

External Awards

2014 IEICE Young Researchers Award

Winner: Shoko Shinohara, NTT Access Network Service Systems Laboratories

Date: March 11, 2015

Organization: Institute of Electronics, Information and Communication Engineers (IEICE), Communications Society

For “Capacity Enhancement with Multi-channel Transmission Technique for High Efficiency WLANs” and “Efficient Transmission of Beacon Frames by Multi-channel Transmission Technique with WLAN-AP Cooperation.”

Published as: S. Shinohara, Y. Inoue, B.A. Hirantha Sithira Abeysekera, Y. Asai, and M. Mizoguchi, “Capacity Enhancement with Multi-channel Transmission Technique for High Efficiency WLANs,” Proc. of the 2014 IEICE General Conference, B-5-142, Niigata City, Niigata, Japan, Mar. 2014; S. Shinohara, Y. Inoue, K. Akira, M. Iwabuchi, and M. Mizoguchi, “Efficient Transmission of Beacon Frames by Multi-channel Transmission Technique with WLAN-AP Cooperation,” Proc. of the 2014 IEICE Society Conference, B-5-105, Tokushima, Japan, Sept. 2014.

2014 IEICE Young Researchers Award

Winner: Masashi Iwabuchi, NTT Access Network Service Systems Laboratories

Date: March 11, 2015

Organization: IEICE, Communications Society

For “A Study on Channel Offset Method for Reduction of Blank Channels Based on Dynamic Channel Selection” and “A Performance Evaluation of Simultaneous Transmission Utilizing Cooperative Back-off Control with Beamforming.”

Published as: M. Iwabuchi, A. Kishida, T. Shintaku, T. Onizawa, and T. Sakata, “A Study on Channel Offset Method for Reduction of Blank Channels Based on Dynamic Channel Selection,” Proc. of the 2014 IEICE General Conference, B-5-141, Niigata City, Niigata, Japan, Mar. 2014; M. Iwabuchi, A. Kishida, T. Shintaku, T. Onizawa, T. Sakata, “A Performance Evaluation of Simultaneous Transmission Utilizing Cooperative Back-off Control with Beamforming,” Proc. of the 2014 IEICE Society Conference, B-5-99, Tokushima, Japan, Sept. 2014.

2014 IEICE Young Researchers Award

Winner: Kei Kitamura, NTT Network Service Systems Laboratories

Date: March 11, 2015

Organization: IEICE, Communications Society

For “Beyond 100G Path Capacity Adjustment Scheme for Elastic Transport Network.”

Published as: K. Kitamura, Y. Yamada, M. Teshima, and A. Hirano, “Beyond 100G Path Capacity Adjustment Scheme for Elastic Transport Network,” Proc. of the 2014 IEICE General Conference, B-10-31, Niigata City, Niigata, Japan, Mar. 2014.

TAF Telecom System Technology Award

Winner: Yukihiro Bandoh, NTT Advanced Technology Corporation; Seishi Takamura, NTT Media Intelligence Laboratories; Hirohisa Jozawa, NTT Network Service Systems Laboratories, and Yoshiyuki Yashima, Chiba Institute of Technology

Date: March 23, 2015

Organization: The Telecommunications Advancement Foundation (TAF)

For “Generalized Theoretical Modeling of Inter-frame Prediction Error for High Frame-rate Video Signal Considering Integral Phenomenon.”

Published as: Y. Bandoh, S. Takamura, H. Jozawa, and Y. Yashima, “Generalized Theoretical Modeling of Inter-frame Prediction Error for High Frame-rate Video Signal Considering Integral Phenomenon,” IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences, Vol. E93-A, No. 8, pp. 1442–1452, Aug. 2010.

JSAP Poster Award

Winner: Tetsuhiko Teshima, Shingo Tsukada, Nahoko Kasai, Satoshi Sasaki, Aya Tanaka, Hiroshi Nakashima, and Koji Sumitomo, NTT Basic Research Laboratories

Date: April 1, 2015

Organization: The Japan Society of Applied Physics (JSAP)

For “Conductive Silk Films for Manipulation of Adherent Cells.”

