

COMMISSION D: Electronics and Photonics

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1. Summary

The Commission D internationally promotes research and reviews new developments in:

1. Electronic systems that push beyond current frontiers.
2. Microwave, millimeter wave and THz devices, circuits and systems
3. Nanotechnologies and nanoelectronics
4. Combined and hybrid photonic and electronic systems.
5. Photonic devices, systems, and their applications.
6. Photonic signal processing schemes, regardless of frequency of signal processed.
7. Optoelectronic systems, plasmonics, and electro-optics
8. Physics, theoretical modeling, and numerical simulation of all of the latter

The Commission focuses on electronics and photonics devices, circuits and systems for the purpose of implementing either previously inaccessible functionalities or of improving the performance of current electronic-only or photonic-only technologies.

In Japan, we also promote the research and reviews new developments in the electronics and photonics. In period of 2021-2023, 2 Japanese professors, Prof. Naoki Shinohara and Prof. Atsushi Kanno, contributed the activities of the Commission D as a chair and as a vice chair, respectively. We, Japanese, also contributed the flagship conferences of the URSI General Assembly and AT-AP-RASC as session conveners and speakers. In Japan, there are some domestic conferences and workshops related to the Commission D and they are very active. Domestic Commission D of the URSI supports both the international activities and domestic activities.

2. Activity Report

2.1 International Activities related to areas covered by Commission D

Session Proposal to URSI General Assembly 2021: will be held on Aug. 28th – Sep. 4th, 2021 in Rome and online hybrid. 5 members contributed to organizing the conference. Dr. Masayuki Suzuki is a convener of session D01 “Photonic Signal Processing, Real-time Instruments and Biomedical Imaging” and gather 6 papers. Prof. Naoki Shinohara is a convener of session D3 “Far-Field Wireless Power Transfer and Energy Harvesting” and gather 16 papers. Prof. Tadao Nagatsuma is a convener of session D08 “Integrated Terahertz Electronic and Photonic Devices and Systems” and gather 9 papers. Dr. Atsushi Kanno and Dr. Kosuke Nishimura are conveners of session D09 “Microwave and

photonic subsystems for Beyond 5G/6G communications” and gather 7 papers. Prof. Shinohara, as a vice chair of international commission D, serve to choose Young Scientist Panel and Student Paper Competition from Commission D in GASS2021.

Contribution to URSI AT-AP-RASC2022: will be held on May. 29th – June. 3rd, 2022 in Gran Canaria, Spain and online hybrid. 7 Japanese members contributed to organizing the conference. Prof. Hiroshi Murata and Dr. Toshimasa Umezawa are conveners of session D01 “Convergence of photonics and radio systems Towards 6G ” and gather 7 papers. Prof. Masayuki Suzuki, is one of conveners of session D2 “Photonic signal processing, real-time instruments and biomedical imaging ” and gather 12 papers. Prof. Morio Toyoshima is one of conveners of session D06 “Photonics and electronics for space applications ” and gathers 7 papers. Prof. Tetsuya Kawanishi is one of conveners of session D07 “Electronic and photonic components for THz Communications” and gathers 3 papers. Prof. Naoki Shinohara and Dr. Atsushi Kanno are conveners of session D09 “Open Session” as a chair and a vice chair of Commission D and gathers 4 papers. Prof. Naoki Shinohara also is one of conveners of workshop session “Wireless Power Transfer Technologies and Applications” and gathers 10 invited talks. Prof. Shinohara, as a chair of international commission D, serves to organize “AI Special Session” and to to choose Young Scientist Panel and Student Paper Competition from Commission D.

