External Awards

Postgres PRIZE Award
Winner: Masahiko Sawada, NTT Open Source Software Center (NTT Software Innvation Center)
Date: March 17, 2017
Organization: PgConf.Russia 2017

For "Built-in Sharding Update and Future."
Published as: M. Sawada, "Built-in Sharding Update and Future," PgConf.Russia 2017, Moscow, Russia, Mar. 2017.

Young Researcher's Award
Winner: Chihiro Kito, NTT Access Network Service Systems Laboratories
Date: March 24, 2017
Organization: The Institute of Electronics, Information and Communication Engineers (IEICE)

For "Loss Distribution Field Measurement of PON Branches with End-reflection Assisted Brillouin Analysis."
Published as: C. Kito, H. Takahashi, K. Toge, S. Ohno, and T. Manabe, "Loss Distribution Field Measurement of PON Branches with End-reflection Assisted Brillouin Analysis," Proc. of the IEICE General Conference 2016, B-13-15, Fukuoka, Japan, Mar. 2016.

Young Researcher's Award
Winner: Kohki Shibahara, NTT Network Innovation Laboratories
Date: March 24, 2017
Organization: IEICE

For "Spectrally-efficient Super-Nyquist Transmission by Multi-stage Successive Interference Cancellation."
Published as: K. Shibahara, A. Masuda, S. Kawai, and M. Fukutoku, "Spectrally-efficient Super-Nyquist Transmission by Multi-stage Successive Interference Cancellation," Proc. of the IEICE General Conference 2016, B-10-62, Fukuoka, Japan, Mar. 2016.

Young Researcher's Award
Winner: Hajime Katsuda, NTT Network Innovation Laboratories
Date: March 24, 2017
Organization: IEICE

For "A Study of Weighting Combining for CSI Estimation in SIC Process."
Published as: H. Katsuda, S. Ohmori, and K. Akabane, "A Study of Weighting Combining for CSI Estimation in SIC Process," Proc. of the IEICE General Conference 2016, B-5-157, Fukuoka, Japan, Mar. 2016.

Young Researcher's Award
Winner: Hiroki Kawahara, NTT Network Innovation Laboratories
Date: March 24, 2017
Organization: IEICE

For "Proposal of SDM Node to Enable Path Assignment in Any Wavelength/Core/Direction Port (1) - Proposal of SDM Node Architecture -."
Published as: H. Kawahara, A. Sawara, H. Yamamoto, S. Kawai, M. Fukutoku, Y. Miyamoto, K. Suzuki, and K. Yamaguchi, "Proposal of SDM Node to Enable Path Assignment in Any Wavelength/Core/Direction Port (1) - Proposal of SDM Node Architecture -," Proc. of the IEICE Society Conference 2016, B-10-55, Sapporo, Hokkaido, Japan, Sept. 2016.

Young Researcher's Award
Winner: Keita Yamaguchi, NTT Device Technology Laboratories
Date: March 24, 2017
Organization: IEICE

For "MxN Optical Switch by Holographic Phase Modulation."
Published as: K. Yamaguchi, M. Nakajima, Y. Ikuma, K. Suzuki, J. Yamaguchi, and T. Hashimoto, "MxN Optical Switch by Holographic Phase Modulation," Proc. of the IEICE General Conference 2016, C-3-54, Fukuoka, Japan, Mar. 2016.

Young Researcher's Award
Winner: Yusuke Muranaka, NTT Device Technology Laboratories
Date: March 24, 2017
Organization: IEICE

For "100-Gbps Optical Packet Switching with Ultralow-power Label Processor and Optical Switch."
Published as: Y. Muranaka, T. Segawa, S. Ibrahim, T. Nakahara, H. Ishikawa, and R. Takahashi, "100-Gbps Optical Packet Switching with Ultralow-power Label Processor and Optical Switch," Proc. of the IEICE Society Conference 2016, C-4-7, Sapporo, Hokkaido, Japan, Sept. 2016.

