Advance Program

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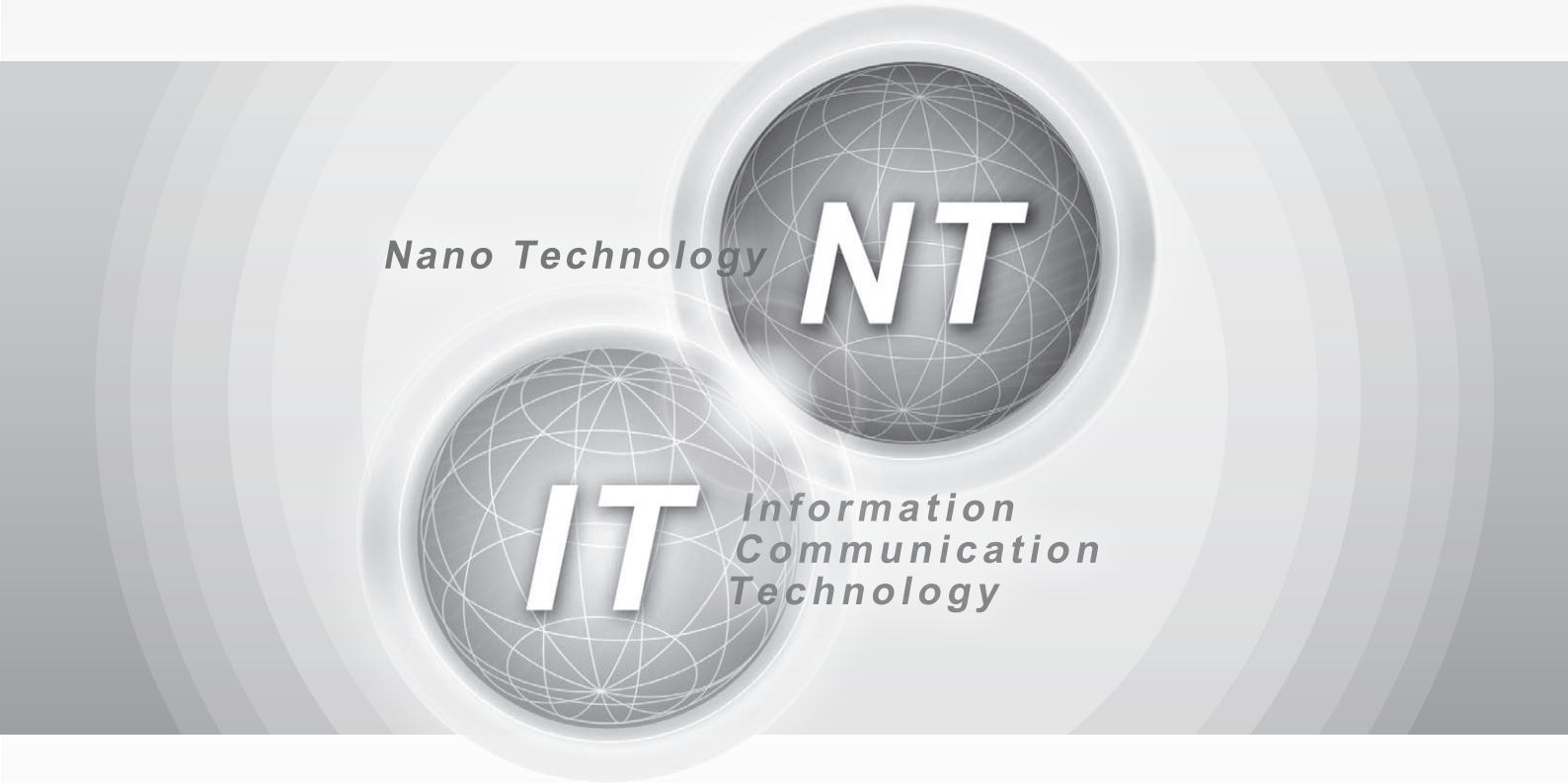
Center of Education and Research for Information Electronics Systems Tohoku University



The 4th International Symposium on Information Electronics Systems

July 7-8, 2010
Sendai Excel Hotel Tokyu 3F, Sendai, Japan
http://www.ecei.tohoku.ac.jp/gcoe/

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The 4th International Symposium on Information Electronics Systems

