External Awards

RIEC Award

Winner: Haruki Sanada, NTT Basic Research Laboratories Date: November 28, 2014 Organization: Research Institute of Electrical Communication (RIEC)

For "Electron spin resonance using spin-orbit interaction."

2015 OSA Fellow Member Winner: William J. Munro, NTT Basic Research Laboratories Date: December 4, 2014 Organization: Optical Society of America (OSA)

For "Research in quantum optics and quantum information pro-

cessing."

William J. Munro was elected in the newest class of OSA Fellow Members with the citation saying "for achievements in optics and photonics. He is a key bridge in the optical quantum information field between academia and industry."

SDN/Cloud Program Competition 2014 Special Award

Winner: Tomoya Hibi, NTT Network Innovation Laboratories; Hirofumi Ichihara and Hiroki Kumazaki, NTT Software Innovation Center

Date: December 9, 2014 **Organization:** Okinawa Open Laboratory

For "Gondola cloud orchestrator."

Papers Published in Technical Journals and Conference Proceedings

High-capacity Scalable Optical Communication for Future Optical Transport Network

Y. Miyamoto

Proc. of the 2014 IEEE International Solid-State Circuits Conference (ISSCC), pp. 118–119, San Francisco, CA, USA, February 2014.

The impact and future scaling of digital signal processing (DSP) on high-capacity optical transport networks are investigated. The developed 100 Gbit/s DSP ASIC (application specific integrated circuit) was recently introduced in a commercial network, where the digital coherent transmission system with the ASIC realized a capacity more than 8 Tbit/s/fiber. The future progress in key DSP areas is discussed toward 1 Pbit/s/fiber capacity in combination with space division multiplexing in an optical transport system.

Petabit/s Transmission Using Multicore Fibers

A. Sano, H. Takara, T. Kobayashi, and Y. Miyamoto

Proc. of the 2014 Optical Fiber Communications Conference and Exposition (OFC), Tu2J. 1, pp. 1–3, San Francisco, CA, USA, March 2014.

Recent developments in high capacity transmission technologies based on multicore fiber (MCF) are reviewed. Propagation-direction interleaving with dual-ring structure 12-core MCF is promising for suppressing inter-core crosstalk and enables spectrally efficient longhaul transmission.

Crosstalk-managed High Capacity Long Haul Multicore Fiber Transmission with Propagation-direction Interleaving

A. Sano, H. Takara, T. Kobayashi, and Y. Miyamoto

IEEE Journal of Lightwave Technology, Vol. 32, No. 16, pp. 2771–2779, April 2014.

This paper describes ultra-high capacity long haul optical transmission technologies based on multicore fibers (MCFs) with spacedivision multiplexing. First, we discuss the factors limiting the total capacity and the attainable distance of MCF and show that the transmission distances are severely limited by crosstalk (XT) between adjacent cores. Next, we discuss a propagation-direction interleaving (PDI) technique to suppress XT. In PDI, adjacent cores have different propagation directions, and thus, bidirectional transmission is realized by a single MCF. We discuss spectral efficiency and attainable distance of several MCFs and show that threefold reach extension is possible by using PDI in 12-core fiber with a dual-ring structure (DRS). We also describe a long haul transmission experiment on a 12-core DRS fiber with PDI.

Large Capacity Transmission Systems Using Multi-core Fibers

A. Sano, H. Takara, and Y. Miyamoto

Proc. of the OptoElectronics and Communication Conference (OECC), Melbourne, VIC, Australia, July 2014.

This paper describes large capacity long haul transmission technologies based on multi-core fibers. Twelve-core fibers with a dualring structure and propagation-direction interleaving are promising in suppressing crosstalk penalty. A large capacity transmission experiment using these techniques is reviewed.

An Overlay-based Data Mining Architecture Tolerant to Physical Network Disruptions

K. Suto, H. Nishiyama, N. Kato, K. Mizutani, O. Akashi, and A. Takahara

IEEE Transactions on Emerging Topics in Computing (TETC), Vol. 2, No. 3, pp. 292–301, September 2014.

This paper proposes an overlay network construction scheme based on node location in a physical network, and a distributed task allocation scheme using overlay network technology. The numerical analysis indicates that the proposed schemes considerably outperform the conventional schemes in terms of service availability against physical network disruption.

Optical Network Optimization Considering Maintenance Cost Related to Operational Expenditures

T. Oda, A. Kadohata, A. Watanabe, and A. Hirano

Proc. of the 40th European Conference on Optical Communications (ECOC 2014), pp. 1–3, Cannes, France, September 2014.

We propose a highly reliable optical network architecture which optimizes the total cost considering maintenance-related operational expenditure (OPEX). Numerical evaluations show that the proposed architecture achieves a lower total cost compared to the conventional one with 1+1 protection.

Maximum Likelihood Demodulators and Their Evaluations on Amplify-and-forward Cooperative OFDM-based Wireless LAN Systems

H. Fukuzono, Y. Asai, R. Kudo, K. Ishihara, and M. Mizoguchi

IEICE Transactions on Communications, Vol. E97-B, No. 11, pp. 2435–2448, November 2014.

In this paper, we propose demodulators for the Alamouti codes in amplify-and-forward (AF) cooperative communication with one relay. The proposed demodulators output exact log likelihood ratios with recursion based on the Jacobian logarithm. The cooperative system with the proposed demodulators offers 1.9 times larger areas in a typical office environment.

Multi-core Multi-mode Dense Space Division Multiplexing for Ultra-high Spectral Efficiency Transmission Systems

T. Mizuno, H. Takara, A. Sano, and Y. Miyamoto

Proc. of Asia Communications and Photonics Conference (ACP) 2014, AFiF. 3, Shanghai, China, November 2014.

