

IEICE

Communications Society —GLOBAL NEWSLETTER—



VOL.46 NO.1

March. 2022



A PUBLICATION OF THE COMMUNICATIONS SOCIETY
The Institute of Electronics, Information and Communication Engineers

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Switching Power Supplies and Power Electronics

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1. Introduction

It is a great honor for me to have been awarded the IEICE fellow for my contribution on “Research and Education on Switching Power Supplies for Electronics, Information Communication.” In this article, I will introduce my research field with comparing the features of technologies in the switching power supplies and that in the power electronics.

For many years, I have been submitting our papers and presenting our research results with focusing on the switching power supplies at the technical conferences organized by the technical committee of Energy Engineering in Electronics and Communications (EE) in the Communications Society (CS) of the Institute of Electronics, Information and Communication Engineers (IEICE). The technical committee of EE is the successor to the former technical committee of Power Supply Engineering for Electronics and Communications (PE). Major topic areas of the technical committee of EE are power devices, power conversion equipment, power system, energy system and batteries. Through these technical conferences, I have deepened my technology.

A typical example of a switching power supply for communication is a so-called “DC-DC Converter” that uses a DC battery installed in a communication station as a source of power and stably supplies power to a DC communication device as a load. When we talk about “Switching Power Supplies,” we often refer to this “DC-DC Converters.” The switching power supplies were originally developed by NASA in the US as satellite power supplies that require small size, light weight and high efficiency characteristics. Today they have been adopted as power supplies for almost all electronic devices. Technological development for further compactness, light weight, and high efficiency is continuing.

While my research is originally based on switching power supplies, that is, DC-DC converters, I have expanded the scope of my research to other power electronics circuits, for example inverters for motor drive and inverters for AC grid interconnection. In addition, I have expanded the venue for presenting our research results at conferences and journals not only to the IEICE, but also to the Institute of Electrical Engineers of Japan (IEEJ) and the Institute of Electrical and Electronics Engineers (IEEE) where the technical contents of power electronics are dealt with in general.

In the following, by comparing the features of technologies in the switching power supplies and that

in the power electronics, I will try to send a message that will be helpful for researchers who are active in both research fields, especially young researchers who will lead the next generation.

2. Switching power supplies and power electronics

The general recognition of the definition of “power electronics” is due to W. E. Newel, a researcher at Westinghouse, as shown in Fig. 1 [1]. He recognized the power electronics as a comprehensive technology which consists of the three of main technical fields of “Power” (static and rotating equipment), “Electronics” (devices and circuits) and “Control” (continuous and sampled-data system). In addition, reference [1] also shows detailed technical issues at that time in each field.

In recent years, in addition to the above technical fields, the power electronics is often regarded as a comprehensive technology that includes layout/cooling technology, passive component technology, reliability, design methods, communication technology, etc. And so, the fields of application are widespread to renewable energy utilization, xEV (electrified vehicle), railroad technology (train), wireless power transmission, LED lighting, etc.

By the way, I think that many people consider “switching power supplies” as one of application fields of “power electronics.” However, I would like to note here that those who started with research on switching power supplies, such as myself, may have different perspectives.

One of those perspectives is that the switching power supply started from the electronic circuit as a nonlinear magnetic application represented by the Royer oscillator. This can be said from the fact that late T. G. Wilson Sr., a pioneer of switching power supply research and his disciple F. C. Lee, both in the US, and Koosuke Harada in Japan have all started switching power supply research as an electronic circuit.

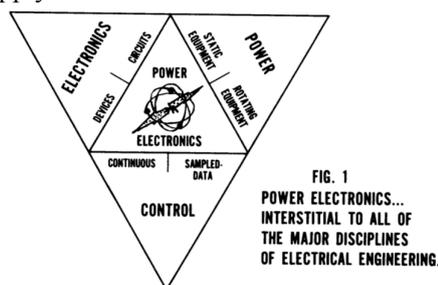


FIG. 1
POWER ELECTRONICS...
INTERSTITIAL TO ALL OF
THE MAJOR DISCIPLINES
OF ELECTRICAL ENGINEERING.

Fig. 1 Definition of “Power Electronics” by
W. E. Newel [1].

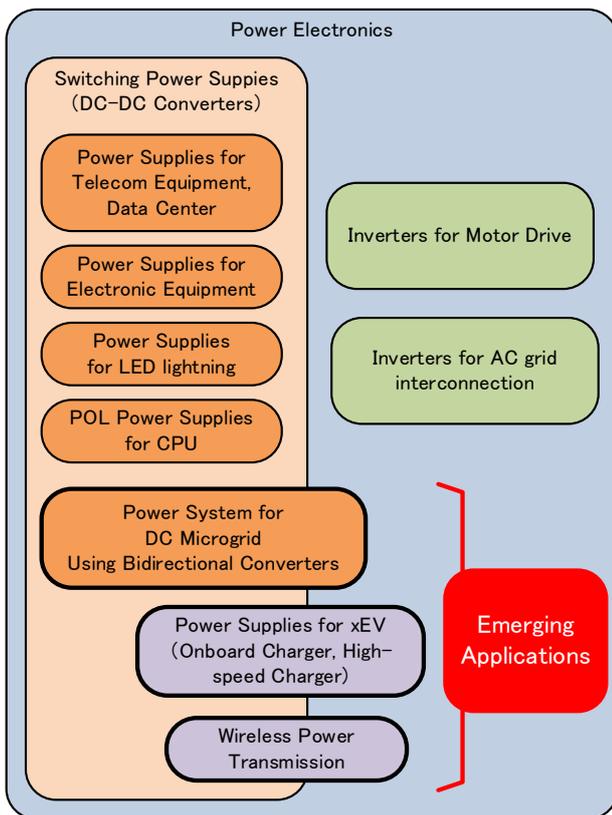


Fig. 2 Application fields of power electronics and switching power supplies.

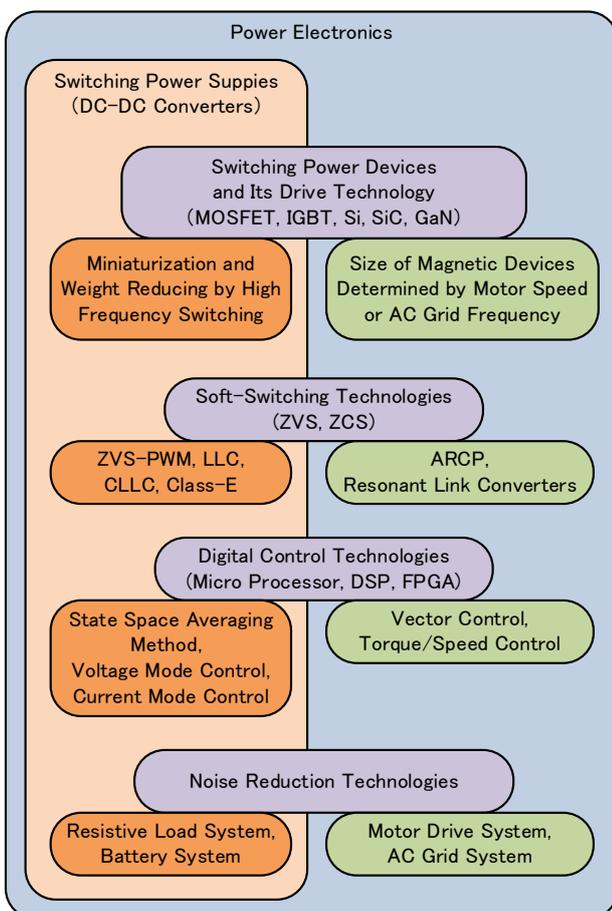


Fig. 3 Important technologies of interest in power electronics and switching power supplies.