Program at a Glance

July 7-8, 2010 at Sendai Excel Hotel Tokyu, Sendai, Japan

Wednesday, July 7 Ball A

9:00–9:20		**Opening Session**	**Chair: Naofumi Homma**
		Opening Remarks	Nei Kato (Organizing Committee Chair)
		Welcome Address	Fumiyuki Aadachi (GCOE Director)
9:20–10:40	**Session 1**	**Intelligent Signal Processing**	**Chair: Naofumi Homma**
9:20–10:10	**1–1(Invited)**	The Use of Sinusoidal Illumination for Optical Super-Resolution and Depth Estimation	Panos Papamichalis, USA (Southern Methodist Universitv)
10:10–10:40	**1–2**	High-Accuracy Machine Vision Technology Using Sub-Pixel Image Matching – From 3D Vision to Medical Image Analysis –	Takafumi Aoki
10:40–11:10		**Break**	
11:10–12:30	**Session 2**	**Acoustic Technologies and Systems**	**Chair: Yukio Iwaya**
11:10–12:00	**2–1(Invited)**	An Objective Quality Assessment Model of Multi-Channel Audio Coding Systems	Koeng-Mo Sung, Korea (Seoul National University)
12:00–12:30	**2–2**	Development of Acoustic Systems Realizing Communications with High Sense-of-Presence	Yôiti Suzuki
12:30–13:30		**Lunch**	
13:30–15:20	**Session 3**	**Nano Technologies and Devices**	**Chair: Toshiro Kaneko**
13:30–14:20	**3–1(Invited)**	Strategy of Carrier Control of Carbon Nanotube Transistor	Young Hee Lee, Korea (Sungkyunkwan University)
14:20–14:50	**3–2**	Green-Nanoelectronics Oriented Nanoscopic Plasma Control	Rikizo Hatakeyama
14:50–15:20	**3–3**	Anodic Titanium Oxide Nanotube Film: Formation and Application to Dye-Sensitized Solar Cells	Michio Niwano
15:20–15:50		**Break**	
15:50–16:50	**Session 4**	**Measurement and Inference Strategies**	**Chair: Yuji Ohashi**
15:50–16:20	**4–1**	Development of Super-Precise Ultrasonic Method and System for Measuring Zero-CTE Temperature of TiO_2–SiO_2 Ultra-Low-Expansion Glasses	Jun-ichi Kushibiki
16:20–16:50	**4–2**	Statistical Inference and Learning Theory in Image Processing	Kazuyuki Tanaka
16:50–18:10		**Poster Session**	**Ball B**
18:10–20:10		**Banquet**	**Ball A**

Thursday, July 8 Ball A

9:00–10:20	**Session 5**	**Photonic Devices and Quantum Information**	**Chair: Hideo Kosaka**
9:00–9:50	**5–1(Invited)**	Managing Multipartite Entanglement Using Photons	Nobuyuki Imoto, Japan (Osaka Universitv)
9:50–10:20	**5–2**	Advanced Entangled Photon Sources	Keiichi Edamatsu
10:20–10:50		**Break**	
10:50–11:50	**Session 6**	**Wireless/Optical Communications and Networks**	**Chair: Toshihiko Hirooka**
10:50–11:20	**6–1**	Broadband Distributed Antenna Network and Its Related Wireless Techniques	Fumiyuki Adachi
11:20–11:50	**6–2**	Challenges to Ultra-Multi Level QAM Coherent Optical Transmission	Masataka Nakazawa
11:50–13:00		**Lunch**	
13:00–14:20	**Session 7**	**Next Generation Communication Networks**	**Chair: Hiroki Nishiyama**
13:00–13:50	**7–1(Invited)**	Protocol Design and Optimization for Next Generation Ubiquitous Networks	Lin Cai, Canada (University of Victoria)
13:50–14:20	**7–2**	Reliable Application Layer Multicast over Heterogeneous Networks	Nei Kato
14:20–14:50		**Break**	
14:50–17:00	**Session 8**	**Advanced Storage and Circuit Technologies**	**Chair: Simon J. Greaves**
14:50–15:40	**8–1(Invited)**	The Quest for Tbits/in^2 : Understanding and Manipulating Nanoscale Magnetism	Tom Thomson, UK (University of Manchester)
15:40–16:10	**8–2**	Future Foresight and Today's Struggle in High Density Information Storage	Hiroaki Muraoka
16:10–17:00	**8–3(Invited)**	Power Management for VLSIs – a Power Electronics Perspective	Wai Tung Ng, Canada (University of Toronto)
17:00–17:10		Closing Session	**Ball A**
		Closing Remarks	Nei Kato (Organizing Committee Chair)

Opening Session & Session 1 (Ball A) Wednesday, July 7th, 9:00-10:40

9:00 Opening Session

Intelligent Signal Processing

9:20 1-1

The Use of Sinusoidal Illumination for Optical Super-Resolution and Depth Estimation

Panos Papamichalis, Southern Methodist University, USA

Scenes captured by a digital camera are subject to constraints imposed both by the camera optics and the sampling density of the digital sensor. Regardless of the sampling density, the camera optics limit the bandwidth of the analog image projected on the sensor, because of diffraction. This presentation investigates how illuminating the scene with sinusoidal patterns can help retrieve frequencies beyond the diffraction limit. The mathematical formulation reveals the appropriate positioning of the projector and the camera to achieve this for the different projected patterns. The same formulation also shows how depth information can be retrieved from the same set-up.

10:10 1-2

High-Accuracy Machine Vision Technology Using Sub-Pixel Image Matching - From 3D Vision to Medical Image Analysis -

Takafumi Aoki, Tohoku University

This paper presents fundamentals of Phase-Only Correlation (POC) --- a technique for high-accuracy registration of 1D, 2D and 3D signals using phase information of discrete Fourier transform. Since 1990s, our research group has developed a novel technique of phase-based image matching for fingerprint verification and industrial machine vision. We have recently proposed an efficient image correspondence algorithm using POC, which can find pairs of corresponding points between the given two images with sub-pixel accuracy. This allows us to apply the POC technique to a wide range of applications, including smart image sensors, microscope image analysis, passive 3D vision, automotive image processing, image-based human interface, biometrics authentication, and medical image analysis.