Published as: T. Teshima, S. Tsukada, N. Kasai, S. Sasaki, A. Tanaka, H. Nakashima, and K. Sumitomo, “Proc. of the 62nd JSAP Spring Meeting, 12a-P11-12, Kanagawa, Japan, Mar. 2015.

IACR Fellow

Winner: Tatsuaki Okamoto, NTT Secure Platform Laboratories

Date: April 8, 2015

Organization: International Association for Cryptologic Research (IACR)

For theoretical and practical contributions to areas including encryption, signatures, identification, elliptic-curve cryptosystems, zero knowledge, and electronic cash, and for service to the IACR.

2014 IEEE Signal Processing Society Best Paper Award

Winner: Hiroshi Sawada, Shoko Araki, NTT Communication Science Laboratories; Shoji Makino, Tsukuba University

Date: April 21, 2015

Organization: Institute of Electrical and Electronics Engineers (IEEE), Signal Processing Society

For “Underdetermined Convolutional Blind Source Separation via Frequency Bin-Wise Clustering and Permutation Alignment.”

This paper presents a blind source separation method for convolutive mixtures of speech/audio sources. The method can even be applied to an underdetermined case where there are fewer microphones than sources. The separation operation is performed in the frequency domain and consists of two stages. In the first stage, frequency-domain mixture samples are clustered into each source by an expectation-maximization (EM) algorithm. Since the clustering is performed in a frequency bin-wise manner, the permutation ambiguities of the bin-wise clustered samples should be aligned. This is solved in the second stage by using the probability of how likely each sample belongs to the assigned class. This two-stage structure makes it possible to attain a good separation even under reverberant conditions. Experimental results for separating four speech signals with three microphones under reverberant conditions show the superiority of the new method over existing methods. We also report separation results for a benchmark data set and live recordings of speech

mixtures.

Published as: H. Sawada, S. Araki, and S. Makino, "Underdetermined Convolutional Blind Source Separation via Frequency Bin-Wise Clustering and Permutation Alignment," *IEEE Transactions on Audio, Speech, and Language Processing*, Vol. 19, No. 3, pp. 516–527, Mar. 2011.

ITU-AJ International Activity Encouragement Award

Winner: Kiyoshi Tanaka, NTT Service Evolution Laboratories

Date: May 15, 2015

Organization: The ITU Association of Japan (ITU-AJ)

For his contribution to the international standardization of IPTV (Internet protocol television) and digital signage by leading discussions in the International Telecommunication Union-Telecommunication Standardization Sector Study Group 16 (ITU-T SG16) and ITU-T IPTV Global Standards Initiative. In addition, he was involved in preparing for and carrying out the ITU-T SG16 Sapporo meeting held in 2014, and greatly contributed to the success of the meeting.

ComEX Best Letter Award

Winner: Kazumitsu Sakamoto, Ken Hiraga, Tomohiro Seki, Tadao Nakagawa, and Kazuhiro Uehara, NTT Network Innovation Laboratories

Date: May 15, 2015

Organization: IEICE, Communications Society

For "Performance Evaluation of a Simple Decoding Method for Millimeter-wave Short-range MIMO Transmission through a Wall."

The simple decoding method we have proposed for short-range multiple-input multiple-output (SR-MIMO) transmission is a promising means for reducing power consumption. The method performs MIMO detection with analog devices, thus reducing the number of quantization bits required in the analog-to-digital converter (ADC) of the receiver and the amount of signal processing calculation for MIMO detection. However, when the method is applied to a wall transmissive wireless repeater on a multilayered wall, the transmission performance degrades due to multipaths generated by the multilayered structure. In this letter, we evaluate the method's performance using data for a millimeter wave propagation channel that we measured from wall samples and the measured S-parameters of the method's analog circuit. As a result, we quantify the influence of multipaths generated by a wall's multilayered structure on transmission performance.

Published as: K. Sakamoto, K. Hiraga, T. Seki, T. Nakagawa, and K. Uehara, "Performance Evaluation of a Simple Decoding Method for Millimeter-wave Short-range MIMO Transmission through a Wall," *IEICE Communications Express*, Vol. 3, No. 4, pp. 131–137, Apr. 2014.

