External Awards

Distinguished Service Award
Winner: Hideki Maeda, NTT Network Service Systems Laboratories
Date: September 11, 2019
Organization: The Institute of Electronics, Information and Communication Engineers (IEICE)

For his distinguished services for planning and operations in Communications Society.

Female Analyst Award
Winner: Yuko Ueno, NTT Basic Research Laboratories
Date: September 12, 2019
Organization: The Japan Society for Analytical Chemistry

For her research on the creation of molecular recognition functional materials and their application to microanalysis.

Young Scientist Presentation Award
Winner: Hiroki Miyazako, NTT Basic Research Laboratories
Date: September 18, 2019
Organization: The Japan Society of Applied Physics

For "Directed Aggregation of Cardiomyocytes by Topographical Guides in Co-culture System."
Published as: H. Miyazako, T. Teshima, and Y. Ueno, "Directed Aggregation of Cardiomyocytes by Topographical Guides in Co-culture System," The 66th JSAP Spring Meeting 2019, Tokyo, Japan, Mar. 2019.

Young Scientist Presentation Award
Winner: Yuki K. Wakabayashi, NTT Basic Research Laboratories
Date: September 18, 2019
Organization: The Japan Society of Applied Physics

For "J_{eff}=3/2 Ferromagnetic Insulating State above 1000 K in a Double Perovskite Osmate Sr_3OsO_6."
Published as: Y. K. Wakabayashi, Y. Krockenberger, N. Tsujimoto, T. Boykin, S. Tsuneyuki, Y. Taniyasu, and H. Yamamoto, "J_{eff}=3/2 Ferromagnetic Insulating State above 1000 K in a Double Perovskite Osmate Sr_3OsO_6," The 80th JSAP Autumn Meeting 2019, Sapporo, Japan, Sept. 2019.

Outstanding Paper Award
Winner: Munekazu Date, Shinya Shimizu, and Hideaki Kimata, NTT Media Intelligence Laboratories
Date: September 19, 2019
Organization: 3D-Conf

For "Table-top Photographic-image 3D Display Using Visually Equivalent Light Field 3D."
Published as: M. Date, S. Shimizu, and H. Kimata, "Table-top Photographic-image 3D Display Using Visually Equivalent Light Field 3D," Proc. of 3D-Conf, P-2, Kanagawa, Japan, July 2019.

Best Paper Award
Winner: Toshiaki Miyazaki, The University of Aizu; Kazuya Anazawa, NTT Network Innovation Laboratories; Yasuyuki Maruyama, Seiya Kobayashi, Toku Segawa, Peng Li, The University of Aizu
Date: October 2, 2019
Organization: The Luxembourg Institute of Science and Technology (LIST)

For "Resilient Information Management for Information Sharing in Disaster-affected Areas Lacking Internet Access."
Published as: T. Miyazaki, K. Anazawa, Y. Maruyama, S. Kobayashi, T. Segawa, and P. Li, "Resilient Information Management for Information Sharing in Disaster-affected Areas Lacking Internet Access," The 18th International Conference on Ad Hoc Networks and Wireless (AdHoc-Now 2019), Luxembourg, Oct. 2019.

Industrial Standardization Merit Award
Winner: Seishi Takamura, NTT Media Intelligence Laboratories
Date: October 8, 2019
Organization: Ministry of Economy, Trade and Industry

For his technical contribution to and leadership in standardization efforts in ISO/IEC JTC 1/SC 29 (International Organization for Standardization/International Electrotechnical Commission Joint Technical Committee 1/Subcommittee 29)—Coding of audio, picture, multimedia, and hypermedia information.

Papers Published in Technical Journals and Conference Proceedings

Experimental Evaluation of WaveRNN Predictor for Audio Lossless Coding

S. Amada, R. Sugiura, Y. Kamamoto, N. Harada, T. Moriya, T. Yamada, and S. Makino

Proc. of the 2019 RISP International Workshop on Nonlinear Circuits, Communications and Signal Processing (NCSP2019), pp. 315–318, Honolulu, HI, USA, March 2019.

This paper describes a new scheme of speech and audio lossless coding. MPEG-4 Audio Lossless Coding (ALS) is the international standard lossless compression scheme of audio signals. It uses linear predictor and compresses the signal by converting the signal into information such as prediction residuals and prediction coefficients. In the compressed signal with MPEG-4 ALS, the prediction residuals occupy a large amount of such information. Improving the performance of the predictor is directly related to improving compression performance. Using non-linear predictors in lossless coding may enable flexible prediction and improve prediction performance. A WaveRNN is a deep neural network performing non-linear prediction. The output of a WaveRNN is the predicted probability distribution of the target sample. Arithmetic coding can generate an optimal code for a set of arbitrary symbols and probabilities. A WaveRNN is trained to minimize the bitrate after encoding when using arithmetic coding for the output of the WaveRNN. This paper proposes a scheme of speech and audio lossless coding that combines a WaveRNN with arithmetic coding. Experimental evaluation confirmed that the proposed scheme reduced the number of bits by around 0.7 bits per sample compared to MPEG-4 ALS in speech coding. DNN-based speech and audio coding techniques are expected to transcend the international standard technologies.