10:40-11:10 Coffee Break

Session 2 (Ball A) Wednesday, July 7th, 11:10-12:30

Acoustic Technologies and Systems

11:10 2-1 **An Objective Quality Assessment Model of Multi-Channel Audio Coding Systems**

Koeng-Mo Sung, Seoul National University, Korea

In the quality assessment of multi-channel audio coding systems, both timbral and spatial quality should be considered. Since conventional objective assessment algorithms for monaural or stereo signal measure only timbral quality in general, it is inadequate to assess multi-channel audio coding systems. This paper introduces four spatial measures that estimates human's nonlinear behaviors on perceived directions of sound sources. Combining the proposed spatial measures with the timbral measures, the proposed objective model of multi-channel audio coding systems achieves an outstanding performance in the prediction of subjective assessment standards, ITU-R Recommendation BS.1116-1 and BS.1534-1.

12:00 2-2 **Development of Acoustic Systems Realizing Communications with High Sense-of-Presence**

Yôiti Suzuki, RIEC, Tohoku University

Realization of communications with a high sense-of-presence necessitates development of systems based on knowledge related to human hearing and multi-modal perceptual processing. Therefore, three-dimensional (3D) sound localization recognition is examined as multi-modal perceptual processing based on hearing and on self-motion perception. A spherical array comprising 252 microphones was developed for comprehensive recording of a 3D sound field.

A 3D sound reproduction system implemented with a 157-loudspeaker array based on higher-order Ambisonics is combined with a 3D projection display to reproduce high-definition audio-visual information. This developed system is useful to improve understanding of human audio-visual perception.

12:30-13:30 Lunch Break

Session 3 (Ball A) Wednesday, July 7th, 13:30-15:20

Nano Technologies and Devices

13:30 3-1

Strategy of Carrier Control of Carbon Nanotube Transistor

Young Hee Lee, Sungkyunkwan University, Korea

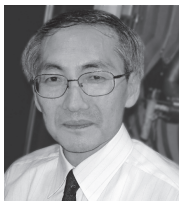
Nanocarbons such as fullerenes, carbon nanotubes, carbon nanofibers, graphite oxides, and graphenes has been the key words in 21th century and has led nanoscience and nanotechnology. Due to the various allotropes of carbons, unexpected scientific new findings and their related applications have been extensively investigated. In this seminar, I will discuss various issues mainly related to their applications to energy area and electronic devices. Pure carbon nanotubes have been known to exhibit ambipolarity. This is very different from the conventional semiconductors that are controlled by an intentional doping with extrinsic materials. The ambipolarity has been a serious drawback in adopting carbon nanotubes for CMOS technology. Carbon nanotubes show p-type behavior in ambient conditions. The difficulty arises from the absence of stable n-type dopants in ambient conditions. A series of chemical approaches have been done in our group to search for n-type dopants. NADH and viologen molecules have demonstrated successfully to show n-type behavior by donating electrons to nanotubes and furthermore show high stability in ambient conditions.[1-5] In addition to these approaches, we will also demonstrate a way of utilizing ambipolarity of nanotuibes without such intentional dopings that ambipolarity is in fact advantageous in fabricating CMOS inverter and logic circuits.[6] I will also discuss a new route of graphene synthesis and the related applications.[7,8]

[1] K. Kim et al., J. Am. Chem. Soc. 130, 12757-12761 (08).
[2] S. M. Yoon et al., J. Am. Chem. Soc. 130, 2610-2616 (08).
[3] H. J. Shin et al., J. Am. Chem. Soc. 130, 2062-2066 (08).
[4] S. M. Kim et al., J. Am. Chem. Soc. 131, 327-331 (09).
[5] B. R. Kang et al., Adv. Func. Mat. 19, 2553-2559 (09).
[6] W. J. Yu et al., Nanolett. 9, 1401-1405 (09).
[7] S. J. chae et al., Adv. Mat. 21, 2328 (09).
[8] H. K. Jeong et al., ACS NANO 4, 1162 (10).

14:20 3-2

Green-Nanoelectronics Oriented Nanoscopic Plasma Control

Rikizo Hatakeyama, Tohoku University



In this report, our emphasis is placed on green information-electronics nanodevices of carbon nanotubes (CNTs) synthesized and functionalized by nanoscopic plasma process control. Firstly, the single-walled carbon nanotubes (SWNTs) growth from nonmagnetic catalysts is successfully realized by diffusion plasma CVD toward a study on novel nano-magneticsemiconductor properties. Secondly, a photovoltaic phenomenon is observed when pn junctions based on fullerene encapsulated SWNTs are illuminated by lights in the infrared region, which is expected to make for a new concept of solar nanocells. Thirdly, when biomolecule DNA is encapsulated inside CNTs, their semiconducting transport properties are found to be versatilely controlled depending on the DNA bases which own different ionization (or redox) potentials.

14:50 3-3

Anodic Titanium Oxide Nanotube Film: Formation and Application to Dye-Sensitized Solar Cells

Michio Niwano, RIEC, Tohoku University

Anodization of titanium in electrolyte is a promising method for fabrication of titanium oxide (TiO_2) nanotubes. For the application of TiO_2 nanotubes to the negative electrode of a dye-sensitized solar cell (DSC) we need to form a TiO_2 nanotube film directly on a TCO layer. It is important for the formation of such a TiO_2 nanotube film to elucidate and control on the nanometer scale the anodization process of titanium that would be greatly influenced by the electrolyte. In the present study, therefore, we have investigated the influence of constituents of the electrolyte on the anodization process.