Best Tutorial Paper Award

Winner: Yusuke Asai, Koichi Ishihara, Tomoki Murakami, Riichi Kudo, Yasushi Takatori, and Masato Mizuguchi, NTT Network Innovation Laboratories

Date: May 15, 2015

Organization: IEICE, Communications Society

For overview of very high throughput wireless LAN standard IEEE 802.11ac and experimental evaluation of multiuser-MIMO transmission.

Published as: K. Ishihara, Y. Asai, R. Kudo, T. Ichikawa, Y. Takatori, and M. Mizoguchi, "Development and Experimental Validation of Downlink Multiuser MIMO-OFDM in Gigabit Wireless LAN Systems," *EURASIP Journal on Advances in Signal Processing*, Vol. 123, pp. 1–10, Jun. 2013.

Best Paper Award

Winner: Ikuma Ando, Gia Khanh Tran, and Kiyomichi Araki, Tokyo Institute of Technology; Takayuki Yamada, Takana Kaho, Yo Yamaguchi, and Kazuhiro Uehara, NTT Network Innovation Laboratories

Date: June 4, 2015

Organization: IEICE

For "Nonlinear Modeling and Analysis on Concurrent Amplification of Dual-band Gaussian Signals."

In the recently developed Flexible Wireless System (FWS), the same platform needs to deal with different wireless systems. This increases nonlinear distortion in its wideband power amplifier (PA) because the PA needs to concurrently amplify multi-band signals. By taking higher harmonics as well as inter- and cross-modulation distortion into consideration, we have developed a method to analytically evaluate the adjacent channel leakage power ratio (ACPR) and error vector magnitude (EVM) on the basis of the PA's nonlinear characteristics. We devise a novel method for modeling the PA amplifying dual-band signals. The method makes it possible to model it merely by performing a one-tone test, making use of the Volterra series expansion and the general Wiener model. We then use the Mehler formula to derive the closed-form expressions of the PA's output power spectral density (PSD), ACPR, and EVM. The derivations are based on the assumption that the transmitted signals are complex Gaussian distributed in orthogonal frequency division multiplexing (OFDM) transmission systems. We validated the method by comparing measurement and simulation results and confirmed that it can appropriately predict the ACPR and EVM performance of the nonlinear PA output with OFDM inputs. In short, the method enables correct modeling of a wideband PA that amplifies dual-band signals merely by conducting a one-tone test.

Published as: I. Ando, G. K. Tran, K. Araki, T. Yamada, T. Kaho, Y. Yamaguchi, and K. Uehara, "Nonlinear Modeling and Analysis on Concurrent Amplification of Dual-band Gaussian Signals," *IEICE Transactions on Electronics*, Vol. E96-C, No. 10, pp. 1254–1262, Oct. 2013.

Achievement Award

Winner: Kazuhiro Uehara, NTT Network Innovation Laboratories

Date: June 4, 2015

Organization: IEICE

For research and development of software defined radio and cognitive radio technologies.

Papers Published in Technical Journals and Conference Proceedings

Q-value Improvement by Electrical Maximum Ratio Combining in Optical Diversity Transmission through Multi-core Fiber

M. Koga, T. Iida, T. Kobayashi, and H. Takara

Proc. of the 19th OptoElectronics and Communication Conference (OECC 2014), pp. 697–698, Melbourne, Australia, July 2014.

This paper evaluates the Q-factor improvement by maximum ratio combining for optical diversity transmission signals under the condition of the parametric process due to the Kerr effect and group velocity dispersion.

Wavelength-dependent Crosstalk in Trench-assisted Multi-core Fibers

F. Ye, J. Tu, K. Saitoh, H. Takara, and T. Morioka

Proc. of OECC 2014, pp. 308–309, Melbourne, Australia, July 2014.

Analytical expressions for wavelength-dependent crosstalk in homogeneous trench-assisted multi-core fibers are derived. The calculated results from the expressions agree well with the numerical simulation results based on finite element method.

