分布測定システム	Koji Kajiwara	System for Measuring Bragg Wavelength Distribution in a Long-length Fiber Bragg Grating by Synthesis of Optical Coherence Function.
北原 邦紀	相互情報量に修飾された自己組織化マップによる概念構築	kunio kitahara	concept generation based on mutual information between multiple self organising maps

基盤情報学専攻

氏名	論文題目	Name	Title
アランニャ クラウド	多目的遺伝的計算を用いたポートフォリオ管理の取引料モデルにかんする研究	Claus Aranha	Portfolio Management with Cost Model Using Multi Objective Genetic Algorithms
斎藤 大	大規模テキストコーパスを対象にした対訳テキスト抽出の高速化	Dai Saito	Improving Efficiency of Parallel Text Extraction from Large Scale Text Corpora
松原 寛	GeO ₂ /Ge MOS 界面の高品質化と低温コンダクタンス法による界面特性評価	Hiroshi Matsubara	Study on Improvement of Interface Properties of GeO ₂ /Ge MOS Structures
藤原 直弘	無線 LAN VoIP ハンドオーバー時における最適 AP 選択手法の検討	Naohiro Fujiwara	A Method for Managing Handoff for Keeping Speech Quality of VoIP over Wireless LAN
鎌田 圭	音声の構造的表象に基づく英語発音評価システムの実用化に関する研究	Kei Kamata	A study for practical use of computer-aided pronunciation training
ダオ ヴィン ニン	ハンドヘルドプロジェクトに関するリアルタイム補正テクニック	Dao Vinh Ninh	Realtime Calibration Techniques for a Handheld Projector
森屋 大輔	柔軟な画像識別システムのための方向性エッジの分布に基づく特徴ベクトル表現	Moriya Daisuke	Feature Vector Representations based on Directional Edge Distribution for Flexible Image Discrimination Systems
高田 友則	低レート DoS 攻撃と反射型 DoS 攻撃に対応した改良型 ICMP Traceback	Tomonori Takada	An Enhanced ICMP Traceback against Low Rate DoS Attack and Reflector based DoS Attack
仁木 祐介	画面時間差分情報の膨張処理を用いたアナログ動体検出 VLSI システム	Yusuke Niki	An Analog Moving-Object-Localization VLSI System Employing OR-Amplification of Pixel Activities
櫻井 覚	DNS の IPv6 対応に関する考察	Satoru Sakurai	Considerations of supporting IPv6 in DNS
永井 貴博	POWER 5 アーキテクチャにおける積和演算命令に基づく高速 4 倍精度演算に関する研究	Takahiro Nagai	A Study on the Fast Quadruple Precision Arithmetic Using Fused Multiply-Add Instruction on POWER 5 Architecture
石田 繁巳	多段ウェイクアップ型無線通信方式の設計と評価	Shigemi ISHIDA	A Design and Evaluation of Wireless Communication Formula using Multi-Step Wake-Up Scheme
アピラックウ イリヤ、ウィ ッターヤ	無線センサネットワークにおける情報収集に適した通信プロトコルに関する研究	APIRAKVIRIYA, WITTAYA	A Research on Communication Protocol for Information Gathering over Wireless Sensor Networks
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キム ドンミ ン	表面波プロセスプラズマを用い た負の直流バイアス電圧印加に よるカーボン系薄膜合成	Dongmin Kim	Synthesis of Carbon Films with Applying Negative DC Bias Voltages in Surface Wave excited Plasma CVD Apparatus

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