15:20-15:50 Coffee Break

Session 4 (Ball A) Wednesday, July 7th, 15:50-16:50

Measurement and Inference Strategies

15:50 4-1

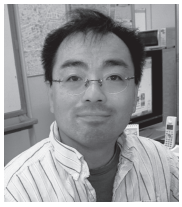
Development of Super-Precise Ultrasonic Method and System for Measuring Zero-CTE Temperature of TiO_2-SiO_2 Ultra-Low-Expansion Glasses

Jun-ichi Kushibiki, Tohoku University

Ultra-low-expansion (ULE) glasses having a zero-CTE (coefficient of thermal expansion) around desired temperatures are required for basic substrate materials for optical components in extreme ultraviolet lithography (EUVL) systems as well as in an ultrahigh-finesse optical cavity for the next-generation frequency standard. TiO_2-SiO_2 glass is the most suitable candidate. It is well-known that commercial ULE glasses contain periodic variations in TiO_2 concentration (namely striae) formed during the glass fabrication process, so that there must exist some CTE distributions and some deviations of zero-CTE temperature, T(zero-CTE), from desired temperatures. This is a serious problem for the optical applications.

In this paper, we developed a practical method and system for super-precise evaluation of T(zero-CTE) of TiO_2-SiO_2 glasses using our ultrasonic micro-spectroscopy (UMS) technology with a resolution of 0.4°C at 225 MHz. We applied the system to realize a glass ingot with T(zero-CTE) around 25°C by controlling fictive temperature TF of the glass ingots homogenized by the zone-melting method.

16:20 4-2



Statistical Inference and Learning Theory in Image Processing

Kazuyuki Tanaka, Tohoku University

We review some practical schemes of Bayesian network to probabilistic image processing. Our algorithms are based on the statistical sciences and statistical-mechanical informatics. Particularly, we explain some statistical learning algorithms based on belief propagation methods. Moreover, we explore some recent developments in statistical performance estimation methods. We apply the statistical performance estimations to new statistical learning algorithms of statistical models from massive vision data.

16:50-18:10 Poster Session (Ball B)

18:10-20:10 Banquet (Ball A)

Session 5 (Ball A) Thursday, July 8th, 9:00-10:20

Photonic Devices and Quantum Information

9:00 5-1 **Managing Multipartite Entanglement Using Photons**

Nobuyuki Imoto, Osaka University, Japan

Entanglement is one of the most bizarre properties in quantum mechanics and is an essential resource for quantum information processing. It is difficult to create a large scale entanglement and also difficult to protect it from noisy circumstance. It is possible, however, to enlarge an entanglement network with a simple scheme and protect it from decoherence using DFS (decoherence-free subspace). Once we create multipartite entanglement, we can utilize it for several tasks such as one-way computing and joint weak measurement by entangling the meters. I report our recent experiments using photons.

9:50 5-2 **Advanced Entangled Photon Sources**

Keiichi Edamatsu, RIEC, Tohoku University

Entanglement is one of the key resources in the quantum information technology. We present our recent activities to develop advanced sources of entangled photons, by use of extended phase-matching and waveguide devices.

10:20-10:50 Coffee Break

Session 6 (Ball A) Thursday, July 8th, 10:50-11:50

Wireless/Optical Communications and Networks

10:50 6-1

Broadband Distributed Antenna Network and Its Related Wireless Techniques

Fumiyuki Adachi, Tohoku University

To realize communications with high sense of presence everywhere, broadband wireless technology which can achieve higher-than-1Gbps data transmission with extremely low transmit power is indispensable. We have been studying the broadband distributed antenna network (DAN) and the frequency-domain block signal detection. In broadband DAN, many antennas are spatially distributed over a service area and they are connected by means of optical fiber cables with DAN signal processing center. A group of distributed antennas cooperatively serve mobile users using spatial multiplexing, diversity, or relaying technique. We will introduce the recent research progresses of broadband DAN and its related wireless techniques.

11:20 6-2

Challenges to Ultra-Multi Level QAM Coherent Optical Transmission

Masataka Nakazawa, RIEC, Tohoku University

Progress on ultra-multi level quadrature amplitude modulation (QAM) coherent transmission is presented. Starting from a multiplicity of 32, we have recently achieved a multiplicity of 256. First, we describe the difficulties involved in realizing a multiplicity of 256, and present transmission results for 256 QAM coherent transmission over 160 km. We mention the possibility of a multiplicity of 512. In addition, we have proposed combining OTDM and the QAM technique to realize high-speed, spectrally efficient transmission. I will describe how such an advanced transmission technique can be realized.

11:50-13:00 Lunch Break

Session 7 (Ball A) Thursday, July 8th, 13:00-14:20

Next Generation Communication and Networks

13:00 7-1

Protocol Design and Optimization for Next Generation Ubiquitous Networks

Lin Cai, University of Victoria, Canada

We have witnessed the explosive growth of the Internet, and the growth will even accelerate in the coming few decades, thanks to the ever-increasing demand for ubiquitous network services, anywhere, anytime, and with any devices. New applications, communication technologies and paradigms are the main driven forces, and they also bring many new challenges. In this talk, we examine some key research problems in the area of performance modeling and analysis, cross-layer protocol design and optimization for next generation ubiquitous networks. We will present our novel solutions to some of these problems and conclude with future directions.

13:50 7-2

Reliable Application Layer Multicast over Heterogeneous Networks

Nei Kato, Tohoku University

Due to the deployment of hybrid wired/wireless networks, the reliable content delivery over such heterogeneous networks becomes a significant issue. Application layer multicast is a promising approach to delivering streaming media contents to a large number of users. However, frequent node joining and departure due to mobility in wireless networks results in undelivered streams. In addition, the link capacities are totally different in heterogeneous networks. In this paper, we propose a method to guarantee the content delivery in a dynamic network, while meeting various bandwidth constraints by using layered multiple description coding.