Impact of Adding/Dropping of Nyquist-WDM Superchannels on Transmission Performance in an Elastic Optical Network

M. Jinno, K. Hosokawa, S. Kuwahara, Y. Yamada, and T. Kataoka

Proc. of OECC 2014, pp. 538–540, Melbourne, Australia, July 2014.

The transmission performance of Nyquist-WDM (wavelength-division multiplexing) superchannels with various modulation formats, which are added, passed through, and dropped at various points in a dispersion-uncompensated elastic optical network, is investigated through simulations.

100 Gbit/s Real-time Digital Coherent Transmission over a 32 km Legacy Multi-mode Graded-index Fiber

T. Hirooka, M. Nakazawa, T. Komukai, and T. Sakano

IEICE Electronics Express, Vol. 11, No. 15, pp. 1–7, August 2014.

We demonstrate 100 Gbit/s real-time digital coherent transmission over a 32-km multi-mode graded-index fiber (GIF) with a 62.5 μm core diameter by compensating for modal dispersion with digital signal processing (DSP). The DSP enables channel estimation and configuration as fast as 20 ms. Furthermore, the optical channel can be switched between GIF and a single-mode fiber within 30 ms.

Fundamental Study on Guided Wave Testing of Cylindrical Bars Embedded in Soil

M. Shoji and Y. Higashi

Proc. of the 2014 IEEE International Ultrasonics Symposium (IUS), pp. 1404–1407, Chicago, USA, September 2014.

Ultrasonic guided wave nondestructive evaluation technologies of long, small-diameter cylindrical steel bars embedded in soil have been experimentally studied using piezoelectric probes attached to the sides of the bars. On the basis of calculated attenuation dispersion curves for cylindrical steel bars surrounded by soil, 60- and 120-kHz longitudinal [L(0,1)] modes were chosen as guided waves for pulse echo measurements of 13-mm-diameter cylindrical steel bars in terms of their low attenuation. Pulse echo measurements were conducted for a 13-mm-diameter cylindrical steel bar embedded vertically to the ground with an underground depth of two meters. The signal-to-noise ratio of the first reflection signal from the bottom end surface of the embedded bar was estimated to be more than 30 dB for both 60- and 120-kHz L(0,1) modes. The evaluated attenuations of the guided waves in the underground part are adequately low for inspecting long bars and consistent with the calculated attenuation dispersion curve.

A Cross-layer Switching of OFDMA and MU-MIMO for Future WLAN Systems

T. Murakami, Y. Takatori, M. Mizoguchi, and F. Maehara

IEICE Communications Express, Vol. 3, No. 9, pp. 263–268, May 2015.

We propose a cross-layer switching method of orthogonal frequency division multiple access (OFDMA) and multiuser multiple input multiple output (MU-MIMO) for future wireless local area network systems. The proposed method, employed on the MAC layer, switches between OFDMA and MU-MIMO as the transmission overhead after processing by using physical layer information such as the overhead of CSI feedback, STA number, and data length in order to improve the transmission efficiency. Simulation results show that the proposed method achieves higher total throughput than conventional OFDMA or MU-MIMO where switching is not performed.

Counting Statistics of Single-electron Thermal Noise

K. Nishiguchi, Y. Ono, and A. Fujiwara

Proc. of the 2014 Workshop on Innovative Nanoscale Devices and Systems (WINDS), Hawaii, USA, November/December 2014.

We introduce a transition between the valid and invalid law of equipartition of energy in thermal noise in a small DRAM (dynamic random access memory). We analyzed Brownian motion, i.e., thermal noise, of single electrons going in and out a small capacitor whose E_c is comparable to $k_B T$. When $E_c > k_B T$, the electron motion is suppressed due to the violation of the law of equipartition of energy.

Long-reach and High-splitting-ratio 10G-EPON System with Semiconductor Optical Amplifier and N:1 OSU Protection

T. Tsutsumi, T. Sakamoto, Y. Sakai, T. Fujiwara, H. Ou, Y. Kimura, and K. Suzuki

Journal of Lightwave Technology, Vol. 33, No. 8, pp. 1–6, April 2015.