Another view is that it emphasizes the function as a “power supply”, that is, a “circuit that supplies power to the load”, and I think this understanding can easily be accepted by everyone.

However, there are many things in common with both basic technologies, such as “controlling power with high efficiency using switching technology by semiconductor switches.” Therefore, there are many common technical issues caused by switching, and many researchers are active across both research fields.

Figure 2 shows the relationship between the application fields of power electronics and switching power supplies. The application fields of power electronics includes both application fields of switching power supplies and those of inverters that handle AC power. Among them, some emerging applications, for example, DC microgrid, power supplies for xEV and wireless power transmission will become very important in promoting renewable energy use, reducing CO₂ emissions and making our lives convenient.

Figure 3 shows the important technologies of interest in power electronics and switching power supplies [2], [3]. As shown in this figure, many of the basic and important technologies are common to both, but it should be noted that the specific applied technologies are different. Particular attention should be paid to inverter applications that handle AC.

3. Conclusions

I have introduced my research field. Many people consider switching power supplies as one of application fields of power electronics. However, it should be noted that research on the switching power supplies started from the electronic circuit as a nonlinear magnetic application.

The application fields of power electronics and those of switching power supplies were classified, and the important technologies of interest were also shown both in power electronics and in switching power supplies. By comparing them, we can get a deeper understanding of both research fields and often find solutions to problems.

I hope that this article will be helpful for researchers who are active in both research fields, especially young researchers who will lead the next generation.

4. References

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Report on the 2021 NS English Session Awards and Award Ceremony

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Chair Prof. Nakao

1. Introduction

In the 2021 IEICE General Conference held on 9th – 12th March 2021, the IEICE Technical Committee on Network Systems (NS) provided the complete English Symposium Session entitled “AI technologies and their applications for future network systems and services”. Although the general conference was canceled due to concerns about COVID-19, the English session this year was held online via Zoom [1] on 9th March. In this year, 13 papers were submitted to the English session and all papers were presented at the online conference. The submitted papers include a variety of interesting research topics related to “in-network intelligence”, such as security/privacy, network virtualization technologies, Internet of Things (IoT) networks, wired/wireless networking, and machine learning [2].

The NS committee selected recipients of NS English Session Award among the 13 papers. The recipients won the award at an award ceremony and presented the progress of their awarded papers as an invited lecture at the NS technical meeting in October 2021.

2. Award Ceremony

The award ceremony was held in the online NS technical meeting on 8th October 2021, and many participants attended the ceremony. Three distinguished papers won the NS English Session Award, and all the recipients received an award certificate and a plaque from NS technical committee chair (Fig. 1). (For the past recipients, please see our English home page. URL: <http://www.ieice.org/cs/ns/eng/index.html>)

3. English Session Awards 2021

The abstracts of the three papers that received the 2021 NS English Session Award are as follows.

“Investigating Dynamic Mining Time of Private Ethereum Blockchain on IoT Devices” [3]

Blockchain technology has emerged to be integrated in many applications, such as finance, healthcare, and the Internet of Things (IoT). Ethereum is one of the most popular open-source blockchain platforms for IoT applications. Proof-of-Work (PoW) is a well-known consensus algorithm. Essentially, the PoW algorithm



Fig. 1 English session award recipients (Mr. Chen: Top left [3], Mr. Fahrianto: top right [4], Mr. Taniguchi: Bottom left [5], and secretary (Yoshida): Bottom right.

solves a mathematical puzzle by enumerating answers one by one until finding a proper one, which authorizes new blocks. Generally, the IoT devices are considerably resource-limited to execute the PoW algorithm. In Ethereum, the computational complexity for generating new virtual currency will be automatically adjusted according to the flow of virtual currency. Therefore, it is possible to optimize the computational complexity according to the amount of resources in IoT devices utilizing the mechanism in Ethereum. This paper investigates the PoW algorithm of the private Ethereum blockchain in IoT applications. More specifically, Chen et al. experiment with running PoW on an IoT device, which is usually considered insufficient for PoW in the previous works. The results show that the PoW algorithm is dynamically adapted to the computing capacity of the device (i.e., Raspberry Pi 4). Moreover, using the curve fitting method, Chen et al. reveal the PoW's exponential distribution after the adjustment.

“Translation Gateway Between IP and NDN Using Dual Channel” [4]

Named-Data Networking (NDN) is expected to be a new network architecture which efficiently transmits its content items. However, it is unrealistic to assume that all IP routers will be replaced by NDN routers at the same time, so it is necessary to consider the environment in which both IP routers and NDN routers exist in networks. The dual-channel translation gateway can transform between IP packet and NDN packet without violating the user privacy by tagging and differentiating interest packets and data packets using two channels. The gateway offers a means to transform the IP to the NDN protocol back and forth utilizing two separate channels devoted to the interest and the data packet. As a result, the IP protocol may connect and interact with the NDN protocol. The throughput of the dual-channel gateway is examined in this study. It describes the relationship between the content hit ratio and throughput performance in the gateway. It also displays the mathematical throughput model and shows it to the emulator results. The finding reveals that the analysis model can predict the gateway throughput with accuracy on average about 70% from the emulator. It also describes the strong relationship between time distribution of each processing time and hit ratio in the total throughput.

“Performance Evaluation on MAC Layer Protocol in Crash Warning Application using PC5-based Cellular-V2X mode4” [5]

A mobile ad-hoc network (MANET) realizes multi-hop communication with the cooperation of wireless terminals (nodes) without relying on an existing network infrastructure such as wireless access points. However, the relay nodes have to consume their communication resources, notably battery, even though they do not acquire any benefit. Therefore, the nodes may tend to act egoistically since users are basically willing not to forward packet for saving own communication resources. For stimulating users to be more cooperative in MANET, an incentive mechanism that offers electric power in exchange for relaying packets by using wireless power transmission (WPT) technology has been proposed on the ground of high feasibility of the WPT technology. In this paper, authors evaluated the availability of WPT-motivated MANET depending on the circumstances surrounding the users, based on realistic user cooperation models. As a result of simulation experiments, the WPT-motivated MANET achieved that more nodes keep cooperative than the conventional MANET, even after changes in circumstances over time. In addition, the WPT-motivated MANET can reduce the occurrences of route construction errors since it can keep more nodes cooperative and precisely selects more stable routes than the conventional MANET. Furthermore, the WPT-motivated MANET can establish robust network

by reducing changes in the number of cooperative nodes and the number of route construction errors over time. However, it was also found that users voluntarily tend to be cooperative even though they do not acquire any incentive, only when the expected time until the next opportunity to recharge their battery is enough short. In this paper, on the basis of the evaluation experiments, Taniguchi et al. revealed that the WPT-motivated MANET can maintain a robust network for longer period of time.