Young Researcher's Award
Winner: Takahiko Shindo, NTT Device Technology Laboratories
Date: March 24, 2017
Organization: IEICE

For "High Modulated Output Power of 9.0 dBm with L-band SOA Assisted Extended Reach EADFB Laser (AXEL)."
Published as: T. Shindo, W. Kobayashi, N. Fujiwara, Y. Ohiso, K. Hasebe, H. Ishii, and M. Itoh, "High Modulated Output Power of 9.0 dBm with L-band SOA Assisted Extended Reach EADFB Laser (AXEL)," Proc. of the IEICE Society Conference 2016, C-4-26, Sapporo, Hokkaido, Japan, Sept. 2016.

Best Presentation Award
Winner: Yoji Yamato, NTT Software Innovation Center
Date: March 31, 2017
Organization: The 5th IIAE International Conference on Industrial Application Engineering 2017 (ICIAE2017)

For "Proposal of Vital Data Analysis Platform Using Wearable Sensor."
Published as: A. Watanabe, Y. Matsuo, K. Watanabe, K. Ishibashi, and R. Kawahara, "Proposal of Vital Data Analysis Platform Using Wearable Sensor," Proc. of ICIAE2017, pp. 138–143, Kitakyushu, Fukuoka, Japan, Mar. 2017.

Papers Published in Technical Journals and Conference Proceedings

Entanglement Assisted Classical Communication Simulates "Classical Communication" without Causal Order

S. Akibue, M. Owari, G. Kato, and M. Murao

arXiv:1602.08835 [quant-ph], February 2016.

Phenomena induced by the existence of entanglement, such as nonlocal correlations, exhibit characteristic properties of quantum mechanics distinguished from classical theories. When entanglement is accompanied by classical communication, it enhances the power of quantum operations jointly performed by two spatially separated parties. Such a power has been analyzed based on the gap between the performances of joint quantum operations implementable by local operations at each party connected by classical communication with and without the assistance of entanglement. In this work, we present a new formulation for joint quantum operations connected by classical communication beyond special relativistic causal order but without entanglement and still within quantum mechanics. Using the formulation, we show that entanglement assisting classical communication necessary for implementing a class of joint quantum operations called separable maps can be interpreted to simulate "classical communication" that does not respect causal order. Our results reveal a new counter-intuitive aspect of entanglement related to spacetime.

Semi-automated Verification of Security Proofs of Quantum Cryptographic Protocols

T. Kubota, Y. Kakutani, G. Kato, Y. Kawano, and H. Sakurada

Journal of Symbolic Computation, Vol. 73, pp. 192–220, April 2016.

This paper presents a formal framework for semi-automated verification of security proofs of quantum cryptographic protocols. We simplify the syntax and operational semantics of quantum process calculus qCCS so that verification of weak bisimilarity of configurations becomes easier. In addition, we generalize qCCS to handle security parameters and quantum states symbolically. We then prove the soundness of the proposed framework. A software tool, named the verifier, is implemented and applied to the verification of Shor and Preskill's unconditional security proof of BB84. As a result, we succeed in verifying the main part in Shor and Preskill's unconditional security proof of BB84 against an unlimited adversary's attack semi-automatically; i.e., it is automatic except for giving user-defined equations.

Reducing Dense Virtual Network for Fast Embedding

T. Mano, T. Inoue, K. Mizutani, and O. Akashi

Proc. of INFOCOM 2016 (the 35th Annual IEEE International Conference on Computer Communications), April 2016.

Virtual network embedding has been intensively studied for a decade. The time complexity of most conventional methods has been reduced to the cube of the number of links. Since customers are likely to request a dense virtual network that connects every node pair directly ($|E| = O(|V|^2)$) based on a traffic matrix, the time complexity is actually $O(|E|^3 = |V|^6)$. If we were allowed to reduce this dense network into a sparse one before embedding, the time complexity could be decreased to $O(|V|^3)$; the time gap can be a million times for $|V| = 100$. The network reduction, however, combines several virtual links into a broader link, which makes the embedding cost (solution quality) much worse. This paper analytically and empirically investigates the trade-off between the embedding time and cost for the virtual network reduction. We define two simple reduction algorithms and analyze them with several interesting theorems. The analysis indicates that the embedding cost increases only linearly with exponential decay of embedding time. Thorough numerical evaluation justifies the desirability of the trade-off.

