External Awards

Technical Committee Prize Paper Award (Second Prize Paper)
Winner: Munekazu Date, Hideaki Takada, Shiro Ozawa, Akira Kojima, NTT Media Intelligence Laboratories, and Satoshi Mieda, NTT Resonant Inc.
Date: October 6, 2014
Organization: The Industrial Lighting and Display Committee, Institute of Electrical and Electronics Engineers (IEEE) Industry and Applications Society

For "Highly Realistic 3D Display System for Space Composition Telecommunication."

We describe a highly realistic three-dimensional (3D) display system that generates composites of current and remote places for telecommunication purposes. It uses a 3D projector and head tracking to display a person in a remote place as a life-size stereoscopic image against background scenery. Since it generates displayed images that correspond to the observer's viewing position, it well reproduces the fidelity of existence and the feel of materials. We also describe a simple, fast, and high quality background scenery generation method, the development of which was inspired by the visual effects of DFD (depth-fused 3D) displays, and applied it to a single direction conceptual demonstration system. Our system is a promising means of achieving real-time communication between two different places in cases where a sense of reality is required.
Published as: M. Date, H. Takada, S. Ozawa, S. Mieda, and A. Kojima, "Highly Realistic 3D Display System for Space Composition Telecommunication," Proc. of the 2013 IEEE Industry Applications Society Annual Meeting, Orland, FL, USA, October 2013.

Innovative Technologies 2014
Winner: NTT Communication Science Laboratories[*]
  * Researchers involved include Tomohiro Amemiya, Shinya Takamuku, Sho Ito, and Hiroaki Gomi
Date: October 23, 2014

Organization: The Ministry of Economy, Trade and Industry of Japan

For "Buru-Navi3: Creating an Illusory Sensation of Being Pulled."

We have succeeded in developing a small force-display gadget, "Buru-Navi3," for experiencing a kinesthetic illusory sensation of being continuously pushed or pulled. We demonstrated Buru-Navi3 at the Digital Content Expo 2014, Tokyo, Japan, on October 23–26, 2014. At our booth, as a basic demonstration, visitors enjoyed this force illusion by specifying a stimulus direction on a touch screen. We also showcased a virtual fishing game with the downward force sensation of fish tugging on a fishing line and a virtual force interaction via a leash while walking a dog, as applications of our force-display gadgets.

Award for Encouragement of Research in IUMRS-ICA 2014
Winner: Kazuyuki Hirama, NTT Basic Research Laboratories
Date: October 31, 2014
Organization: International Union of Materials Research Societies, International Conference in Asia (IUMRS-ICA)

For "Nitride/Diamond Heterostructure Systems - From Growth to Devices."

I introduced ultraviolet emission from an AlN/diamond LED (light-emitting diode) and excellent thermal properties of an AlGaN/GaN FET (field-effect transistor) on diamond as successful examples of nitride/diamond heterostructure systems. Moreover, I reported the thin film growth of single-crystal c-BN, which has not been successfully applied in nitride semiconductors.
Published as: K. Hirayama, "Nitride/diamond heterostructure systems - from growth to devices," Proc. of the 15th IUMRS-ICA, Fukuoka, Japan, August 2014.

Papers Published in Technical Journals and Conference Proceedings

Efficient Multi-User Transmission Technique with Frequency Division for WLANs
S. Shinohara, B. A. Abeysekera, Y. Inoue, Y. Asai, and M. Mizoguchi
Proc. of the 79th IEEE Vehicular Technology Conference (VTC 2014-Spring), Seoul, Korea, May 2014.
The upcoming wireless LAN standard IEEE 802.11ac extends the

channel bandwidth from conventional 20 or 40 MHz to 80 or 160 MHz to increase the data rate. Consequently, there could be stations supporting different channel bandwidths in one area. Stations belonging to the same basic service set (BSS) have to operate on the primary channel, which is a common 20-MHz sub-channel. In such a situation, the secondary channels associated with the primary channel may remain unused and, as a result, the system capacity will be

degraded. To address this problem, we propose a multi-user multi-channel transmission technique to improve the efficiency of downlink transmissions. The computer simulation results confirm the effectiveness of the proposed method.