14:20-14:50 Coffee Break

Session 8 (Ball A) Thursday, July 8th, 14:50-17:00

Advanced Storage and Technologies

14:50 8-1

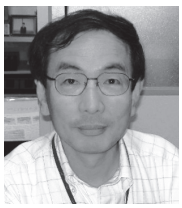
The Quest for Tbits/in^2 : Understanding and Manipulating Nanoscale Magnetism

Tom Thomson, University of Manchester, UK

The phenomenal success of the hard disk drive (HDD) industry in providing cheap and almost limitless data storage capacity continues to be a key enabling technology that unpins almost every aspect of a modern information society. The principal magnetic components of HDD's are the head which incorporates both write and read elements, and the recording medium. In this talk I will focus on the scientific challenges encountered in creating magnetic media with ever greater areal density. Three potential schemes are currently under consideration to enable > 1Tbit/in^2 recording; (i) conventional or not so conventional perpendicular media (ii) bit patterned media (BPM) and (iii) energy assisted recording. All of these schemes have some media requirements in common, in particular the necessity to understand and control anisotropy distributions and the need to engineer the relationship between magnetisation reversal and thermal stability. Our recent work exploring reversal and thermal stability in exchange spring thin films using magnetometry and neutron scattering, together with results on determining anisotropy distributions in BPM provide some insights into the critical issues needed to create > 1Tbit/in^2 recording media.

15:40 8-2

Future Foresight and Today's Struggle in High Density Information Storage



Hiroaki Muraoka, RIEC, Tohoku University

Fast growth of amount of created information continues, 10 times in these 5 years. The demand of areal density of HDD is therefore strong. The 1 Tbit/inch^2 is just around the corner, where the bit size is approximately 25 nm, but several challenges are foreseen to go beyond. The first challenge will be magnetic uniformity limit at bit size of 8 nm or density of 10 Tbit/inch^2. Magnetic fluctuations such as switching field distribution or grain size dispersion must be solved for SNR or error rate. Next challenge will be at around 3 nm or 100 Tbit/inch^2, where we will confront thermal and granular limit. Obviously the ultimate density limit is the atomistic dimension of 0.2 nm, or 10 Peta-bit/inch^2. Entirely new idea will be required, but we have another 30 years even with the growth rate of 140%/year.

16:10 8-3

Power Management for VLSIs - a Power Electronics Perspective

Wai Tung Ng, University of Toronto, Canada

The aggressive scaling of CMOS technology has allowed rapid increases in the gate density and gate count in modern VLSIs. The power consumed by today's VLSI chips under maximum performance situation could cause over-heat and even become destructive. This is especially critical in portable multimedia and telecommunication products where form factor, cooling and battery life impose very stringent limitations. Power management is currently one of the most critical enabling technologies to further increase VLSI performance and integration density. Dynamically scaling of the power supply voltage and clock frequency according to performance needs has been investigated for more than 10 years. Most of the previous work focused only on saving power at the VLSI chip level. The design of the power efficient variable output power supplies (DC-DC converters) is often assumed to be trivial and as an afterthought. While significant power saving has been reported at the VLSI chip level, the overall power saving at the system level is often difficult to realize. In this paper, we will examine some of the design techniques used to broaden the power conversion efficiency and to provide tight regulation in digitally controlled switched mode power supplies suitable for VLSI power management.

17:00-17:10 Closing Session

A Group

PO-01 **Advanced Entangled Photon Sources**

Keiichi Edamatsu, RIEC, Tohoku University

Entanglement is one of the key resources in the quantum information technology. We present our recent activities to develop advanced sources of entangled photons, by use of extended phase-matching and waveguide devices.

PO-02 **Challenge to Terabits per Square Inch Magnetic Recording**

Hiroaki Muraoka, RIEC, Tohoku University

Recording system should be changed from the conventional recording technology to new one so that we can overcome thermal limit and achieve the areal density of over Terabit/inch^2 in the near future. High- density recording utilizing bit patterned media, energy assisted magnetic recording scheme, and two- dimensional magnetic recording scheme are studied as next generation HDD systems through experiments and micromagnetic simulations. Study on mass storage HDD architecture for the data centers is also carried out in order to achieve low-power consumption.

PO-03 **Semiconductor Spintronics**

Hideo Ohno, RIEC, Tohoku University

Our research focuses on the area of "Semiconductor Spintronics," in which we explore new functionality utilizing both 'charge' and 'spin' degrees of freedom in semiconductors. We also study THz light emitting devices that utilize optical transition in semiconductor heterostructures, and magnetic metal devices for non-volatile spin memories.

PO-04 **Actual Information Storage with a Recording Density of 4 Tbit/inch^2 in a Ferroelectric Recording Medium**

Yasuo Cho, RIEC, Tohoku University

A new method to achieve real information recording with a density above 1 Tbit/inch^2 in ferroelectric data storage systems is proposed. In this system, data bits were written in the form of the polarization direction, and the data were read by Scanning Nonlinear Dielectric Microscopy technique. The domain-switching characteristics of the virgin and inversely prepolarized media were compared, and the conditions of the pulse voltage for writing were optimized. As a result, actual data containing 64 × 64 bits were recorded at an areal density of 4 Tbit/inch^2. The bit error rate was evaluated to be 1.2×10^{-2}.