A Mobility-based Mode Selection Technique for Fair Spatial Dissemination of Data in Multi-channel Device-to-device Communication

H. Kuribayashi, K. Suto, H. Nishiyama, N. Kato, K. Mizutani, T. Inoue, and O. Akashi

Proc. of the 2016 IEEE International Conference on Communications, Kuala Lumpur, Malaysia, May 2016.

Wireless communication devices have spread widely in our society. However, they usually depend heavily on communication infrastructure, leaving them vulnerable to disasters or congestion of base stations. In these situations, a method to send out data without the support of infrastructure is required. Data transmission by device-to-device (D2D) communication is a reliable method that does not rely on infrastructure. In this paper, we aim to improve the data dissemination using D2D transmission by applying the concept of assigning "modes" to devices according to their own mobility. In our study, we assume a multi-channel environment, where devices will be allocated different amounts of frequency channels according to their modes. We propose a mode selection function that uses velocity information of the devices to assign modes. By using this function, it is possible to allocate more frequency channels to devices of high mobility, so that they can transmit their data to more devices as they move through a wide area. By mathematical analysis, we evaluated the fairness of disseminated data density among devices of various velocities, and the obtained results indicate the effectiveness of the proposed method for improving the efficiency of data dissemination.

Acceleration of Network Reachability Tests against a Huge Number of Hypercube Queries

R. Chen, T. Inoue, T. Mano, K. Mizutani, H. Nagata, and O. Akashi

Proc. of the 36th IEEE International Conference on Distributed Computing Systems, pp. 743–744, Nara, Japan, June 2016.

This paper proposes a novel windowing algorithm for network verification. Unlike existing windowing algorithms, our algorithm runs on a compressed data structure because the search space has to be represented in a compressed form due to the space complexity.

Security of Six-state Quantum Key Distribution Protocol with Threshold Detectors

G. Kato and K. Tamaki

Scientific Reports, Vol. 6, 30044, July 2016.

The security of quantum key distribution (QKD) is established by a security proof, and the security proof puts some assumptions on the

devices consisting of a QKD system. Among such assumptions, security proofs of the six-state protocol assume the use of a photon number resolving (PNR) detector, and as a result, the bit error rate threshold for secure key generation for the six-state protocol is higher than that for the BB84 protocol. Unfortunately, however, this type of detector is demanding in terms of the technological level compared to the standard threshold detector, and removing the necessity of such a detector enhances the feasibility of the implementation of the six-state protocol. Here, we develop the security proof for the six-state protocol and show that we can use the threshold detector for the six-state protocol. Importantly, the bit error rate threshold for the key generation for the six-state protocol (12.611%) remains almost the same as the one (12.619%) that is derived from the existing security proofs assuming the use of PNR detectors. This clearly demonstrates the feasibility of the six-state protocol with practical devices.

Efficient Virtual Network Optimization across Multiple Domains without Revealing Private Information

T. Mano, T. Inoue, D. Ikarashi, K. Hamada, K. Mizutani, and O. Akashi

IEEE Transactions on Network and Service Management, Vol. 13, No. 3, pp. 477–488, September 2016.

Building optimal virtual networks across multiple domains is an essential technology for offering flexible network services. However, existing research is founded on an unrealistic assumption that providers will share their private information including resource costs. Providers, as well known, never actually do that so as to remain competitive. Secure multi-party computation, a computational technique based on cryptography, can be used to secure optimization, but it is too time consuming. This paper presents a novel method that can optimize virtual networks built over multiple domains efficiently without revealing any private information. Our method employs secure multi-party computation only for masking sensitive values; it can optimize virtual networks under limited information without applying any time-consuming techniques. It is solidly based on the theory of optimality and is assured of finding reasonably optimal solutions.