Reflective Multi-view Screen and Mobile Projectors for Communication Displays

M. Date, T. Kawakami, M. Sasai, S. Ozawa, S. Mieda, H. Takada, Y. Suzuki, and T. Uchida

Proc. of Society for Information Display's (SID) Display Week 2014 International Symposium, Seminar and Exhibition, Vol. 45, No. 1, pp. 892–895, San Diego, CA, USA, June 2014.

A reflective multi-view projection screen for portable video group communication is proposed. Its stack structure of Fresnel lens, mirror, and optical diffuser enables the directivity display that is important for video conferencing, and its high optical efficiency enables the use of mobile projectors.

Large-scale Integration of Wavelength-addressable All-optical Memories in a Photonic Crystal Chip

E. Kuramochi, K. Nozaki, A. Shinya, K. Takeda, T. Sato, S. Matsuo, H. Taniyama, H. Sumikura, and M. Notomi

Nature Photonics, Vol. 8, pp. 474–481, June 2014.

We have demonstrated for the first time that over 100-bit wavelength addressable all-optical memory was monolithically integrated on a silicon photonic crystal chip. We have also demonstrated limitless storage time and random write/readout operation of 28-bit all-optical memory with a total power consumption of less than 150 μW by using a buried-heterostructure InP photonic crystal nanocavity array.

Toward Integrating Overlay and Physical Networks for Robust Parallel Processing Architecture

K. Suto, H. Nishiyama, N. Kato, T. Nakachi, T. Fujii, and A. Takahara

IEEE Network Magazine, Vol. 28, No. 4, pp. 40–45, July 2014.

In this paper, we introduce a design methodology of an overlay-based parallel processing architecture based on integration of overlay and physical networks. Additionally, we introduce basic principles based on the design methodology. Through numerical calculation, we evaluate the effectiveness of an integration approach on the performance of parallel data processing in terms of higher service availability against physical network failures while minimizing traffic load.

Performance Measurement of Broadband Simple Decoding in Short-range MIMO

K. Hiraga, K. Sakamoto, T. Seki, T. Tsubaki, H. Toshinaga, and T. Nakagawa

Proc. of the IEEE 25th International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC 2014), pp. 289–292, Washington DC, USA, September 2014.

This paper presents a demonstration of a simple decoding method for two-branch short-range multiple-input multiple-output (MIMO) transmission in a broadband with eight percent relative bandwidth, which corresponds to two-channel usage in the 60-GHz band. An

experimental evaluation of the method was performed after prototyping the array antenna and weight matrix circuit. The evaluation results showed signal separation performance of 15 dB was obtained through the frequency range of 24.0–26.0 GHz. Bit error rate (BER) was simulated using measured transmission characteristics and we determined that 16 QAM signals at this band can be transmitted in the prototype system.

Combining Calibration Schemes on a Real-time Multiuser MIMO-OFDM System with Implicit Feedback

H. Fukuzono, T. Murakami, R. Kudo, S. Shinohara, Y. Takatori, and M. Mizoguchi

Proc. of PIMRC 2014, pp. 87–91, Washington DC, USA, September 2014.

This paper evaluates the performance of a real-time multiuser MIMO system with implicit feedback, we have developed using FPGAs (field-programmable gate arrays), in an indoor environment. It is shown that our proposed calibration scheme, WCC (World Calibration Centre), has superior performance to conventional schemes.

A Basic Study on High Bandwidth Streaming in Realtime over Multipath Using LDPC-IRA Codes and Its Evaluation

M. Kitamura, H. Kimiyama, T. Ogura, and T. Fujii

Proc. of the 7th International Conference on Internet and Distributed Computing Systems (IDCS 2014), pp. 217–226, Calabria, Italy, September 2014.

This paper describes a distributed video streaming system using widely dispersed storage, in which each storage host sends chunked video packets to a single receiver through a multipath network. By adding parity packets by forward error correction (FEC) along with source video data in each storage host, this system enables real-time video streaming even if there is an imbalance between the hosts. In this paper, we introduce a model of this imbalance and its effect on the number of packets that need to be sent, then discuss how to design the redundancy rate in FEC. The results are shown to have a trade-off between the range of balancing and the additional number of sent packets needed for stable video streaming.