Contribution to URSI General Assembly 2023: will be held on Aug. 19th – 26th, 2023 in Sapporo, Japan. 13 Japanese members contributed to organizing the conference. Prof. Kyoya Takano and Dr. Shinsuke Hara are conveners of session D01 “Electronic devices, circuits and systems for THz communications” and gather 5 papers. Prof. Yoshihisa Takayama and Prof. Tomoyuki Miyamoto are conveners of session D02 “Advanced technologies for underwater wireless systems” and gather 7 papers. Prof. Atsushi Kanno and Dr. Atsushi Matsumoto are conveners of session D03 “Electronics and photonic systems for vehicular applications” and gather 6 papers. Dr. Isao Morohashi is one of conveners of session D04 “Microwave/millimeter-wave/THz and photonic systems for Beyond 5G/6G communications” and gathers 16 papers. Prof. Qiaowei Yuan and Prof. Naoki Shinohara are conveners of session D05 “Near Field WPT” and gather 4 papers. Dr. Bo Yang and Dr. Tsunayuki Yamamoto are conveners of session D06 “Far Field WPT” and gather 6 papers. Dr. Masayuki Suzuki is one of conveners of session D07 “Photonic Signal Processing, Real-time Instruments and Biomedical Imaging” and gathers 11 papers. Prof. Hiroshi Murata is one of conveners of session D09 “Electronic and photonic technologies for electromagnetic field measurement and their applications” and gathers 8 papers. Prof. Naoki Shinohara and Prof. Atsushi Kanno are conveners of session D11 “Recent Advances in Electronics and Photonics” and gather 10 papers. Prof. Shinohara, as a chair of international commission D, and Prof. Atsushi Kannno ,as a vice chair of international

commission D, make a program of session in Commission D and choose Young Scientist Panel and Student Paper Competition from Commission D.

Other activities: 2020 International Topical Meeting on Microwave Photonics (MWP) was held virtually on Nov. 24th -26th, 2020. Some of Commission D members served as Technical Program Committee and the other committees. Dr. Atsushi Kanno had a keynote talk entitled “Radio and Optical Integration Toward Society 5.0 and 6G,” in 13th International Conference on Advanced Technologies for Communications, held in Nha Trang, Vietnam and online on Oct. 8th – 10th, 2020.

2.2 Domestic Activities related to areas covered by Commission D

Technical Committees on Microwave Photonics (IEICE):

The following technical meetings were held; On Oct. 21st, 2020, online, with 3 invited talks and 1 regular talk. On Jan. 21st – 22nd, 2021, online, with 5 invited talks and 13 regular talks, co-organized with Technical Committee on Photonic Network, Technical Committee on Electromagnetic Theory, IEE-J Technical Committee on Electromagnetic Theory, and IEEE Photonics Society Kansai Chapter. On May 26th, 2021, online, with 3 invited talks and 5 regular talks. On July 15th – 16th, 2021, online with 1 invited talk and 11 regular talks, co-organized with Technical Committee on Optoelectronics, Technical Committee on Microwaves, Technical Committee on Electronics Simulation Technology, Technical Committee on Electromagnetic Theory, and Tech. Group on Terahertz Application System. On Nov. 26, 2021, online, with 4 invited talks, entitled “Antenna near field measurement using radio over fiber system and industrial robot”, “R&D for higher frequency bands radio-over-fiber systems”, “Antenna-coupled electrode electro-optic modulators for beyond 5G mobile communication systems and millimeter-wave radars”, and “Field demonstration of eye-safe high capacity FSO system with multi-aperture transmission and digital coherent reception”, and 3 regular talks. On Jan. 27, in Kyoto and online, with 1 invited talk entitled “Standardizations activities on radio over fiber technologies” and 6 invited talks.

Technical Committees on Terahertz Application Systems (IEICE):

The following technical meeting was held; On Aug. 5, 2021, online, with 5 invited talks related on “Photo-excited THz wave radiation from multi-layer quantum well structure”, “MEMS based THz meta-material”, “Waste plastic identification with THz wave”, “THz electronics and spintronics with topological semimetal”, “Development of small dielectric antenna for 300 GHz band based on visualization of the electric field and application to wireless communication” and 7 regular talks.