We successfully demonstrate a 41.3-km-reach and 128-split 10G-EPON system with dual-rate semiconductor optical amplifier on a commercial access network infrastructure. It uses N:1 optical subscriber unit (OSU) protection in order to improve system reliability cost-effectively. N:1 OSU protection also can switch from an active system to a redundant system without any frame loss. Moreover, the quality of bidirectional frame transmission is not degraded after switching, even with four-class priority control. Error-free transmission over 130 hours is also confirmed. These results indicate that N:1 OSU protection with automatic level control semiconductor optical amplifiers is a promising approach to practical 10G-EPON systems that are cost-effective and reliable.

All-photonic Quantum Repeaters

K. Azuma, K. Tamaki, and H.-K. Lo

Nature Communications, Vol. 6, No. 6787, pp. 1–7, April 2015.

Quantum communication holds promise for unconditionally secure transmission of secret messages and faithful transfer of unknown quantum states. Photons appear to be the medium of choice for quantum communication. Owing to photon losses, robust quantum communication over long lossy channels requires quantum repeaters. It is widely believed that a necessary and highly demanding requirement for quantum repeaters is the existence of matter quantum memories. Here we show that such a requirement is, in fact, unnecessary by introducing the concept of all-photonic quantum repeaters based on flying qubits. In particular, we present a protocol based on photonic cluster-state machine guns and a loss-tolerant measurement equipped with local high-speed active feedforwards. We show that, with such all-photonic quantum repeaters, the communication efficiency scales polynomially with the channel distance.

Quantum Benchmark via an Uncertainty Product of Canonical Variables

R. Namiki and K. Azuma

Physical Review Letters, Vol. 114, pp. 140503-1–6, April 2015.

We present an uncertainty-relation-type quantum benchmark for continuous-variable (CV) quantum channels that works with an input ensemble of Gaussian-distributed coherent states and homodyne measurements. It determines an optimal trade-off relation between canonical quadrature noises that is unbeatable by entanglement breaking channels and refines the notion of two quantum duties introduced in the original papers of CV quantum teleportation. This benchmark can verify the quantum-domain performance for all one-mode Gaussian channels. We also address the case of stochastic

channels and the effect of asymmetric gains.

Deviation from the Law of Energy Equipartition in a Small Dynamic-random-access Memory

P. A. Carles, K. Nishiguchi, and A. Fujiwara

Japanese Journal of Applied Physics, Vol. 54, pp. 06FG03-1–5, April 2015.

A small dynamic-random-access memory (DRAM) coupled with a high charge sensitivity electrometer based on a silicon field-effect transistor is used to study the law of equipartition of energy. By statistically analyzing the movement of single electrons in the DRAM at various temperature and voltage conditions in thermal equilibrium, we are able to observe a behavior that differs from what is predicted by the law of equipartition energy; when the charging energy of the capacitor of the DRAM is comparable to or smaller than the thermal energy $k_B T/2$, random electron motion is ruled perfectly by thermal energy; on the other hand, when the charging energy becomes higher in relation to the thermal energy $k_B T/2$, random electron motion is suppressed, which indicates a deviation from the law of equipartition of energy. Since the law of equipartition is analyzed using the DRAM, one of the most familiar devices, we believe that our results are perfectly universal among all electronic devices.

Real-time Robust Formant Tracking System Using a Phase Equalization-based Autoregressive Exogenous Model

H. Oohashi, S. Hiroya, and T. Mochida

Proc. of the 40th IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2015), Brisbane, Australia, April 2015.

This paper presents a real-time robust formant tracking system for speech signals and electroglottography (EGG) signals using a real-time phase equalization-based autoregressive exogenous model (RT-PEAR). PEAR can estimate formant frequencies robustly even for speech with high fundamental frequencies using phase equalization preprocessing and linear prediction coding (LPC) with an impulse train. To reduce the computational complexity of the original PEAR, a novel formulation of LPC with an impulse train is derived. EGG signals were used for stable detection of pitch marks since PEAR requires them. Formant estimation errors for the proposed method were less than 5% regardless of fundamental frequencies with 12-ms processing delay. This technique will be useful for real-time speech conversion and speech-language therapy.