External Awards

Research Encouragement Award
Winner: Hitoshi Niigaki, Ken Tsutsuguchi, and Tetsuya Kinebuchi, NTT Media Intelligence Laboratories
Date: June 22, 2018
Organization: The Institute of Image Electronics Engineers of Japan

For "Detection of Tree Trunk from 3D Point-cloud Measured by Mobile Mapping System –Feature Extraction for Sweep Object Detection–."

Best Paper Award
Winner: Kyoko Sudo, Toho University; Kazuhiko Murasaki, Tetsuya Kinebuchi, Media Intelligence Laboratories; Shigeko Kimura, Kayo Waki, and Kazuhiko Ohe, The University of Tokyo
Date: July 15, 2018
Organization: Multimedia on Cooking and Eating Activities, Human Communication Group, the Institute of Electronics, Information and Communication Engineers (IEICE)

For "Intuitively Estimating the Healthiness of Meals from Their Images."
Published as: K. Sudo, K. Murasaki, T. Kinebuchi, S. Kimura, K. Waki, and K. Ohe, "Intuitively Estimating the Healthiness of Meals from Their Images," Proc. of the Joint Workshop on Multimedia for Cooking and Eating Activities and Multimedia Assisted Dietary Management, Stockholm, Sweden, July 2018.

IEEE Photonics Society Distinguished Lecturer
Winner: Hiroki Takesue, NTT Basic Research Laboratories

Date: July 18, 2018
Organization: The Institute of Electrical and Electronics Engineers (IEEE) Photonics Society

For "Coherent Ising Machine: A Photonic Ising Model Solver Based on Degenerate Optical Parametric Oscillator Network."

Suzuki Memorial Award
Winner: Shota Orihashi, NTT Media Intelligence Laboratories
Date: August 30, 2018
Organization: The Institute of Image Information and Television Engineers (ITE)

For "A Study on Fast Block Partitioning in HEVC Using Convolutional Neural Network" (in Japanese).
Published as: S. Orihashi, S. Kudo, M. Kitahara, and A. Shimizu, "A Study on Fast Block Partitioning in HEVC Using Convolutional Neural Network," ITE Annual Convention, 21B-3, Tokyo, Japan, Aug./Sept. 2017.

IPSJ Yamashita SIG Research Award
Winner: Hiroyuki Kirinuki, NTT Software Innovation Center
Date: August 30, 2018
Organization: Information Processing Society of Japan (IPSJ)

For "Automatic Locator Repair on GUI Test Scripts."
Published as: H. Kirinuki, H. Tanno, and K. Natsukawa, "Automatic Locator Repair on GUI Test Scripts," Proc. of IPSJ/SIGSE Software Engineering Symposium (SES2017), Tokyo, Japan, Aug./Sept. 2017.

Papers Published in Technical Journals and Conference Proceedings

Interactive Proofs with Polynomial-time Quantum Prover for Computing the Order of Solvable Groups
F. Le Gall, T. Morimae, H. Nishimura, and Y. Takeuchi
Proc. of the 43rd International Symposium on Mathematical Foundations of Computer Science (MFCS 2018), Vol. 117, No. 1, pp. 26:1–26:13, Liverpool, UK, August 2018.
In this paper we consider what can be computed by a user interacting with a potentially malicious server, when the server performs polynomial-time quantum computation but the user can only perform polynomial-time classical (i.e., non-quantum) computation. Understanding the computational power of this model, which corresponds to polynomial-time quantum computation that can be efficiently verified classically, is a well-known open problem in quantum computing. Our result shows that computing the order of a solvable group, which is one of the most general problems for which quantum computing exhibits an exponential speed-up with respect to classical computing, can be realized in this model.

Novel Optimizing Technique for Linear Optical Mach-Zehnder Modulator and Its Experimental Verification Using PAM-8 Signal
H. Kawakami, H. Yamazaki, and Y. Miyamoto
Proc. of the 44th European Conference on Optical Communication (ECOC 2018), We2.13, Rome, Italy, September 2018.