4. Future Plans

In the 2022 IEICE General Conference, the English Session entitled “Enabling Technologies for Network Systems and Services during the 5G/Beyond 5G Era” will be held on 15th – 18th March. Many interesting studies on “network” and “service” including “wireless” and “optical” will be presented. We plan to hold the IEICE General Conference and enjoy the NS English session during the four days.

5. Acknowledgement

We would like to give special thanks to Prof. Yoshiaki Tanaka for his great contributions.

6. References

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- [3] X. Chen, K. Nguyen, and H. Sekiya: “Investigating Dynamic Mining Time of Private Ethereum Blockchain on IoT Devices,” *IEICE General Conference*, BS-7-13, March 2021.
- [4] F. Fahrianto, and N. Kamiyama: “Translation Gateway Between IP and NDN Using Dual Channel,” *IEICE General Conference*, BS-7-4, March 2021.
- [5] Y. Taniguchi, T. Yamazaki, T. Miyoshi, T. Silverston, and T. Asaka: “Performance Evaluation of the WPT-motivated MANET Based on Realistic User Cooperation Models,” *IEICE General Conference*, BS-7-3, March 2021.

Report on the 16th International Conference on Space, Aeronautical and Navigational Electronics 2021 (ICSANE2021)

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²Tokai University

³Mitsubishi Electric Corporation



1. Introduction

The 16th International Conference on Space, Aeronautical and Navigational Electronics (ICSANE2021) was held online on November 11th – 12th, 2021. This conference was organized by the Technical Group on Space, Aeronautical and Navigational Electronics (SANE) of the Institute of Electronics, Information and Communication Engineers (IEICE), with the support of IEEE AESS Japan Chapter, IEEE GRSS Japan Chapter, and Electronic Navigation Research Institute (ENRI). This year, ICSANE was jointly held with the Ground Penetrating Radar Workshop (GPRWS). In this report, we provide the objective and summary of ICSANE2021.

2. Objective of conference

The first ICSANE (former Workshop on Space, Aeronautical and Navigational Electronics (WSANE)) was held in Daejeon, Korea, 2005. After that, ICSANE takes place every year in Asia-Pacific region. ICSANE aims at providing an opportunity for system engineers and researchers to discuss new and viable technical topics of electronics system in spacecraft, aircraft, ships and ground facilities. The ICSANE2021 covered the following topics:

- (1) Satellite and space-station systems
- (2) Remote sensing and scientific observation technology
- (3) Radar systems and applications
- (4) Navigational and communication systems

3. Organizing Committee

The steering committee of ICSANE2021 was strongly led by General Chair and General Co-Chairs, with the support of Co-Chairs of Organizing Committee. The other organization is technical program committee. These main committee members are listed as the followings.

- Steering/Organizing Committee:

Chair:

Toshifumi Moriyama (Nagasaki Univ., Japan)

Members:

Makoto Tanaka (Tokai Univ., Japan)

Takeshi Amishima (MELCO, Japan)

Ryo Natsuaki (Univ. of Tokyo, Japan)

Shunichi Futatsumori (ENRI, Japan)

Takayuki Kitamura (MELCO, Japan)

- Technical Program Committee:

Chairs:

Kun-Shan Chen (China)

Toshifumi Moriyama (Japan)

Member:

Ying Yang (China)

4. Program and Activities

At the opening ceremony of ICSANE2021, Prof. Toshifumi Moriyama, Chair of SANE, delivered his warm welcome address and expressed the importance of international academic exchange for understanding and making progress in the areas of the aerospace, aviation and remote sensing. The photos of his opening address are shown in Fig.1. Next, Prof. Motoyuki Sato (Tohoku Univ.), Chair of GPRWS, expressed his thanks and talked about the history of GPRWS.

The technical program of ICSANE2021 consisted of 13 oral sessions. The 36 papers in regular and invited sessions were presented. The papers covered the various technologies which are satellite, aircraft navigation, radar signal processing, synthetic aperture radar (SAR), remote sensing, etc. Total number of participants reached around 130 from 6 countries: Korea, Japan, China, Taiwan, Nigeria, and USA. The photos of the participants are shown in Fig.2.

The invited speakers are the following:

- Kazuo Ouchi (IIS, U-Tokyo), “Synthetic Aperture Radar Over Ocean: A Review”
- Tamer Inanc (University of Louisville, USA), “Adaptive System Identification and Control Theory for Precise Personalized Drug Delivery”
- Josaphat Tetuko Sri Sumantyo (Chiba Univ.), “Development of Airborne Circularly Polarized Synthetic Aperture Radar: Systems and Its Applications”
- Susumu Saito (ENRI, MPAT), “Observations of the ionosphere by a GNSS network and application for GNSS-based navigation”

- Hirokazu Kobayashi (Electromagnetic Wave System Lab.), “Applications of Electromagnetic Array-Factor for Radar Engineering”
- Takuji Kubota (JAXA/EORC), “Recent Progresses of the Global Precipitation Measurement (GPM) Mission in Japan”



Fig. 1 Welcome speech of ICSANE2021

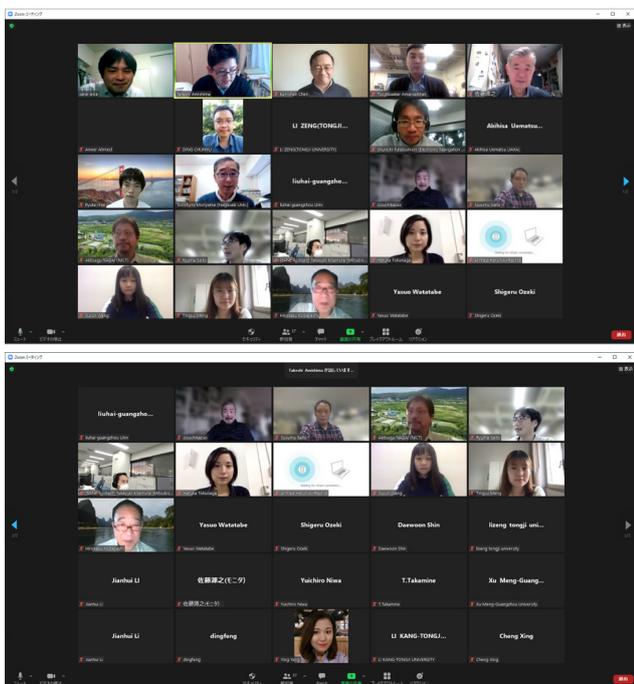


Fig. 2 Group photos of ICSANE2021

5. Award Ceremony

The ceremony of Young Scientist Award was held at the closing. Prof. Toshifumi Moriyama, TPC chair, presented a testimonial to each award recipient. The winners are as follows:

