External Awards

38th CHEMINAS Poster Award

Winner: Hiroki Miyazako, Tetsuhiko Teshima, and Yuko Ueno, NTT Basic Research Laboratories
Date: November 1, 2018
Organization: Society for Chemistry and Micro-Nano Systems (CHEMINAS)

For "Direction of Topological Defects in Cell Population by Computer-aided Design of Geometrical Boundaries."
Published as: H. Miyazako, T. Teshima, and Y. Ueno, "Direction of Topological Defects in Cell Population by Computer-aided Design of Geometrical Boundaries," 38th CHEMINAS, 1P28, Sapporo, Japan, Oct./Nov. 2018.

APMC 2018 Prize

Winner: Hiroshi Hamada, Takuya Tsutsumi, Hiroki Sugiyama, and Hideyuki Nosaka, NTT Device Technology Laboratories
Date: November 9, 2018
Organization: 2018 Asia-Pacific Microwave Conference (APMC 2018)

For "High-output-power and Reverse-isolation G-band Power Amplifier Module Based on 80-nm InP HEMT Technology."
Published as: H. Hamada, T. Tsutsumi, H. Sugiyama, and H. Nosaka, "High-output-power and Reverse-isolation G-band Power Amplifier Module Based on 80-nm InP HEMT Technology," Proc. of APMC 2018, Kyoto, Japan, Nov. 2018.

Papers Published in Technical Journals and Conference Proceedings

Merlin-Arthur with Efficient Quantum Merlin and Quantum Supremacy for the Second Level of the Fourier Hierarchy

T. Morimae, Y. Takeuchi, and H. Nishimura
Quantum, Vol. 2, p. 106, November 2018.

We introduce a simple sub-universal quantum computing model, which we call the Hadamard-classical circuit with one-qubit (HC1Q) model. It consists of a classical reversible circuit sandwiched by two layers of Hadamard gates, and therefore it is in the second level of the Fourier hierarchy. We show that output probability distributions of the HC1Q model cannot be classically efficiently sampled within a multiplicative error unless the polynomial-time hierarchy collapses to the second level. The proof technique is different from those used for previous sub-universal models such as IQP, Boson Sampling, and DQC1, and therefore the technique itself might be useful for finding other sub-universal models that are hard to classically simulate. We also study the classical verification of quantum computing in the second level of the Fourier hierarchy. To this end, we define a promise problem, which we call the probability distribution distinguishability with maximum norm (PDD-Max). It is a promise problem to decide whether output probability distributions of two quantum circuits are far apart or close. We show that PDD-Max is BQP-complete, but if the two circuits are restricted to some types in the second level of the Fourier hierarchy such as the HC1Q model or the IQP model, PDD-Max has a Merlin-Arthur system with quantum polynomial-time Merlin and classical probabilistic polynomial-time Arthur.

Development and Evaluation of an Applause and Hand-clapping Sound Feedback System to Improve Realistic Feeling on Live Viewing

A. Fujimori, K. Kawahara, Y. Kamamoto, T. G. Sato, M. Nishikawa, A. Omoto, and T. Moriya

IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences, Vol. J101-A, No. 12, pp. 273–282, December 2018 (in Japanese).

Considering the increasing popularity of public viewing, improvement of immersive content is becoming an important issue. This paper presents APRICOT: APplause for Realistic-Immersive COntents Transmission system as one of the solutions for enhancing the quality of live-viewing services. APRICOT detects the sounds of applause and hand-clapping at a remote site, transmits the information as meta-data, and represents the data at the host site. Since hand-clapping is the most common response for an audience and is simple to replay, the system can transmit the excitement in real time with low delay. Experiments indicate that feedback of the applause and hand-clapping enhances the immersive sound, especially at the host site.

Impossibility of Blind Quantum Sampling for Classical Client

T. Morimae, H. Nishimura, Y. Takeuchi, and S. Tani
arXiv:1812.03703 [quant-ph], December 2018.

Blind quantum computing enables a client, who can only generate or measure single-qubit states, to delegate quantum computing to a remote quantum server in such a way that the input, output, and

program are hidden from the server. It is an open problem whether a completely classical client can delegate quantum computing blindly. In this paper, we show that if a completely classical client can blindly delegate sampling of sub-universal models, such as the DQC1 model and the IQP model, then the polynomial-time hierarchy collapses to the third level. Our delegation protocol is the one where the client first sends a polynomial-length bit string to the server, and then the server returns a single bit to the client. Generalizing the no-go result to more general setups is an open problem.

