External Awards

DCASE 2019 Best Paper Award

Winners: Shota Ikawa, The University of Tokyo; Kunio Kashino, NTT Communication Science Laboratories
Date: October 25, 2019
Organization: The Workshop on Detection and Classification of Acoustic Scenes and Events (DCASE) Community

For "Neural Audio Captioning Based on Conditional Sequence-to-Sequence Model."
Published as: S. Ikawa and K. Kashino, "Neural Audio Captioning Based on Conditional Sequence-to-Sequence Model," Proc. of DCASE2019, pp. 99–103, NY, USA, Oct. 2019.

CHI 2020 Honorable Mention Award

Winner: Kentaro Yasu, NTT Communication Science Laboratories
Date: April 16, 2020
Organization: Association for Computing Machinery's Special Interest Group on Computer Human Interaction (ACM SIGCHI)

For "MagneLayer: Force Field Fabrication by Layered Magnetic Sheets."
Published as: K. Yasu, "MagneLayer: Force Field Fabrication by Layered Magnetic Sheets," Proc. of the 2020 CHI Conference on Human Factors in Computing Systems, Apr. 2020.

IEEE SPS Young Author Best Paper Award

Winners: Daichi Kitamura, National Institute of Technology, Kagawa College; Nobutaka Ono, Tokyo Metropolitan University; Hiroshi Sawada, Hirokazu Kameoka, NTT Communication Science Laboratories; Hiroshi Saruwatari, The University of Tokyo
Date: May 5, 2020
Organization: IEEE Signal Processing Society

For "Determined Blind Source Separation Unifying Independent Vector Analysis and Nonnegative Matrix Factorization."
Published as: D. Kitamura, N. Ono, H. Sawada, H. Kameoka, and H. Saruwatari, "Determined Blind Source Separation Unifying Independent Vector Analysis and Nonnegative Matrix Factorization," IEEE/ACM Trans. Audio, Speech, Language Process., Vol. 24, No. 9, 2016.

AI2000 Most Influential Scholar Honorable Mention

Winner: Tomohiro Nakatani, NTT Communication Science Laboratories
Date: May 10, 2020
Organization: AMiner.org, Tsinghua University

For his outstanding contributions to the field of speech recognition between 2009 and 2019.

OSA Senior Member

Winner: Salah Ibrahim, NTT Device Technology Laboratories
Date: June 1, 2020
Organization: The Optical Society (OSA)

For his professional accomplishments with emphasis on optically switched networks and their enabling technologies.

DICOMO2020 Best Presentation Award

Winner: Keisuke Tsunoda, NTT Service Evolution Laboratories/NTT Smart Data Science Center
Date: June 26, 2020
Organization: Information Processing Society of Japan (IPSJ)

For "Estimation Number and Dwell Time of Visitors from CO_2 Concentration Based on Partial Modeling with Variable Time Window."
Published as: K. Tsunoda, N. Arai, and K. Obana, "Estimation Number and Dwell Time of Visitors from CO_2 Concentration Based on Partial Modeling with Variable Time Window," Proc. of the Multimedia, Distributed, Cooperative, and Mobile Symposium (DICOMO) 2020, pp. 259–266, June 2020.

Civil Engineering Informatics (CEI) Paper Award

Winners: Daisuke Uchibori, NTT Access Network Service Systems Laboratories; Sho Ashikaga, NTT EAST; Taishi Deguchi, Kazuhiro Nishimoto, NTT InfraNet Corporation; Hiroyuki Takahashi, Research and Development Planning Department, NTT; Masafumi Nakagawa, Kazuhiko Goto, NTT EAST; Shuichi Yanagi, NTT Device Technology Laboratories
Date: July 3, 2020
Organization: Japan Society of Civil Engineers

For "Development of a Manhole Cover with Pattern for Improved Durability and Visibility of Worn Condition."
Published as: D. Uchibori, S. Ashikaga, T. Deguchi, K. Nishimoto, H. Takahashi, M. Nakagawa, K. Goto, and S. Yanagi, "Development of a Manhole Cover with Pattern for Improved Durability and Visibility of Worn Condition," Journal of Japan Society of Civil Engineers F3 (Civil Engineering Informatics), Vol. 75, No. 1, pp. 1–12, 2019.