- Winners of Young Scientist Award:
- Mr. Tingyu Meng (Chinese Academy of Sciences, China), “Bistatic Scattering Simulation of Oil-Covered Sea Surface and Sensitivity Analysis of Oil thickness”
 - Ms. Haruka Tokunaga (Osaka University, Japan), “Drone-based Millimeter-wave Radar System Using Fiber-optic Technologies”
 - Mr. Yan Wang (Beijing Institute of Technology, China), “Spaceborne SAR Terrain Matching Framework: Opportunities, Challenges and Strategies”

In addition, Encouragement award were presented to the following speakers:

- Mr. Cheng Xing (Tsinghua University, China), “Vegetation height estimation: four-stage inversion algorithm for GRVoG-vtd model”
- Mr. Yoon Taek Jung (Sejong Univ., Korea), “Detection of frost heave using time-series Interferometry SAR data”
- Ms. Suyun Wang (NICT, Japan), “Theoretical and Experimental Analysis of Terahertz Scattering from Rough Surfaces”

6. Conclusions

ICSANE2021 was successfully held online. We hope that all the participants in this conference enjoyed the presentation and discussions on the future trends and the latest advances of research and development on Space, Aeronautical and Navigational Electronics. Next ICSANE (ICSANE2022) will be held in Guilin, China. The photo of the welcome address is shown in Fig.3. Call for paper of ICSANE2022 will be provided in the next spring. We look forward to seeing you in Guilin.

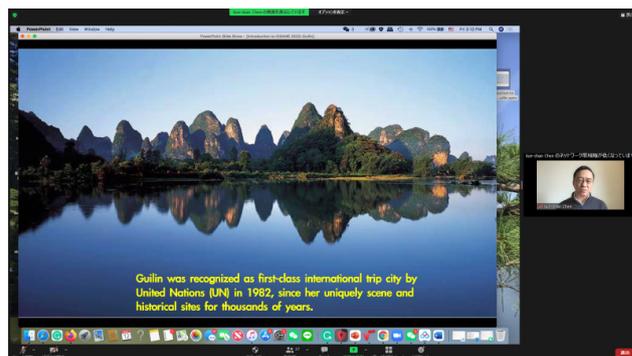


Fig. 3 ICSANE2022 addressed by Prof. Kun-Shan Chen

Report on the Japan-Korea Joint Conference on Satellite Communications (JC-SAT 2021)

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1. Overview

This article reports on the Japan-Korea Joint Conference on Satellite Communications (JC-SAT) that was held on October 7th and 8th, 2021. Unfortunately, it was held online for Japanese and, on/off-line in Pusan for Korean, due to the COVID-19 pandemic.

This conference was jointly organized by Technical Committee on Satellite Communications of IEICE in Japan and the Korean Society of Space Technology (KOSST) in South Korea and sponsored by the IEEE VTS Tokyo/Japan Chapter.

The JC-SAT intends to provide a forum for researchers in the field of satellite communications and applications to discuss the current status, technical challenges, standards, fundamental issues, and future services (Fig.1).

2. Report on Sessions

The technical program of the JC-SAT 2021 consisted of 6 sessions, in which 23 general papers and 5 special papers were presented. The total number of registered participants reached about 60 from Japan and Korea. The presented papers covered a wide range of unique and novel technical topics on satellite communication.

On the first day, two general sessions including three special talks were held. Dr. Ki-kuen Kim, a general chairperson of the JC-SAT 2021, gave a welcome speech, and Prof. Hiroyasu Ishikawa, a general co-chairperson of the JC-SAT 2021, presented a congratulatory address in the opening ceremony. During the sessions, following special talks were presented;

- Prof. Yuichi Kawamoto, “Toward Realizing Space-Air-Ground Integrated Networks”,
- Prof. Hongyul Paik, “Ring of Equator”, and
- Dr. Franck Beillevaire, “Thales TWT for satellites: last developments and technical progress”.

On the second day, four general sessions, including the following special talks were held;

- Dr. Hyoung Yoll Jun, “New Korean GEO Communication Satellite Program”, and
- Dr. Byoung-Sun Lee, “ETRI SATCOM R&D Activities - Past Achievements, Current Projects, and Future Plans”.

3. JC-SAT Award Ceremony

At the end of the second day, the technical committee of the JC-SAT 2021 announced the winners of the

outstanding research paper award (JC-SAT Award) among all submitted general papers.

Both IEICE and KOSST technical members profoundly reviewed all the papers and discussed the review results of award candidate papers, which was a mandatory condition for award authorization.

Through the above procedure, the following two papers were honored with the JC-SAT Award.

- Sang-Pil Lee, Sung-Min Noh, Deuk-Hyeon Ga, Jaesin Kim and Yong-Hyeok Lee, “Design of Stacked Microstrip Patch Antenna Unit with 4 × 4 Sub Array Using Shared Aperture Tx/Rx Phased Arrays at Ka Band”
- Ryouichi Nishimura, Byeongpyo Jeong, Hajime Susukita and Takashi Takahashi, “A potential cause of pulsed noises in receiving BS signals”

During the JC-SAT Award ceremony on the second day, the winners were handed the award certificates (Fig.2).

4. Conclusions

Dr. Sangil Ahn, a chairperson of the technical committee of the JC-SAT 2021, delivered a closing speech, reporting that the JC-SAT 2021 concluded with a great success despite the first on/off-line style. The technical committee members held a pre-meeting on the day before the first day of the JC-SAT 2021. At the pre-meeting, it was discussed the next JC-SAT schedule. JC-SAT 2022 will be held on October 6th and 7th, 2022 in Fukuoka, Japan.



Fig.1 CFP.



Fig.2 Award Certificate.

Report on the 35th Optical Communication Systems Symposium “Optical Communication Technology Pioneering the Future ~Toward Realization of a Distributed Society~”

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1. Introduction

The 35th Optical Communication Systems (OCS) Symposium “Optical Communication Technology Pioneering the Future ~Toward Realization of a Distributed Society~” was held online as the previous year due to the COVID-19 on Dec. 14–15, 2021. It was organized by the IEICE Technical Committee on OCS, in cooperation with the IEEE Photonics Society Tokyo Section Chapter, the Photonic Internet Forum (PIF), and the IEICE Technical Committee on Extremely Advanced Optical Transmission Technologies (EXAT). As the rage of COVID-19 accelerates the digital transformation of society and industry, transition to distributed societies where local areas are responsible for the economic activities and information management is considered. The diffusion of ICT is very important for the development of a distributed society. Therefore, it is indispensable to advance the optical communication technologies that support the new society. This year's symposium, with 24 exhibitors and more than 260 attendees, was held as an opportunity to explore the future pioneered by optical communication technologies toward the realization of distributed societies.