Technical Committees on Microwave Photonics and Terahertz Photonic-Electronics Technologies (MWPThz) (IEICE)

On Apr. 1, 2022, Technical Committees on Microwave Photonics (MWP) and Technical Committees on Terahertz Application Systems (THz) merged to become Technical Committees on Microwave Photonics and Terahertz Photonic-Electronics Technologies. Dr. Atsushi Kanno is a chair and Prof. Masayuki Fujita is one of the co-chairs. The following technical meetings were held; On June 3, 2022, in Tokyo and online, with 3 invited talks, entitled “Semiconductor-based terahertz optical science and application development”, “Exploration of wide-area water energy resources on the lunar surface using terahertz waves”, and “Advanced technologies for microwave/THz-wave control and transfer using phonic technique”, and 2 regular talks. On Jul. 19-20, 2022, in Asahikawa and online, with 11 regular talks with 31 talks of EST Tech. Com., MW Tech. Com., EMT Tech. Com, OPE Tech. Com., and IEE-EMT. On Dec. 19-20, 2022, in Sendai and online, with 6 invited talks entitled “Terahertz irradiation effects on protein structure and cell function”, “Monolithic Integrated 300GHz band rectenna with GaAsSb/InGaAs backward diodes”, “InP-HEMT fabrication process technology for Beyond 5G wireless network with Tera-Hertz band”, “10mW class high power terahertz oscillator using resonant tunneling diode”, “Directional terahertz radiation based on the interaction of electron beams with metamaterials”, and “Bi-directional real-time 300GHz radio communication system”, and 9 regular papers with ED Tech. Com.. On Jan. 23-24, 2023, in Osaka and online, with 3 regular talks with 13 talks of PN Tech. Com., EMT Tech. Com., and IEE-EMT.

2020 IEICE Society Conference online: was held on Sep. 15-18, 2020, online. Microwave and mm-wave photonics session (C-14) was held and 10 regular talks were presented.

2021 IEICE General Conference online: was held on Mar. 9-12, 2021, online. Microwave and mm-wave photonics session (C-14) was held and 21 regular talks were presented. Technical Committees on Microwave Photonics organized special sessions, CI-6 “Frontier of terahertz research for Beyond 5G” with 7 papers, co-organized with Tech. group on terahertz application system, and CI-7 “Challenges of high-frequency sensing and optical transmission technology for new IoT era” with 7 papers, co-organized with Tech. Group on Terahertz Application System.

2021 IEICE Society Conference: was held on Sept. 14-17 online. Technical Committees on MWP and Technical Committees on THz organized a special session, CI-5 “Device and material technologies and their applications for beyond 5G and 6G.” Microwave and mm-wave photonics session (C-14) was held, and 12 regular talks were presented.

2022 IEICE General Conference: was held on Mar. 15-18 online. Technical Committees on MWP organized a special session, CI-6 “Current status and recent trends on microwave photonics technology.” Technical Committees on THz organized a special session, CI-7 “Recent trends on

communication technology for beyond 5G and 6G.” Microwave and mm-wave photonics session (C-14) was held, and 12 regular talks were presented.

2022 IEICE Society Conference: was held on Sept. 6-7, 2022, online. Technical Committees on MWPTHz organized special sessions, CK-2 “Basic technology of microwave/millimeter-wave/THz and photonic for THz wireless communication” with 9 talks and BSC-1 “Transversal transmission technology utilizing optics and radio waves in the Society 5.0” with 10 talks. Microwave Photonics and Terahertz Photonic-Electronics Technologies session (C-16) was held with 16 talks.

2023 IEICE General Conference: was held on Mar. 7-10, 2023, in Saitama. Technical Committees on MWPTHz organized a special session, BCI-1 “Frontier of research and development of millimeter wave/terahertz wave wireless technology for Beyond 5G/6G” with 8 talks. Microwave Photonics and Terahertz Photonic-Electronics Technologies session (C-16) was held with 16 talks.