Pilot Study on Semi-automated Patch Diffing by Applying Machine-learning Techniques

A. Nakajima

Proc. of ROOTCON 13, Tagaytay, The Philippines, September 2019.

When developing a 1-day exploit code, patch diffing (binary diffing) is one of the major techniques to identify the part of the code to which security fixes are applied. This technique is well-known among reverse engineers; thus, to support diffing, various tools such as BinDiff, TurboDiff, and Diaphora have been developed. Although these tools effectively support analysis, patch diffing is still difficult because it requires extensive knowledge and experience. To address this issue, we conducted a pilot study to achieve semi-automated patch diffing by applying machine-learning techniques. Based on the hypothesis that "similar types of vulnerabilities will be fixed in a similar manner," we applied an unsupervised machine-learning technique to extract patterns and considered an approach to achieve semi-automated patch diffing. In the talk, we will give details of our pilot study and share the insights that we have gained. We believe that our insights will help other researchers conduct similar research in the future.

Shape Control of Discrete Generalized Gaussian Distributions for Frequency-domain Audio Coding

R. Sugiura, Y. Kamamoto, and T. Moriya

IEEE/ACM Trans. Audio, Speech, Language Process., October 2019.

Entropy coding, which is an essential component of audio compression, is required to manage the tradeoffs between compression efficiency and computational complexity, and the strategy to achieve entropy coding highly depends on the distributions of inputs. We present a coder for controlling distributions of input numbers to enhance the compression efficiency of Golomb-Rice (GR) encoding, one of the simplest entropy coding methods optimal for Laplacian distributions. We argue that the proposed coder enables GR encoding to assign nearly the optimal code length for a wider range of distributions, generalize Gaussian distributions, and maintain low computational cost. A simulation using random numbers revealed that the proposed coder works about 6 times faster than the state-of-the-art arithmetic coder for Gaussian-distributed integers by maintaining the increase in relative redundancy to around 2.6%, which is much lower than that of a conventional GR coder. We also present an application of our coder to a practical speech and audio coding scheme. An objective evaluation for real speech and audio signals confirms the advantages of the proposed coder in compression. This coder is expected to widen the capability of low-complexity entropy coding, providing us with more flexible codec designs.

Quantum Key Distribution with Simply Characterized Light Sources

A. Mizutani, T. Sasaki, Y. Takeuchi, K. Tamaki, and M. Koashi

npj Quantum Information, Vol. 5, Article no. 87, October 2019.

To guarantee the security of quantum key distribution (QKD), security proofs of QKD protocols have assumptions on devices. Commonly used assumptions are, for example, each random bit of information chosen by a sender needs to be precisely encoded on an optical emitted pulse and the photon-number probability distribution of the pulse needs to be precisely known. These typical assumptions imposed on such light sources are rather strong and would be difficult to verify in practical QKD systems. Our goal was to replace those strong assumptions on light sources with weaker ones. We adopted the differential-phase-shift (DPS) QKD protocol and drastically reduced the requirements on light sources, while assuming trusted and photon-number-resolving detectors for the measurement unit. Specifically, we only assume the independence among emitted pulses, independence of the vacuum emission probability from a chosen bit, and upper bounds on the tail distribution function of the total photon number in a single block of pulses for single, two, and three photons. Notably, no other detailed characterizations, such as the amount of phase modulation, are required. Our security proof significantly relaxes the demands for light sources, which paves the way to guarantee implementation security with simple verification of devices.

Understanding Community Structure in Layered Neural Networks

C. Watanabe, K. Hiramatsu, and K. Kashino

Neurocomputing, Vol. 367, pp. 84–102, November 2019.

A layered neural network is now one of the most common choices for predicting high-dimensional practical data sets, where the relationship between input and output data is complex and cannot be represented well with simple conventional models. This network's effectiveness has been shown in various tasks, such as image recognition and natural language processing; however, the lack of interpretability of the trained result by such a network has limited its application area. In our previous studies, we proposed methods for extracting a simplified global structure of a trained layered neural network by applying a network analysis method and classifying the units into communities according to their connection patterns with adjacent layers. These methods provided us with knowledge about the strength of the relationship between communities from the existence of bundled connections, which are determined by the threshold processing of the connection ratio between pairs of communities. However, it has been difficult to precisely understand the role of each community by observing the resulting modular structure with these previous methods. We could only determine to which sets of the input and output dimensions each community was mainly connected by tracing the bundled connections from the community to the input and output layers. Another problem is that the finally obtained modular structure is highly dependent on the setting of the threshold hyperparameter used for determining bundled connections, leading to a different result to the discussion about the role of each community. We propose a method called Community Analysis for Modular Neural Networks (CA-MNN) for quantitatively interpreting the role of each community regarding inference, which we extracted using our previously reported methods, by defining the effect of each input dimension on a community and the effect of a community on each output dimension. We experimentally show that CA-MNN can reveal the role of each component of a layered neural network by applying the neural networks to three types of data sets, extracting communities from the trained network, and applying CA-MNN to the community structure.