This paper describes our recent work on dense space division multiplexing (DSDM) over a multi-core few-mode fiber. We show that using both multi-core and multi-mode is an effective approach towards ultra-high capacity transmission systems.

Advanced Progress in IEEE 802.11 WLAN Standardization Y. Asai

Proc. of the 2014 Asia-Pacific Microwave Conference (APMC 2014), pp. 911–913, Sendai, Miyagi, Japan, November 2014.

This paper describes recent wireless local area network (WLAN) standardization activities and their specifications. First, the technical overview of the latest "very high throughput" WLAN standard, 802.11ac is introduced. To achieve more than 1 G bit/s of the system throughput, the physical layer parameters are extended for a peer-topeer bit rate increase. In addition, a downlink (DL) multiuser (MU-) MIMO (multiple-input and multiple-output) technique is supported for more efficient usage of spatial resources. Then, the future forecast of the next generation WLAN standard is presented. The task group (TG) ax in the 802.11 working group was formed in May 2014 and is now working to create the post-802.11ac standard. The most crucial problem that TGax addresses is poor throughput performance of the current WLAN systems in congested environments.

Computational Power of Quantum Circuits with a Small Number of Steps

Y. Takahashi

The Journal of the Institute of Electronics, Information and Communication Engineers, Vol. 97, No. 12, pp. 1110–1114, December 2014.

One of the main problems in realizing quantum computers is that the states of qubits, which represent the status of computation, change into unintended ones in a short time. This prevents us from implementing quantum algorithms correctly. In this paper, we describe techniques that address the problem.

Virtual Scent: Obscuring User Location without Compromising Privacy and Accuracy

H. Sato, T. Inoue, H. Iwamoto, and K. Koyanagi

Journal of Japan Society for Fuzzy Theory and Intelligent Informatics, Vol. 26, No. 5, pp. 820–829, December 2014.

With the spread of mobile devices with positioning systems such as GPS, user locations can be obtained in real time with great accuracy. However, this real-time and accurate location information allows malicious people to identify users in the real space, which causes serious loss of anonymity. Though users can be anonymized by adding noise to their location, the quality of location services would also be degraded. This paper proposes Virtual Scent, which is a novel method to visualize user locations without compromising *k*anonymity or accuracy. Virtual Scent shows its users as ambiguous *scents* on a map, which can anonymize them. Though each scent has noise in its location, they are positioned so as to be mixed up at a most likely location. We evaluated Virtual Scent with through simulation and experiments, which revealed its accuracy and practicality. This paper is the first work to quantitatively discuss the location accuracy for user anonymity.

Efficient *K*-nearest Neighbor Graph Construction Using MapReduce for Large-scale Data Sets

T. Warashina, K. Aoyama, H. Sawada, and T. Hattori

IEICE Transactions on Information and Systems, Vol. E97-D, No. 12, pp. 3142–3154, December 2014.

This paper presents an efficient method using Hadoop MapReduce for constructing a *K*-nearest neighbor graph (*K*-NNG) from a large-

scale data set. K-NNG has been utilized as a data structure for data analysis techniques in various applications. If we are to apply the techniques to a large-scale data set, it is desirable that we develop an efficient K-NNG construction method. We focus on NN-Descent, which is a recently proposed method that efficiently constructs an approximate K-NNG. NN-Descent is implemented on a sharedmemory system with OpenMP-based parallelization, and its extension for the Hadoop MapReduce framework is implied for a larger data set such that the shared-memory system is difficult to deal with. However, a simple extension for the Hadoop MapReduce framework is impractical since it requires extremely high system performance because of the high memory consumption and the low data transmission efficiency of MapReduce jobs. The proposed method relaxes the requirement by improving the MapReduce jobs, which employs an appropriate key-value pair format and an efficient sampling strategy. Experiments on large-scale data sets demonstrate that the proposed method both works efficiently and is scalable in terms of a data size, the number of machine nodes, and the graph structural parameter K.

Simpler Exact Leader Election via Quantum Reduction

H. Kobayashi, K. Matsumoto, and S. Tani

Chicago Journal of Theoretical Computer Science, 2014, Article 10, pp. 1–31, December 2014.

This paper presents a new quantum leader election algorithm that is based on quantum reduction via exact amplitude amplification to a classically solvable problem, computing a certain symmetric function, which provides more intuitive reasoning behind the existence of exact quantum algorithms for leader election. The algorithm first achieves a round complexity that is linear in the number of parties, i.e., the largest possible diameter plus one of the underlying graphs of the network.

Leveraging Dependency Relations and Sentence Examples in Web-scale Corpus for Open-domain Utterance Generation

H. Sugiyama, T. Meguro, R. Higashinaka, and Y. Minami

Transactions of the Japanese Society for Artificial Intelligence, Vol. 30, No. 1, pp. 183–194, January 2015.

The development of open-domain conversational systems is difficult since user utterances are too flexible for such systems to respond properly. To address this flexibility, previous research on conversational systems has selected system utterances from web articles based on word-level similarity with user utterances; however, the generated utterances, which originally appeared in different contexts from the conversation, are likely to contain irrelevant information with respect to the input user utterance. To leverage the variety of web corpora in order to respond to the flexibility and suppress the irrelevant information simultaneously, we propose an approach that generates system utterances with two strongly related phrase pairs: one that composes the user utterance and another that has a dependency relation to the former. Our experiments showed that our proposed approach significantly outperformed other retrieval and rule-based approaches.