We propose an optimizing technique for a linear optical modulator for selecting whether to linearize the optical power or electric field response. With this technique, a PAM-8 signal was successfully generated with a driving signal having a swing voltage of 0.7Vpi.

Quantum Computational Universality of Hypergraph States with Pauli-X and Z Basis Measurements

Y. Takeuchi, T. Morimae, and M. Hayashi

arXiv:1809.07552 [quant-ph], September 2018.

Measurement-based quantum computing is one of the most promising quantum computing models. Among various universal resource states proposed so far, the Union Jack state is the best in the sense that it requires only Pauli-X, Y, and Z basis measurements. It was open whether only two Pauli bases are enough for universal measurement-based quantum computing. In this paper, we construct a universal hypergraph state that only requires X and Z-basis measurements. We also show that the fidelity between a given state and our hypergraph state can be estimated in polynomial time using only X and Z-basis measurements, which is useful for the verification of quantum computing. Furthermore, in order to demonstrate an advantage of our hypergraph state, we construct a verifiable blind quantum computing protocol that requires only X and Z-basis measurements for the client.

Verification of Many-qubit States

Y. Takeuchi and T. Morimae

Proc. of the 18th Asian Quantum Information Science Conference (AQIS 2018), p. 48, Nagoya, Aichi, Japan, September 2018.

Verification is a task to check whether a given quantum state is close to an ideal state or not. In this paper, we show that several many-qubit states can be verified with only single-qubit Pauli measurements. Specifically, we introduce protocols for ground states of Hamiltonians, quantum states generated by some quantum circuits, and all polynomial-time-generated hypergraph states. Importantly, we do not make any assumption that the i.i.d. copies of the same states are given. Our protocols work even if entanglement is created among copies in any artificial way. As an application, we consider the verification of the Bremner-Montanaro-Shepherd-type IQP circuits.

Power of Uninitialized Qubits in Shallow Quantum Circuits

Y. Takahashi and S. Tani

Proc. of AQIS 2018, p. 49, Nagoya, Aichi, Japan, September 2018.

We study the computational power of shallow quantum circuits with $O(\log n)$ initialized and $n^{O(1)}$ uninitialized ancillary qubits, where n is the input length and the initial state of the uninitialized ancillary qubits is arbitrary. First, we show that such a circuit can compute any symmetric function on n bits that is computable by a uniform family of polynomial-size classical circuits. Then, we regard such a circuit as an oracle and show that a polynomial-time classical algorithm with the oracle can estimate the elements of any unitary matrix corresponding to a constant-depth quantum circuit on n qubits. Since it seems unlikely that these tasks can be done with only $O(\log n)$ initialized ancillary qubits, our results give evidences that adding uninitialized ancillary qubits increases the computational power of shallow quantum circuits with only $O(\log n)$ initialized ancillary qubits. Lastly, to understand the limitations of uninitialized ancillary qubits, we focus on sub-logarithmic-depth quantum circuits with them and show the impossibility of computing the parity function on n bits.

Resource-efficient Verification of Quantum Computing Using Serfling's Bound

Y. Takeuchi

AQIS 2018 Kyoto satellite workshop on quantum computing, Kyoto, Japan, September 2018.

In measurement-based quantum computing, checking whether correct graph states are generated or not is essential for reliable quantum computing. Several verification protocols for graph states have been proposed, but none of these are particularly resource efficient: Many copies are required in order to extract a single state that is guaranteed to be close to the ideal graph state. For example, the best protocol currently known requires $O(n^{15})$ copies of the state, where n is the size of the graph state. In this talk, we propose a significantly more resource-efficient verification protocol for graph states that needs only $O(n^5 \log n)$ copies. The key idea that achieves such a drastic improvement is to employ Serfling's bound, which is a probability inequality in classical statistics. Utilizing Serfling's bound also enables us to generalize our protocol for qudit graph states and continuous-variable weighted hypergraph states. This talk is based on joint work with Atul Mantri, Tomoyuki Morimae, Akihiro Mizutani, and Joseph F. Fitzsimons. The detail is given in arXiv:1806.09138.