PO-05 **Anodic Titanium Oxide Nanotube Film: Formation and Application to Dye-Sensitized Solar Cells**

Michio Niwano, RIEC, Tohoku University

Anodization of titanium in electrolyte is a promising method for fabrication of titanium oxide (TiO_2) nanotubes. For the application of TiO_2 nanotubes to the negative electrode of a dye-sensitized solar cell (DSC) we need to form a TiO_2 nanotube film directly on a TCO layer. It is important for the formation of such a TiO_2 nanotube film to elucidate and control on the nanometer scale the anodization process of titanium that would be greatly influenced by the electrolyte. In the present study, therefore, we have investigated the influence of constituents of the electrolyte on the anodization process.

PO-06 **Development of High Quality and Large Size 3D Display**

Tatsuo Uchida, Tohoku University

We have established the fundamental theories necessary for the development of high quality and large size displays. In this paper, we discuss a development of large size 3D display. New design rules for optimization of screen-brightness, light diffusing distribution, and polarization state is developed based on the DLC (Diffused Light Control) theory. As a result, high performance 160inch diagonal 3D projection display system is successfully realized.

PO-07

Green-Nanoelectronics Oriented Nanoscopic Plasma Control

Rikizo Hatakeyama, Tohoku University

In this report, our emphasis is placed on green information-electronics nanodevices of carbon nanotubes (CNTs) synthesized and functionalized by nanoscopic plasma process control. Firstly, the single-walled carbon nanotubes (SWNTs) growth from nonmagnetic catalysts is successfully realized by diffusion plasma CVD toward a study on novel nano-magneticsemiconductor properties. Secondly, a photovoltaic phenomenon is observed when pn junctions based on fullerene encapsulated SWNTs are illuminated by lights in the infrared region, which is expected to make for a new concept of solar nanocells. Thirdly, when biomolecule DNA is encapsulated inside CNTs, their semiconducting transport properties are found to be versatilely controlled depending on the DNA bases which own different ionization (or redox) potentials.

PO-08

Tailor-Made Nano Structured Material for Highly Qualified Spin Related Devices

Migaku Takahashi, Tohoku University

Highly qualified spin related devices such as ultra-high density hard disk drive (HDD) and magnetic random access memory (MRAM), inductor and antenna for high frequency use are inevitable requirements for recent IT technology. Tailor-made spin nano structured materials by precisely controlled fabrication technology with nano-scale in each devices and understanding their nanomagnetics are essential from the view point of material, process, and physics. Within the frame work of the present paper, correlation between tailor-made nano structured material and magnetic properties developed for each categorized research items mentioned above will be widely discussed in connection with spin related devices.

PO-09

Development of Super-Precise Ultrasonic Method and System for Measuring Zero-CTE Temperature of TiO_2-SiO_2 Ultra-Low-Expansion Glasses

Jun-ichi Kushibiki, Tohoku University

Ultra-low-expansion (ULE) glasses having a zero-CTE (coefficient of thermal expansion) around desired temperatures are required for basic substrate materials for optical components in extreme ultraviolet lithography (EUVL) systems as well as in an ultrahigh-finesse optical cavity for the next-generation frequency standard. TiO_2-SiO_2 glass is the most suitable candidate. It is well-known that commercial ULE glasses contain periodic variations in TiO_2 concentration (namely striae) formed during the glass fabrication process, so that there must exist some CTE distributions and some deviations of zero-CTE temperature, T(zero-CTE), from desired temperatures. This is a serious problem for the optical applications.

In this paper, we developed a practical method and system for super-precise evaluation of T(zero-CTE) of TiO_2-SiO_2 glasses using our ultrasonic micro-spectroscopy (UMS) technology with a resolution of 0.4°C at 225 MHz. We applied the system to realize a glass ingot with T(zero-CTE) around 25°C by controlling fictive temperature TF of the glass ingots homogenized by the zone-melting method.

PO-10

Atomically Controlled Processing for Future Si-Based Devices

Junichi Murota, RIEC, Tohoku University

Atomically controlled processing based on atomic-order surface reaction control is indispensable for future ULSI fabrication. In Si or $Si_{1-x}Ge_x$(100) epitaxial growth, C atomic-layer doping at heterointerface of strained $Si_{1-x}Ge_x$/Si suppresses strain relaxation as well as intermixing. In P atomic-layer doping for Si/strained $Si_{0.55}Ge_{0.45}$/Si(100), low-temperature and high-growth-rate Si cap layer growth suppresses the P surface segregation. Tensile strain in Si layer reduces the incorporated P amount around the heterointerface. The Si layer growth rate and the electrical activity of P and B atoms for heavy doping over around 10^{20} cm^{-3} in tensile-strained Si are lower than those in unstrained Si.

B Group

PO-11 Broadband Distributed Antenna Network and Its Related Wireless Techniques

Fumiyuki Adachi, Tohoku University

To realize communications with high sense of presence everywhere, broadband wireless technology which can achieve higher-than-1Gbps data transmission with extremely low transmit power is indispensable. We have been studying the broadband distributed antenna network (DAN) and the frequency-domain block signal detection. In broadband DAN, many antennas are spatially distributed over a service area and they are connected by means of optical fiber cables with DAN signal processing center. A group of distributed antennas cooperatively serve mobile users using spatial multiplexing, diversity, or relaying technique. We will introduce the recent research progresses of broadband DAN and its related wireless techniques.