A Supervised Learning Approach to Granger Causality Inference

Y. Chikahara and A. Fujino

IPSJ Transactions on Mathematical Modeling and Its Applications, Vol. 11, No. 3, pp. 58–73, December 2018 (in Japanese).

Granger causality is one of the definitions of temporal causality between variables, and inferring Granger causality is an important task in time series analysis. Traditional methods use regression models for this task. Since the inference accuracies of these methods depend largely on whether or not we select an appropriate regression model for each time series data element. However, it is not easy because such selection of regression models requires a deep understanding of data analysis. This paper proposes a supervised learning framework that utilizes a classifier instead of regression models. Our proposed method employs a feature representation that utilizes the distance between the conditional distributions given past variable values. We experimentally show that the feature representation gives sufficiently different feature vectors for time series with different Granger causality.

FiveStar VR: Shareable Travel Experience through Multisensory Stimulation to the Whole Body

K. Shimizu, G. Sueta, K. Yamaoka, K. Sawamura, Y. Suzuki, K. Yoshida, V. Yem, Y. Ikei, T. Amemiya, M. Sato, K. Hirota, and M. Kitazaki

Proc. of the 11th ACM SIGGRAPH Conference and Exhibition on Computer Graphics and Interactive Techniques in Asia (SIGGRAPH ASIA 2018), Tokyo, Japan, December 2018.

We have developed a multisensory virtual reality system, FiveStar VR (five senses theater for VR), that enables participants to relive or share each other's behavior through well-designed simultaneous stimulation to multiple modalities. FiveStar VR consists of somatosensory displays in addition to the conventional audio-visual VR setup. In the FiveStar VR, the body parts of the participant are forced to move, which is synchronized with those of an avatar in the VR space, resulting in inducing a strong perception of presence at the past walking behavior of someone else. By taking advantage of the cyclic nature of walking, the arms, the lower limbs, and the body are synchronously moved to simulate the sensation of real walking. These motion profiles do not completely follow the measured data of real walking, but each gain of magnitude of the modalities is adjusted on the basis of the subjective intensity of motion impression, mainly due to the lack of the sensory suppression from the motor command of the participant. The demonstration of our exhibition booth presents a virtual trip to tourist sites in Toronto and Niagara Falls, Canada. A short-time experience of walking around the area is relived/shared by the attendee.

Leg-Jack: Generation of the Sensation of Walking by Electrical and Kinesthetic Stimuli to the Lower Limbs

H. Kaneko, T. Amemiya, V. Yem, Y. Ikei, K. Hirota, and M. Kitazaki

Proc. of SIGGRAPH ASIA 2018, Tokyo, Japan, December 2018.

We developed a neurosensory and kinesthetic stimulation system that generated a walking sensation for a seated user. An electrical stimulus was applied to the Achilles' and tibialis anterior tendons with a kinesthetic stimulus generated by a lower limb device driven synchronously with an egocentric visual scene during virtual walking. The system works as part of an experience replication scheme that aims to receive the physical activity of another (person, entity, etc.). As a common bodily activity of humans, walking motion was focused on. The evaluation experiment has shown that walking sensation was increased by each stimulation at a 1% significance level. In this demonstration, the user on a chair can feel as if he/she is walking in a haunted house. The user can move the upper body freely to look around with a virtual flashlight; however, the lower body is possessed by the other entity. The user walks into the house despite his/her intention. The work gives the user a realistic experience which was not sufficiently generated with only a movie and sounds.

Channel Code Using Constrained-random-number Generator Revisited

Jun Muramatsu and S. Miyake

IEEE Transactions on Information Theory, Vol. 65, No. 1, pp. 500–510, January 2019.

A construction of a channel code by using a source code with decoder side information is introduced. The encoder and decoder pair of any source code can be used for the construction. Constrained-random-number generators, which generate random numbers satisfying a condition specified by a function and its value, are used to construct stochastic encoders and decoders. The result suggests that we can divide the channel coding problem into the problems of channel encoding and source decoding with side information.