Papers Published in Technical Journals and Conference Proceedings

Classically Simulating Quantum Circuits with Local Depolarizing Noise

Y. Takahashi, Y. Takeuchi, and S. Tani

arXiv:2001.08373v1 [quant-ph], January 2020.

We studied the effect of noise on the classical simulatability of quantum circuits defined by computationally tractable (CT) states and efficiently computable sparse (ECS) operations. Examples of such circuits, which we call CT-ECS circuits, are instantaneous quantum polynomial-time (IQP), Clifford Magic, and conjugated Clifford circuits. This means that there exist various CT-ECS circuits such that their output probability distributions are anti-concentrated and not classically simulatable in a noise-free setting (under plausible assumptions). First, we consider a noise model where a depolarizing channel with an arbitrarily small constant rate is applied to each qubit at the end of computation. We show that, under this noise model, if an approximate value of the noise rate is known, any CT-ECS circuit with an anti-concentrated output probability distribution is classically simulatable. This indicates that the presence of small noise drastically affects the classical simulatability of CT-ECS circuits. Then, we consider an extension of the noise model where the noise rate can vary with each qubit and provide a similar sufficient condition for classically simulating CT-ECS circuits with anti-concentrated output probability distributions.

Si-nanowire-FET Sensor Detecting High-frequency Oscillation of a Multilayer-graphene MEMS by Means of Reflectometry Technique

K. Nishiguchi and A. Fujiwara

Proc. of the 67th Japan Society of Applied Physics Spring Meeting, 12p-D311-7, March 2020.

Using a field-effect transistor (FET)-based sensor composed of multiple Si nanowire channels, we demonstrated the detection of mechanical oscillations of a multilayer-graphene microelectromechanical system (MEMS). The multilayer graphene sheet is suspended above the FET's channels, which is driven by a high-frequency signal via microwave probes connected to double LC matching circuits. Such a reflectometry technique enables detection of graphene's mechanical oscillations at 240 MHz.

Control of Thermal Noise Originating from Single-electron Brownian Motion

K. Nishiguchi, K. Chida, and A. Fujiwara

Proc. of the 6th International Symposium toward the Future of Advanced Researches in Shizuoka University (ISFAR-SU 2020), pp. 24–25, March 2020.

The performance of a data-processing circuit composed of Si field-effect transistors (FETs) has been improved by the miniaturization of FETs. However, this FET miniaturization generates more noise, which degrades FET performance. Among various kinds of noises, thermal noise, which originates from the Brownian motion of electrons in electronic devices, is one of fundamental and unavoidable noises. This noise is also a main factor in providing the lowest limit of energy for one bit of information in data processing, which is known as Landauer's limit. Therefore, thermal noise is one of the most important topics that could provide insight into achieving low-power-consumption electric devices.

We introduce the microscopic analysis of thermal noise, i.e., counting statistics of single-electron Brownian motion, using Si FETs. Based on the analogy of Maxwell's demon controlling single-electron Brownian motion, we also discuss electric power generation from the Brownian motion.

Single-electron-resolution Noise Analysis and Application Using High-sensitivity Charge Sensor

K. Nishiguchi, K. Chida, and A. Fujiwara

AAPPS (Association of Asia Pacific Physical Societies) Bulletin, Vol. 29, No. 3, pp. 4–9, June 2020.

We introduce an analysis of thermal noise using a high-sensitivity charge sensor. Since the sensor is based on a Si field-effect transistor with a channel size of approximately 10 nm, it exhibits high sensitivity to detect single-electron motion even at room temperature. By connecting this sensor to a small capacitor composed of dynamic random-access memory, thermal noise in the capacitor can be monitored in real time with single-electron resolution. Such real-time monitoring reveals that when the capacitor is small enough that the charging energy for storing one electron in the capacitor is greater than the thermal energy, thermal noise is suppressed and enhanced. This represents a deviation from the law of energy equipartition. In addition to this noise analysis, we conducted an experiment on power generation using an analogy of Maxwell's demon that detects and manipulates single-electron motion, which should accelerate research in the field of thermodynamics. These experimental results indicate that the high-sensitivity charge sensor can function as a superior platform for microscopic analysis of noise, small electronic devices, and thermodynamics as well as a demonstration of theoretical expectation in basic research.