Fig. 2 Keynote speech by Dr. Y. Miyamoto.

transmission exceeding 40 Gbit/s/ch ~With gratitude to technical committee on OCS~” (Fig. 2). He introduced the history of his research and development and practical application of 40 Gbit/s/ch long-distance optical transmission system, and his activities of the OSC society. He also described the future prospects for ultra-high capacity optical communication technologies.

The award ceremony whose details described later was followed by an online exhibition, where the research results of nine national research projects were reported.

After that, we had workshop entitled “From urban concentration type to regional distributed type: Social and technical issues toward realization of a distributed society.” It was contributed by the following four invited speakers (Fig. 3): Prof. Hiroshi Yamamoto (Ritsumeikan University) speaking about IoT systems and their applications for solving regional issues, Dr. Amane Miura (NICT) presenting on space communication technologies and a distributed society in beyond 5G, Dr. Koji Fukuda (Hitachi) talking about a policy proposal AI technology aiming at a distributed society, and Mr. Takashi Hasegawa (Sansan) describing recent activities for establishing national institute of technology in Kamiyama-cho, Tokushima. From these talks, the present state and issues for constructing new distributed society, and the importance of information and communication technologies that supports the society were realized.

There were totally 245 participants on Day 1. Day 1



Fig. 1 Picture of online OCS symposium, from top, Dr. Shuto Yamamoto (Secretary of OCS), and Dr. Takeshi Hoshida (OCS committee chair).

2. Technical sessions

On Day 1 (Dec. 14), following the welcome address (Fig. 1) by Dr. Takeshi Hoshida, the IEICE OCS committee chair, the symposium started with a keynote speech given by Dr. Yutaka Miyamoto (NTT) entitled “Review on research and development and practical application toward the realization of optical



Fig. 3 The presenters of Workshop 1: from left, Prof. H. Yamamoto, Dr. A. Miura, Dr. K. Fukuda, and Mr. T. Hasegawa.

of the symposium was closed with an online get-together, where 25 people participated and free discussions on the activities with and after COVID-19 were held.

There were three invited talks at the beginning of Day 2 (Dec. 15) (Fig. 4). The first invited talk was presented by Associate prof. Ryoichi Horisaki (The University of Tokyo) on “Computational imaging technology.” He introduced a machine learning type scattering imaging technology that enables us to realize simplification and miniaturization of the system. Dr. Hidemi Tsuchida (AIST) presented on “Digital coherent LiDAR.” He described the progress of the research on frequency modulation continuous wave light detection ranging (FMCW-LiDAR) using a coherent detection technique featuring high-sensitivity and high-speed detection. Finally, Mr. Kaoru Kenyoshi (NICT) gave an invited talk entitled “Standardization and social implementation of quantum key distribution network.” He introduced the standardization trends for ITU-T SG13 network architecture, ITU-T SG17 security, and ITU-T SG11 protocol of QKD network. He also described the quantum cryptography communication system under construction in Japan.



Fig. 4 The presenters of Invited talks: from left, Associate prof. R. Horisaki, Dr. H. Tsuchida, and Mr. K. Kenyoshi.

The invited talks were followed by an online poster session, where 11 posters were presented by 10 young researchers, including this year’s OCS award winners, presented on their latest research results.

After that, an invited lecture, organized by IEEE Photonics Society Tokyo Section Chapter, was given by Prof. Masaya Notomi (Tokyo Institute of Technology) (Fig. 5). His lecture was entitled “New development by nanophotonics technologies with nanomaterials.” He introduced the recent progress of research on ultra-high speed, low-power consumption optical switches using a hybrid platform that combines plasmonic waveguides and graphene. He also talked on the future prospects for research on hybrid platforms.

The invited lecture was followed by an online exhibition, in which nine exhibitors introduced the latest optical communication devices and systems.

In the afternoon session, we had another workshop



Fig. 5 The presenters of Invited lecture: Prof. M. Notomi.

entitled “Innovative optical transmission technology that attracts attention.” Invited talks were given by Dr. Shigehiro Takasaka (Furukawa Electric) on Raman amplifier using incoherent light, Dr. Tsuyoshi Umeki (NTT) on advances in an optical parametric amplification technology and its applications, Mr. Keisuke Matsuda (Mitsubishi Electric) on free-space optical communication system by applying optical fiber communication technologies and Mr. Takanori Inoue (NEC) on the research trends in space-division multiplexing transmission technologies for submarine optical cable systems (Fig. 6). The advanced technologies introduced in the session are expected to realize future large-capacity, long distance optical communication systems and greatly contribute to the realization of new distributed societies. There were totally 263 attendees on Day 2.



Fig. 6 The presenters of Workshop 2: from left, Dr. S. Takasaka, Dr. T. Umeki, Mr. K. Matsuda, and Mr. T. Inoue.

3. Award ceremony

During the technical sessions, we celebrated this year’s OCS award winners at the award ceremony (Fig. 7). The OCS Technical Committee presented the awards to the following winners:

- OCS Best Paper Award: “Real-time strongly-coupled 4-core fiber transmission.” by Mr. Shohei Beppu (KDDI Research) et al.
- OCS Young Researchers Award: Mr. Takeo Sasai (NTT) for “Digital backpropagation for optical path monitoring – Loss and dispersion profile estimation –.”
- OCS Young Researchers Award: Mr. Kozo Sato (Tohoku University) for “Study on chromatic dispersion dependence of GAWS noise.”



Fig. 7 OCS award-winners: from left, Mr. S. Beppu, Mr. T. Sasai, and Mr. K. Sato.

4. Conclusion

This year’s OCS symposium was held online as the previous year under the continued influence of COVID-19. The OCS technical committee would like to express its gratitude to all the speakers, exhibitors, and audiences, for their contributions to the successful symposium. We hope that the innovative optical communication technologies discussed in this symposium will open up future distributed societies.

Report on the International Symposium on Extremely Advanced Transmission Technologies (EXAT 2021)

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1. Introduction

The 6th international symposium on Extremely Advanced Transmission Technologies (EXAT 2021) was held from 3rd to 5th November 2021 [1]. It was organized by the IEICE Technical Committee on Extremely Advanced Transmission Technologies (EXAT) and the National Institute of Information and Communications Technology (NICT). Since its inauguration in 2008 the symposium's venue has traditionally been a town in Japan with a rich historical and cultural background. However, due to the special circumstances effectuated by the ongoing COVID-19 pandemic and the resultant travel restrictions for visitors from overseas, the organizing committee decided to present the symposium this time in an all-virtual format.