Experiments show that our method is fast and optimal in practice, even though it conceals private information; it finds near optimal solutions in just a few minutes for large virtual networks with tens of nodes. This is the first work that can be implemented in practice for building optimal virtual networks across multiple domains.

Towards Low-delay Edge Cloud Computing through a Combined Communication and Computation Approach

T. G. Rodrigues, K. Suto, H. Nishiyama, N. Kato, K. Mizutani, T. Inoue, and O. Akashi

Proc. of the 2016 IEEE 84th Vehicular Technology Conference, Montreal, Canada, September 2016.

There are many applications which cannot be executed by mobile devices due to their limitations in memory, processing, and battery, among others. One solution to this would be offloading heavy tasks to cloud servers at the edge of the network, in a service model called edge cloud computing. The main Quality of Service requirement of this model is a low service delay, which can be achieved by lowering transmission delay and processing delay. Works in literature focus on either one of those two types of delay. This paper, however, argues that an approach which combines transmission and processing technologies to lower service delay would be more efficient. This idea is defended by an analysis of the service model and existing stochastic modeling of the edge cloud computing system. We conclude that a dual-focus approach would be the only way of truly minimizing the service delay, therefore being the desired method to improve Quality of Service. We conclude by laying the foundation for a future model that follows such a concept.

Statistical Estimation of the Names of HTTPS Servers with Domain Name Graphs

T. Mori, T. Inoue, A. Shimoda, K. Sato, S. Harada, K. Ishibashi, and S. Goto

Computer Communications, Vol. 94, pp. 104–113, November 2016.

This work develops a novel framework called Service-Flow map (SFMap), which estimates names of HTTPS servers by analyzing precedent domain name graph (DNS) queries/responses in a statistical way. The SFMap framework introduces the domain name graph, which can characterize the highly dynamic and diverse nature of DNS mechanisms. Such complexity arises from the recent deployment and implementation of DNS ecosystems, i.e., canonical name tricks used by CDNs (content delivery networks), the dynamic and diverse nature of DNS TTL (Time To Live) settings, and incomplete and unpredictable measurements due to the existence of various DNS caching instances. First, we demonstrate that SFMap establishes good estimation accuracies and outperforms a state-of-the-art approach. We also aim to identify the optimized setting of the SFMap framework. Next, based on the preliminary analysis, we introduce techniques to make the SFMap framework scalable to large-scale traffic data. We validate the effectiveness of the approach using large-scale Internet traffic.

An Efficient Framework for Data-plane Verification with Geometric Windowing Queries

T. Inoue, R. Chen, T. Mano, K. Mizutani, H. Nagata, and O. Akashi

Proc. of 2016 IEEE 24th International Conference on Network Protocols, Singapore, Singapore, November 2016.

This paper presents a novel framework of data-plane verification, which flexibly checks the inconsistency with great efficiency. For the purpose of generality, our framework formalizes a verification process with three abstract steps; each step is related to 1) packet behaviors defined by a configuration, 2) operator intentions described in a policy, and 3) the inspection of their relation. These steps work efficiently with each other on the simple quotient set of packet headers. This paper also reveals how the second step can be regarded as the windowing query problem in computational geometry. Two novel windowing algorithms are proposed with solid theoretical analyses. Experiments on real network datasets show that our framework with the windowing algorithms is surprisingly fast even when verifying the policy compliance; e.g., in a medium-scale network with thousands of switches, our framework reduces the verification time of all-pairs reachability from ten hours to ten minutes.

Overlapping of /o/ and /u/ in Modern Seoul Korean: Focusing on Speech Rate in Read Speech

T. Igeta, S. Hiroya, and T. Arai

Journal of the Korean Society of Speech Sciences, Vol. 9, No. 1, pp. 1–7, March 2017.