1-day, 2 Countries—A Study on Consumer IoT Device Vulnerability Disclosure and Patch Release in Japan and the United States

A. Nakajima, T. Watanabe, E. Shioji, M. Akiyama, and M. Woo

IEICE Transactions on Information and Systems, Vol. E103-D, No. 7, pp. 1524–1540, July 2020.

With our ever-increasing dependence on computers, many governments around the world have started to investigate strengthening the regulations on vulnerabilities and their lifecycle management. Although many previous works have studied this problem space for mainstream software packages and web applications, relatively few have studied this for consumer Internet of Things (IoT) devices. As the first step towards filling this void, this paper presents a pilot study on the vulnerability disclosures and patch releases of three prominent consumer IoT vendors in Japan and three in the United States. Our goals include (i) characterizing the trends and risks in the vulnerability lifecycle management of consumer IoT devices using accurate long-term data and (ii) identifying problems, challenges, and potential approaches for future studies of this problem space. To this end, we collected all published vulnerabilities and patches related to the consumer IoT products of these vendors between 2006 and 2017 then analyzed this dataset from multiple perspectives, such as the severity of the included vulnerabilities and timing of the included patch releases with respect to the corresponding disclosures and exploits. We uncovered several important findings that may inform future studies. These findings include (i) a stark contrast between how the vulnerabilities in this dataset were disclosed in the two markets, (ii) three alarming practices by the included vendors that may significantly increase the risk of 1-day exploits for customers, and (iii) challenges in data collection including crawling automation and long-term data availability. For each finding, we also provide discussions on its consequences and/or potential migrations or suggestions.

Experimental Demonstration of Secure Quantum Remote Sensing

P. Yin, Y. Takeuchi, W. Zhang, Z. Yin, Y. Matsuzaki, X. Peng, X. Xu, J. Xu, J. Tang, Z. Zhou, G. Chen, C. Li, and G. Guo

Physical Review Applied, Vol. 14, 014065, July 2020.

Quantum metrology aims to enhance the precision of various measurement tasks by taking advantage of quantum properties. In many scenarios, precision is not the sole target; the acquired information must be protected once it is generated in the sensing process. Considering a remote sensing scenario where a local site performs cooperative sensing with a remote site to collect sensitive information at that remote site, the loss of sensing data inevitably reveals sensitive information . Quantum key distribution is known to be a reliable solution for secure data transmission; however, it fails if an eavesdropper accesses the sensing data generated at a remote site. In this study, we demonstrated that, by sharing entanglement between local and remote sites, secure quantum remote sensing is possible, and the secure level is characterized by asymmetric Fisher information gain. Concretely, only the local site can acquire the estimated parameter accurately with Fisher information approaching 1. In contrast, the accessible Fisher information for an eavesdropper is nearly zero even if he or she obtains the raw sensing data at the remote site. This achievement is primarily due to the nonlocal calibration and control of the probe state at the remote site. Our results explore one significant advantage of “quantumness” and extend the notion of quantum metrology to the security realm.

Determination of Frequency Response of MEMS Microphone from Sound-field Measurements Using Optical Phase-shifting Interferometry Method

D. Hermawanto, K. Ishikawa, K. Yatabe, and Y. Oikawa

Applied Acoustics, Vol. 170, No. 15, 107523, July 2020.

Accurate determination of microphone sensitivity is important to build reliable acoustical instruments. Sensitivity is usually determined by calibration. However, because current microphone-calibration methods determine sensitivity from a mathematical model derived from the geometry of a conventional condenser microphone, they cannot be applied to the calibration of a microelectromechanical systems (MEMS) microphone straightforwardly. To compensate for this geometry difference with current calibration methods, some researchers proposed the development of adapters that fit the conventional calibration apparatus and modified the calibration procedure. In this paper, we propose a different approach to calibrate a MEMS microphone. Sensitivity is calculated directly from the measurement of the sound field applied to the MEMS microphone and its output voltage. The projection of the sound field is measured by parallel phase-shifting interferometry (PPSI), and sound pressure on the MEMS microphone is obtained by tomographic reconstruction. Experimental calibration of a MEMS microphone was conducted and validated using a microphone-substitution method to evaluate the discrepancies in the sensitivity results. It is shown that the proposed method can be used to determine the frequency response of a MEMS microphone in the frequency range of 1000 to 12000 Hz.