2. Background

The objective of the EXAT symposium is to discuss the status and future trends of optical fiber communication technologies with a focus on Space Division Multiplexing (SDM). SDM is seen as a promising solution to overcome the capacity limits of single-mode fiber and deal effectively with the exponential growth in data traffic experienced in optical networks over recent years. Research in this field aims at exploiting spatial diversity in network elements such as optical transceivers, fibers, and amplifiers and, over the past decade, has brought forth sophisticated multi-core and multi-mode fiber (MCF and MMF) components as well as transmission techniques that are capable of transporting beyond 100x more data than conventional technologies. Although the effectiveness of SDM so far has been demonstrated only in research laboratories, numerous efforts are also under way now to take SDM out of the laboratory and bring it closer to its adoption in commercial systems.

The EXAT community in Japan initiated the development of SDM technology in 2008 and since then has been playing a leading role in the investigations of the so-called 3M (multi-core, multi-mode, and multi-level modulation) technologies both in Japan and on the international stage. The symposium is held bi-yearly and forms one of the highlights in EXAT's activity to promote information exchange on SDM and optical communications technologies featuring presentations from world-renowned experts talking about the latest advancements in their respective field. This year's

symposium was very well attended with over 150 registrants from Japan and overseas and about 65 live participants per session on average. It featured 2 plenary and 19 invited talks, as well as an on-line poster session with 22 contributed posters where attendees could engage in in-depth discussions with the authors and thus gain an excellent overview of on-going SDM related research projects and some of the latest and hot research topics in this field.

3. Technical Sessions

On the first day, the symposium's morning session started with an opening remark by Dr. Itsuro Morita, the incumbent IEICE EXAT committee chair, presenting an overview of the symposium as shown in Fig. 1 on the left. After that, Prof. Joseph Kahn (Stanford University, USA), depicted in Fig. 1 on the right, gave a plenary talk about the progress on coherent detection for short-haul links such as data-center links and capacity optimization for ultra-long haul submarine transmission.

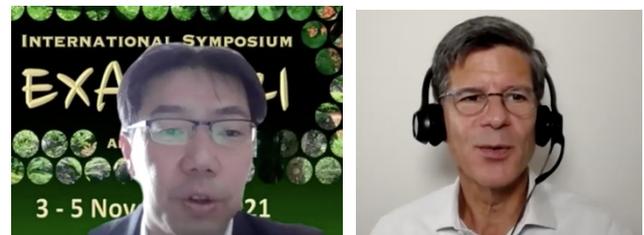


Fig. 1 Dr. Morita giving the opening remarks (left), and Prof. Kahn presenting the first plenary talk (right)

His talk was then followed by three invited talks. In the first one, Dr. Victor Kopp (Chiral Photonics, USA) reviewed the vanishing core technology that is used to fabricate efficient MCF fan-in/fan-out devices. Next, Dr. Yutaka Miyamoto (NTT, Japan) reviewed SDM photonic node technologies. In the third talk, Prof. Koji Igarashi (Osaka University, Japan) reported on the latest progress about real time digital signal processing techniques for mode-division multiplexed transmission systems. The afternoon session consisted of three invited and another plenary talk. First, Dr. Ricardo Veronese (Prysmian Group, Italy) presented his work on the characterization of few-mode fibers where he elaborated on a technique that he has been using to measure mode dispersion and modal birefringence between non-degenerate mode groups with high spatial resolution. In the second talk

Dr. Francesco Da Ros (Technical University of Denmark, Denmark) reviewed recent experimental work on all-optical nonlinearity compensation in few-mode fibers using optical phase conjunction. Next, Prof. Andrew Ellis (Aston University, UK), shown in Fig. 2 on the left, presented the second plenary talk where he first gave an overview of the evolution of optical communications and then shared some thoughts on challenges that need to be addressed in the future as well as the potential role of optical wireless communications in bringing high-speed Internet access to areas where deploying optical fiber may not be economically viable. Finally, in the last talk of the first day, Dr. Filipe Ferreira (University College London) discussed the modelling and simulation of SDM based lightwave systems to mitigate nonlinear effects.

The program of the second day consisted of five invited talks in the morning and a poster session in afternoon. In the first talk, Dr. Ming-Jun Li (Corning Incorporated, USA) reviewed his recent work on the design and experimental investigations with high core counts MCF for short-haul interconnects. In the second one, Dr. Haoshuo Chen (Nokia Bell Labs, USA) presented a mode-multiplexing transmission system consisting of a 2D VCSEL based transmitter and a MMF to transmit 200 Gb/s with direct detection and discussed its potential application toward co-packaged optics. Next, Dr. Shigehiro Takasaka (Furukawa Electric, Japan) reviewed his work on SDM optical amplifiers and optimization techniques to reduce the amplifier's power consumption. In the fourth talk, Prof. Ryo Nagase (Chiba Institute of Technology, Japan) reviewed the optical connector technology that will be required to build future optical networks based on SDM fibers. Finally, Dr. Yuta Wakayama (KDDI Research, Japan) discussed the capacity impact of SDM transmission and summarized recent record transmission demonstrations over transoceanic distances. The topics of the poster session ranged from SDM fiber design, fabrication and characterization methods to mode converters and wide-band transmission. After an introductory session where each poster author presented a 3-minute summary of his work, individual on-line breakout rooms were provided for each poster where the attendants could directly engage in free discussions with the poster authors.

The third day was divided again in a morning and afternoon session with four invited talks each. In the first talk of the morning session, Dr. David Neilson (Nokia Bell Labs, USA) reviewed the factors that contribute to exponential traffic growth in optical networks and shared his vision on the upcoming era of optical communications where massive and efficient parallel optical data transport will become critical to sustain the ongoing traffic growth. Next, Dr. Lara Garrett (SubCom, USA) reviewed trends in undersea system architecture and discussed the importance of flexible capacity routing to build future systems. In the third talk, Dr. Hirotaka Sakuma (Sumitomo Electric, Japan) presented the latest progress on fabrication techniques for low loss uncoupled and coupled MCFs to be used in long-haul

transmission systems. Finally, in the last talk of the morning session, Dr. Takashi Matsui (NTT, Japan) discussed the progress on the design of MCFs with a standard cladding diameter of 125 μm and introduced the roadmap toward standardization of SDM fiber components. The afternoon session started with a talk by Prof. Christian Koos who summarized his group's impressive work on silicon photonics covering silicon-organic hybrid integration, silicon nanowire waveguides as well as multi-chip integration with application in high-speed optical communications as well as on-chip THz signal processing. Next, Prof. Hervé Rigneault discussed some interesting application of MCF to endoscopy for microscopic imaging of biological tissue in vivo. In the third talk, Prof. Robert Thomson (Heriot Watt University, UK) reviewed the field of spatial multiplexers with a focus on ultrafast laser inscribed 3D waveguides that have been used as fan-in/fan-out devices of SDM fibers. Finally, Dr. Tiago Alves (Institute of Telecommunications, Portugal) presented an overview of the impact of inter-core crosstalk in weakly-coupled MCFs on direct-detection systems.