PO-12 Fundamental Technologies towards New Paradigm VLSI Computing

Takahiro Hanyu, RIEC, Tohoku University

In order to solve the recent VLSI problems causing performance and reliability degradation, we focus on a "new-paradigm VLSI computing" concept that investigates the optimal design through all the VLSI design layers such as a device/material design level, a circuit-architecture level, a logic-synthesis level, a system-architecture level, and an application-oriented algorithm level. The use of "logic-in-memory VLSI architecture," where storage elements are distributed over a logic-circuit plane, makes global wires reduced greatly. To implement a logic-in-memory VLSI compactly, we utilize multi-functional and nonvolatile devices such as ferroelectric devices, TMR (MTJ) devices and phase-change devices.

PO-13 High-Accuracy Digital Signal Processing and Its Applications

Masayuki Kawamata, Tohoku University

This poster presents two of our recent achievements on digital signal processing. First presented is adaptive filtering based on a variable digital filter (VDF), where we realize a new system for adaptive detection of narrowband signals using a high-order VDF. We also propose a new method for realization of high-accuracy VDFs. The other achievement is the digital restoration for old film sequences. We develop an automatic restoration system with high-accuracy and low-computational cost; this system is capable of restoring the high-resolution old film sequences degraded by typical defects of old films, such as frame displacement, intensity flicker, blotches, and scratches.

PO-14 Challenges to Ultra-Multi Level QAM Coherent Optical Transmission

Masataka Nakazawa, RIEC, Tohoku University

Progress on ultra-multi level quadrature amplitude modulation (QAM) coherent transmission is presented. Starting from a multiplicity of 32, we have recently achieved a multiplicity of 256. First, we describe the difficulties involved in realizing a multiplicity of 256, and present transmission results for 256 QAM coherent transmission over 160 km. We mention the possibility of a multiplicity of 512. In addition, we have proposed combining OTDM and the QAM technique to realize high-speed, spectrally efficient transmission. I will describe how such an advanced transmission technique can be realized.

PO-15 Dual-Antenna Development for Eliminating Blind Spots in Wireless Communications

Kunio Sawaya, Tohoku University

It is a significant problem that blind spots in wireless communications are caused in the narrow street of urban area due to the existence of high buildings. It is required to develop a device to control the microwave propagation with a broad angle to solve the problem. In this report, a new dual-antenna system is proposed, which includes a receiving and a reradiating antennas to realize a broad-angle beam control. An equivalent bistatic radar cross section is deduced and calculated to evaluate the antenna performance which shows its flexible beam control capability.

PO-16

Reliable Application Layer Multicast over Heterogeneous Networks

Nei Kato, Tohoku University

Due to the deployment of hybrid wired/wireless networks, the reliable content delivery over such heterogeneous networks becomes a significant issue. Application layer multicast is a promising approach to delivering streaming media contents to a large number of users. However, frequent node joining and departure due to mobility in wireless networks results in undelivered streams. In addition, the link capacities are totally different in heterogeneous networks. In this paper, we propose a method to guarantee the content delivery in a dynamic network, while meeting various bandwidth constraints by using layered multiple description coding.

C Group

PO-17 Adaptive Functional-Module Selection for Live-Feeling Communication

Michitaka Kameyama, Tohoku University

We present an approach to the real-world live-feeling communication. The application is based on an adaptive TV-set that reconfigures itself based on the user emotional state, in order to provide the user with the most satisfactory viewing experience. The setup contains cameras that can be zoomed and pan/tilted and microphones that can be oriented toward different sources of sounds. The content of the cameras and microphones is transmitted to the TV screen and speakers. The user is observed through another set of video cameras that perform face detection and posture detection. Using this information the system estimates the user's emotional state and adapts its cameras and microphones action.

The system reconfigures itself by adaptively selecting functional modules. The functional modules represent all the available computational resources and each particular selection of functional modules generates a different output behavior. The reconfiguration uses cellular automaton (CA) to generate combinations of functional modules. The use of the cellular automaton is motivated by the fact that by only specifying a set of local rules, novel behaviors can be generated. Also, the pseudo-random behavior of the CA is used to actively query the user for emotional responses and thus permits to distinguish and categorize emotional user state even if they are not explicitly recognizable.

The advantage of using the proposed approach is in the fact that it is robust because the reconfiguration of the whole system is directly dependent on the perceived emotional user state. This means that the proposed approach is designed to work in a various environments as well as various task contexts. Moreover, by adaptively selecting these resources we can minimize the power consumption. This is in contrast to the traditional behavioral approach to robotics where the behaviors are predefined and are always active. Another advantage resides in the fact that the CA based reconfiguration is scalable and can be extended to a multi-level functional behavior generation.

PO-18 Development of Acoustic Systems Realizing Communications with High Sense-of-Presence

Yôiti Suzuki, RIEC, Tohoku University

Realization of communications with a high sense-of-presence necessitates development of systems based on knowledge related to human hearing and multi-modal perceptual processing. Therefore, three-dimensional (3D) sound localization recognition is examined as multi-modal perceptual processing based on hearing and on self-motion perception. A spherical array comprising 252 microphones was developed for comprehensive recording of a 3D sound field. A 3D sound reproduction system implemented with a 157-loudspeaker array based on higher-order Ambisonics is combined with a 3D projection display to reproduce high-definition audio-visual information. This developed system is useful to improve understanding of human audio-visual perception.

PO-19 Higher-Order Model Checking and Program Verification

Naoki Kobayashi, Tohoku University

Model checking has been successfully applied to software and hardware verification. Higher-order model checking is an extension of model checking, where models are described as higher-order functional programs. We show how higher-order model checking problems can be solved efficiently and applied to program verification. We have implemented a higher-order model checker TRecS and constructed a software verification tool on top of it. To our knowledge, TRecS is the first implementation of a higher-order model checker; Despite its theoretical interests, there has been no practical implementation, because of the extremely high time complexity of higher-order model checking.