Previous studies have reported on the overlapping of F1 and F2 distribution for the vowels /o/ and /u/ produced by young Korean

speakers of the Seoul dialect. However, few studies have examined whether speech rate influences the overlapping of /o/ and /u/. In the current study, we examined whether speech rates affect overlapping of /o/ and /u/ in read speech by male and female speakers. For female speakers, discriminant analysis showed that the discriminant rate became lower as the speech rate increased from slow to fast. Thus, this indicates that speech rate is one of the factors affecting the overlapping of /o/ and /u/. For male speakers, on the other hand, the discriminant rate was not correlated with speech rate, but the overlapping was larger than that of female speakers in read speech. Moreover, read speech by male speakers was less clear than by female speakers. This indicates that the overlapping may be related to unclear speech by sociolinguistic reasons for male speakers.

Online MVDR Beamformer Based on Complex Gaussian Mixture Model with Spatial Prior for Noise Robust ASR

T. Higuchi, N. Ito, S. Araki, T. Yoshioka, M. Delcroix, and T. Nakatani

IEEE/ACM Transactions on Audio, Speech, and Language Processing, Vol. 25, No. 4, pp. 780–793, April 2017.

This paper considers acoustic beamforming for noise robust automatic speech recognition. A beamformer attenuates background noise by enhancing sound components coming from a direction specified by a steering vector. Hence, accurate steering vector estimation is paramount for successful noise reduction. Recently, time–frequency masking has been proposed to estimate the steering vectors that are used for a beamformer. In particular, we have developed a new form of this approach, which uses a speech spectral model based on a complex Gaussian mixture model (CGMM) to estimate the time–frequency masks needed for steering vector estimation, and extended the CGMM-based beamformer to an online speech enhancement scenario. Our previous experiments showed that the proposed CGMM-based approach outperforms a recently proposed mask estimator based on a Watson mixture model and the baseline speech enhancement system of the CHiME-3 challenge. This paper provides additional experimental results for our online processing, which achieves performance comparable to that of batch processing with a suitable block-batch size. This online version reduces the CHiME-3 word error rate (WER) on the evaluation set from 8.37% to 8.06%. Moreover, in this paper, we introduce a probabilistic prior distribution for a spatial correlation matrix (a CGMM parameter), which enables more stable steering vector estimation in the presence of interfering speakers. In practice, the performance of the proposed online beamformer degrades with observations that contain only noise or/and interference because of the failure of the CGMM parameter estimation. The introduced spatial prior enables the target speaker's parameter to avoid overfitting to noise or/and interference. Experimental results show that the spatial prior reduces the WER from 38.4% to 29.2% in a conversation recognition task compared with the CGMM-based approach without the prior, and outperforms a conventional online speech enhancement approach.

Human Perception of Sub-resolution Fineness of Dense Textures Based on Image Intensity Statistcs

M. Sawayama, S. Nishida, and M. Shinya

Journal of Vision, Vol. 17, No. 4, April 2017.

We are surrounded by many textures with fine dense structures, such as human hair and fabrics, whose individual elements are often finer than the spatial resolution limit of the visual system or that of a digitized image. Here we show that human observers have an ability to visually estimate subresolution fineness of those textures. We carried out a psychophysical experiment to show that observers could correctly discriminate differences in the fineness of hair-like dense line textures even when the thinnest line element was much finer than the resolution limit of the eye or that of the display. The physical image analysis of the textures, along with a theoretical analysis based on the central limit theorem, indicates that as the fineness of texture increases and the number of texture elements per resolvable unit increases, the intensity contrast of the texture decreases and the intensity histogram approaches a Gaussian shape. Subsequent psychophysical experiments showed that these image features indeed play critical roles in fineness perception; i.e., lowering the contrast made artificial and natural textures look finer, and this effect was most evident for textures with unimodal Gaussian-like intensity distributions. These findings indicate that the human visual system is able to estimate subresolution texture fineness on the basis of diagnostic image features correlated with subresolution fineness, such as the intensity contrast and the shape of the intensity histogram.