Low-loss and Low-power-consumption Wavelength Tunable Filter Enabling Colorless/Directionless/Contentionless Optical Drop in ROADMs

S. Takashina, Y. Mori, H. Hasegawa, K. Sato, and T. Watanabe

Proc. of the 40th European Conference on Optical Communications (ECOC 2014), Cannes, France, September 2014.

We proposed a novel tunable-filter configuration for optical C/D/C (colorless/directionless/contentionless) drop in reconfigurable optical add-drop multiplexers (ROADMs), which achieves low insertion loss and low power consumption. A prototype is monolithically fabricated with PLC (planar lightwave circuit) technologies and its good filtering performance is experimentally confirmed by BER (bit-error-ratio) measurement.

Novel Large-port-count Optical-switch Architecture for Optical Interconnection in Datacenter

K. Ueda, Y. Mori, H. Hasegawa, K. Sato, and T. Watanabe

Proc. of ECOC 2014, Cannes, France, September 2014.

We propose a novel optical-switch configuration for intra-datacenter interconnection that consists of tunable lasers, non-cyclic AWGs (arrayed-waveguide gratings), and combinations of small-size optical switches and couplers. We developed an 800×800 switch prototype and verified its good performance and scalability in experiments.

Commuting Quantum Circuits with Few Outputs are Unlikely to be Classically Simulatable

Y. Takahashi, S. Tani, T. Yamazaki, and K. Tanaka

arXiv, 1409.6792v1 [quant-ph], September 2014.

We study the classical simulatability of commuting quantum circuits with n input qubits and $O(\log n)$ output qubits. We show that there exists a commuting quantum circuit that is not classically simulatable (under a plausible assumption). This is the first formal evidence that a commuting quantum circuit is not classically simulatable even when the number of output qubits is exponentially small.

Education × ICT = ?

Y. Kato

Journal of the Japanese Society for Information and Systems in Education (Japanese edition), Vol. 31, No. 4, pp. 249–250, October 2014.

As a preface note of the Journal of the Japanese Society for Information and Systems in Education in October 2014, this paper overviews the history of the field of education × information and communication technology (ICT). It also covers trends such as MOOCs (massive open online courses) and flipped classrooms and reviews future directions.

Influence of InGaN/GaN Multiple Quantum Well Structure on Photovoltaic Characteristics of Solar Cell

N. Watanabe, M. Mitsuhara, H. Yokoyama, J. Liang, and N. Shigekawa

Japanese Journal of Applied Physics, Vol. 53, 112301, October 2014.

We have investigated InGaN/GaN multiple quantum well (MQW) solar cells in terms of the relationship between the short-circuit current and the MQW structure. The dependence of short-circuit current on the MQW structure can be explained by the hypothesis that the transport characteristics of photoinduced carriers are characterized by the specific length within which carriers photoinduced in the InGaN well layer can move before recombination. The carrier collection efficiency is improved by the drift in the barrier layer due to the forward internal electric field and degraded by the carrier accumulation in the well layer caused by the inverse internal electric field and the potential barrier between layers, which well describes the influence of the MQW structure on the specific length. Using this model, we discuss how we can determine the MQW structure that yields higher short-circuit current.

Systematic Hole-shifting of L-type Nanocavity with an Ultrahigh Q Factor

E. Kuramochi, E. Grossman, K. Nozaki, K. Takeda, A. Shinya, H. Taniyama, and M. Notomi

Optics Letters, Vol. 39, No. 19, pp. 5780–5783, October 2014.

We report simple systematic hole-shifting rules applicable to any Lx (x:2; 3; 4; 5;…) nanocavity. The rules specify six sets of holes to be tuned with only two or three shift parameters. While keeping the same cavity wavelength and nearly the same mode volume, the new rule increases the Q factor by nearly one order of magnitude compared with an edge-hole-shifted Lx nanocavity. The Q factor of the high-order mode is also greatly increased. This merit is obvious from the maximum experimental Q factors of over 500,000 at L2 and of over 1,000,000 at L3, L4, and L5 achieved in Si photonic crystals.