In the closing session, Dr. Naoto Kadowaki, Vice President of NICT shown in Fig. 2, asserted the importance of international collaboration and information exchange through events such as the EXAT symposium after describing NICT's and the EXAT community's pivotal role in promoting the development and standardization of SDM technology.



Fig.2 Prof. Ellis presenting the second plenary talk (left), and Dr. Kadowaki giving the closing remarks (right)

4. Conclusion

Owing to the effort of all speakers preparing presentations of outstanding quality despite the daily challenges everybody has been facing in this ongoing COVID-19 pandemic, and the possibility to attend the symposium from anywhere in the world, EXAT 2021 closed with great success offering ample opportunity for learning new aspects as well as exchanging ideas on cutting-edge SDM technologies and optical fiber communications. The symposium organizers would like to express their sincere thanks to all the invited speakers as well as poster presenters and participants for having made the symposium such a wonderful forum of information sharing information in this rapidly growing field of communications.

Reference

[1] <https://exat-sympo.org/2021>

Report on 2021 International Conference on Emerging Technologies for Communications (ICETC 2021)



Nobuyoshi Kikuma, Masaharu Takahashi,
Hisaya Hadama, Takaya Yamazato, Kiyoshi Fukuchi,
Shigeki Shiokawa, Keisuke Ishibashi, Daisuke Umehara,
Masashi Higashinaka, Yohei Hasegawa, Masaki Bandai, Mikio Hasegawa,
Koya Sato, Yoshifumi Morihiro, Nazuki Honda, Dai Kanetomo,
Kiyoshi Fukui, Ryo Yamamoto, Masayuki Takase
ICETC 2021 Organizing Committee

1. Introduction

The IEICE Communications Society hosted the 2021 International Conference on Emerging Technologies for Communications (hereinafter referred to as “ICETC 2021”) online from December 1-3, 2021 [1]. Figure 1 is a photo in the opening ceremony on Dec. 1.

This conference was the second flagship international conference organized by the IEICE Communications Society. 258 participants from various countries attended in the conference.

2. Conference Program and Statistics

Figure 2 is the conference program of ICETC 2021 including five keynote sessions, six invited sessions, three special sessions, 12 oral sessions, and four poster sessions. All sessions except poster sessions were held in Zoom. Poster sessions were held in EventIn, which is the online event platform operated by V-cube.

We received 145 paper submissions for this conference: 71 papers for oral presentation, and 74 papers for poster presentation. Each paper was reviewed by two experts. After the careful reviews, 55 papers were accepted for oral presentation, and 90 papers were accepted for poster presentations. We have four research areas, called track, in this conference. Track 1 is Physical & Fundamental; Track 2 is Communications; Track 3 is Network; Track 4 is Information & Application. 19 papers in Track 1, 44 papers in Track 2, 41 papers in Track 3, and 41 papers in Track 4 were accepted in the conference, respectively. All accepted papers were published on the IEICE Proceedings Series [2] as open access papers.

3. Keynote Sessions

We organized seven keynote sessions. Keynote speakers are as follows. A large number of participants attended in the keynote sessions.

- Theodore S. Rappaport (New York University)
 - The Impending Data Explosion in Wireless Communications (Fig. 3)

- Masugi Inoue (National Institute of Information and Communications Technology (NICT))
 - Toward making the world more resilient: a work on resilient communication and information sharing platform and its deployment (Fig. 4)
- Tomoaki Ohtsuki (Keio University)
 - Machine Learning for Intelligent Wireless Communications (Fig. 5)
- Etsushi Yamazaki (NTT)
 - Recent R&D efforts in digital coherent optical transmission technology
- Ryuji Wakikawa (SoftBank)
 - SoftBank network vision towards 6G



Fig.1. Opening ceremony with Prof. Kikuma, General Co-Chairs (left top), Prof. Hadama, General Vice Co-Chairs (right top), and Prof. Shiokawa, Secretary (bottom).

4. Invite Sessions

ICETC 2021 had six invited sessions. This conference invited 20 invited speakers. Four of them were recommended from the IEICE International Sections. 16 of them were recommended by the technical committees of the IEICE Communications Society. The invited speakers recommended from the International Sections are as follows.

Time JST	Dec. 1 (Wed)		Dec. 2 (Thu)		Dec. 3 (Fri)	
	Zoom	EventIn	Zoom	EventIn	Zoom	EventIn
9:00					Oral 4 3 Sessions	Poster 3 1 Session
9:30	Opening		Invited 2 2 Sessions		B4, C3, D4	P4
10:00	Keynote 1		IA2, IB2			
10:30	Keynote 2					
11:00			Keynote 4		Keynote 5	
11:30						
12:00						
12:30						
13:00	Invited 1 2 Sessions		Oral 2 3 Sessions		Special Session 1 1 Session	
13:30	IA1, IB1		B2, C1, D2	Poster 2 1 Session		
14:00				P2	Special Session 2 2 Sessions	
14:30					SS2, SS3	
15:00	Oral 1 3 Sessions		Oral 3 3 Sessions		Special Session 3 2 Sessions	
15:30	A1, B1, D1	Poster 1 1 Session	B3, C2, D3	Poster 3 1 Session	SS4, SS5	
16:00		P1		P3		
16:30					Closing	
17:00	Keynote 3		Invited 3 2 Sessions			
17:30			IA3, IB3			
18:00						
18:30			Award Ceremony and Reception			
19:00						
19:30						

Fig. 2. Conference Program

- Kampol Woradit (Chiang Mai University, Thailand)
 - Communication Technologies in Wireless Sensor Networks
- Titipat Achakulvisut (Mahidol University, Thailand)
 - Towards Improving Online Conferences: Lessons from the Neuromatch Conferences
- Arokiaswami Alphones (Nanyang Technological University, Singapore)
 - Integrated Visible Light Communication and Positioning Systems
- Arturo Buscarino (DIEEI, University of Catania, Italy)
 - Controlling Energy Flows in a Network of Electrical Oscillators by using Active Chaos

In addition, we appreciate for the recommendations of excellent speakers from the Technical Committee on Antennas and Propagation (AP), Communication Systems (CS), Communication Quality (CQ), Extremely Advanced Optical Transmission Technologies (EXAT), Information and Communication Management (ICM), Healthcare and Medical Information Communication Technology (MICT), Optical Communication Systems (OCS), Photonic Network (PN), Radio Communication

Systems (RCS), Satellite Communications (SAT), Sensor Networks and Mobile Intelligence (SeMI), Standardization & Innovation in ICT technologies (SIIT), Smart Radio (SR). The invited speakers are shown in the ICETC 2021 website.