PO-20 Feature-Word-Topic Model for Image Annotation and Retrieval

Takeshi Tokuyama, Tohoku University

Image annotation is to automatically associate semantic labels with images in order to obtain a more convenient way for indexing and searching images on the Web. This poster presentation proposes a novel method for the image annotation based on mixture hierarchies and multiple instance learning, which models feature-word distributions and topic modeling to provide word-topic distributions. Experiment shows that our method gives promising improvement over a state-of-the-art method.

PO-21

Probabilistic Graphical Model for Vision Data

Kazuyuki Tanaka, Tohoku University

Attempts at digital image processing using probabilistic models have been developed in probabilistic information processing field. In recent years, the probabilistic image processing techniques have gathered attention with machine learning techniques and then have applied to many applications e.g. image denoising, inpainting, low-level vision and so on. By using machine learning techniques, we can find non-trivial regularities behind huge amount of empirical data. Machine learning techniques then automatically adjust given probabilistic models to practical real data. In this presentation, we introduce Gaussian graphical models and a machine learning algorithm for them, and show their some applications to image processing problems.

PO-22

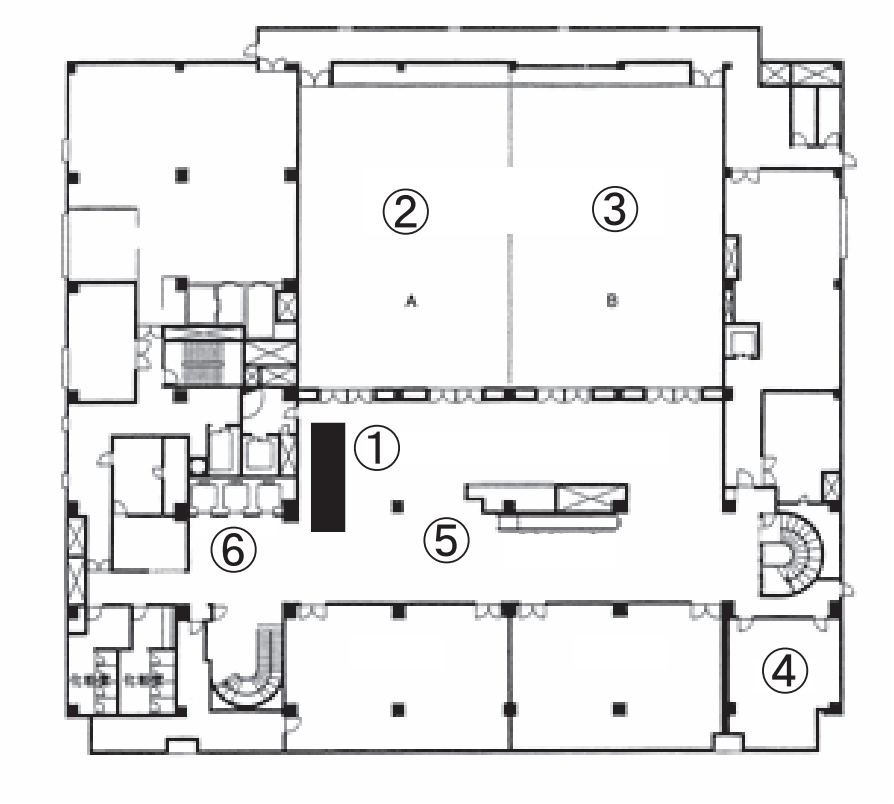
High-Accuracy Machine Vision Technology Using Sub-Pixel Image Matching - From 3D Vision to Medical Image Analysis -

Takafumi Aoki, Tohoku University

This paper presents fundamentals of Phase-Only Correlation (POC) - a technique for high-accuracy registration of 1D, 2D and 3D signals using phase information of discrete Fourier transform. Since 1990s, our research group has developed a novel technique of phase-based image matching for fingerprint verification and industrial machine vision. We have recently proposed an efficient image correspondence algorithm using POC, which can find pairs of corresponding points between the given two images with sub-pixel accuracy. This allows us to apply the POC technique to a wide range of applications, including smart image sensors, microscope image analysis, passive 3D vision, automotive image processing, image-based human interface, biometrics authentication, and medical image analysis.

Conference Space Layout

3F



① Registration Desk
② Ball Room A
③ Ball Room B
④ Wood (Committee Room)
⑤ Escalator
⑥ Elevator

Transportation

Sendai Airport

Sendai Airport Access Line (25 minutes)

Narita International Airport

Railway (JR East)
Ltd. Express “Narita Express”
(60 minutes)

Tokyo Station

Railway (JR East)
Tohoku Shinkansen “Hayate/Komachi” or “Yamabiko”
(2.0 hours)

Sendai Station

TAXI: 5 minutes

WALK: 15 minutes straight down “AOBA DORI”

BUS: 5 minutes
Take bus marked:
(No.9 bus stop)
715:“宮教大" (MIYAKYODAI)
710"青葉台" (AOBADAI)
(No. 11 bus stop)
700:“緑ヶ丘三丁目” (MIDORIGAOKA)
(No. 12 bus stop)
707“長町南駅・長町(営)” (NAGAMACHI-MINAMI)
Get off at "晩翠草堂前" (BANSUISODO MAE). It is the second stop.

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