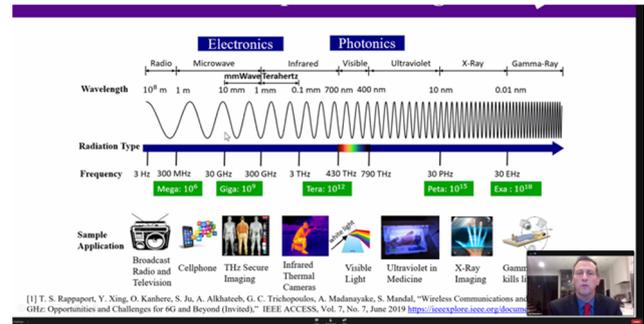


Fig. 3. Keynote speech by Prof. Theodore S. Rappaport.

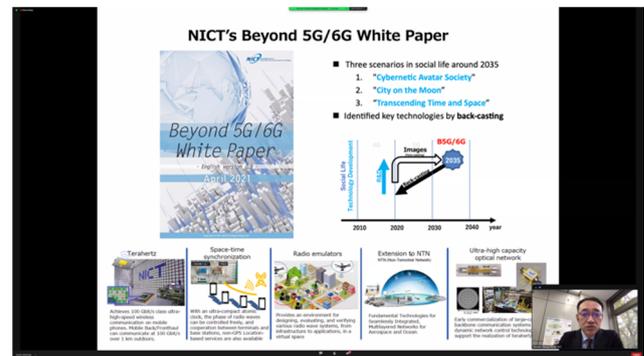


Fig. 4. Keynote speech by Dr. Masugi Inoue.

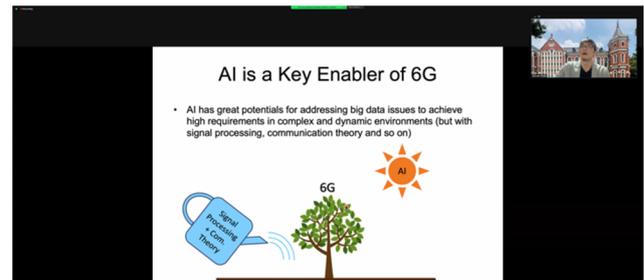


Fig. 5. Keynote speech by Prof. Ohtsuki.

5. Special Sessions

This conference had five special sessions organized by the IEICE Communications Society Editorial Board. We invited eleven speakers who were the winners of the best paper awards of IEICE Transactions on Communications and IEICE Communications Express. All participants enjoyed their interesting talk. The list of the invited speakers is shown in the ICETC 2021 website.

6. International Advisory Committee

This conference would not be succeeded without the great support from TPC Track Chairs, TPC Members, and Technical Advisors. In addition, the following International Advisory Committee supported the active promotion in the IEICE International sections. We appreciate their contributions.

- Arokiaswami Alphones (Nanyang Technological University, Singapore)
- Widhyakorn Asdornwised (Chulalongkorn University, Thailand)
- Luigi Fortuna (University of Catania, Italy)
- Huang-Tien Lin (National Time and Frequency Standard Lab., TL)
- Duy-Hieu Bui (Vietnam National University, Hanoi, Vietnam)

7. Award

Three best papers and three best posters, 21 excellent student presentations were awarded in the Award Ceremony on Dec. 2. The best paper winners are as follows:

- “Performance comparison between injection-locked carrier frequency conversion and self-heterodyne detection methods in coherently-linked optical and wireless transmission for 6G”
Keisuke Kasai (Tohoku University), Taisei Sato (Tohoku University), Koichi Shirahata (Tohoku University), Toshihiko Hirooka (Tohoku University), Masato Yoshida (Tohoku University), Masataka Nakazawa (Tohoku University)
- “A Wideband Double-Balanced Multiplier Integrated Circular-Polarization Switchable Microstrip Antenna with Parasitic Elements”
Tatsuki Kayashima (Saga University), Eisuke Nishiyama (Saga University), Ichihiko Toyoda (Saga University)
- “Privacy-Protective Distributed Machine Learning Using Rich Clients”
Saki Takano (Ochanomizu University), Akihiro Nakao (the University of Tokyo), Saneyasu Yamaguchi (Kogakuin University), Masato Oguchi (Ochanomizu University)

The winners were also recommended as recommended papers to the IEICE Transactions on Communications and IEICE Communications Express. In addition, four outstanding contributors were awarded. The Award winners are listed on the ICETC 2021 website [1].

8. Information on ICETC 2022

ICETC 2022 will be held at Waseda University, Tokyo in December 2022. It will be the good timing for you to visit Japan. The website will be available in 2022 Spring. We look forward to your submission and participation in ICETC 2022.

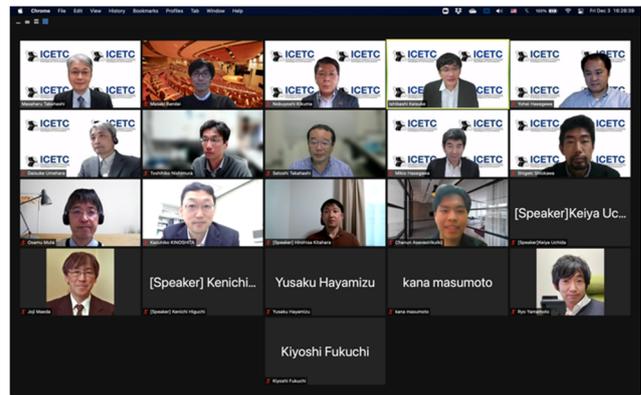


Fig. 6. Closing Ceremony.

9. Conclusion

Thanks to all of you, ICETC 2021, the second flagship international conference of the IEICE Communications Society, ended successfully. Figure 6 is a photo in the closing ceremony on Dec. 3. Although this conference was held fully online due to the COVID-19, a large number of papers were presented in the conference, and many researchers and students participated in each session. The advantage of online conference is to join easily from various countries. We are happy if all participants enjoyed discussions with researchers beyond the countries. Your continuous support is necessary for this conference to be a flagship conference of the IEICE communications society.

References

- [1] ICETC 2021 website,
<https://www.ieice.org/cs/icetc/>
- [2] IEICE Proceeding Series,
<https://www.ieice.org/publications/proceedings/>

From Editor's Desk

●IEICE General Conference 2022

IEICE General Conference 2022 will be held online, from 15th to 18th of March 2022. Complete English sessions are also scheduled in the conference. Please check out the latest conference information on the IEICE web site:

<https://www.ieice-taikai.jp/2022general/en/index.html>

We welcome your contribution of article submissions to GNL. For article submission, please refer to the Submission Guideline of IEICE-CS GLOBAL NEWSLETTER:

[ENG] https://www.ieice.org/cs_r/eng/gnl/submission_guideline.html

[JPN] https://www.ieice.org/cs_r/jpn/gnl/submission_guideline.html

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