# COMMISSION D: Electronics and Photonics (November 2016 – October 2020)

Edited by *Hiroyuki Toda* (*Doshisha University*)

## 1. Summary

Electronics and Photonics cover huge scientific and technological fields. In this report, I attached activity reports submitted between November 2016 and October 2020. I also attached reference list showing published materials by the committee members between 2016 and 2020.

## 2. Activity Report

### Commission D (Electronics and Photonics) Activity Report

November 2016 - March 2017

March 30, 2017

Katsutoshi Tsukamoto

### 1. Domestic Activities related to areas covered by Commission D

**Technical Committees on Microwave Photonics (IEICE)**: Technical Committee on Microwave Photonics (IEICE): Following technical meeting was held on specific subjects including regular contributions, November 14, 2016 (Tokyo); Three Special Lectures: Technology overview of high speed and stable quantum key distribution, Future Optical Access Systems Using Burst-Mode Optical Amplifiers, Recent development of terahertz communication using resonant tunneling diode oscillators, and 8 contributed paper related MMW and THz wave photonics devices, systems, and applications were provided. The committee chair was Prof. Yuichi Kado (Graduate School of Science and Technology, Kyoto Institute of Technology), who is a member on Japan Commission D.

**Technical meeting on Microwave Photonics (IEICE)** was held in cooperation with other five technical committees related with Electronics and photonics on January 18-19, 2017, at Ise, Mie. Prof. Kado, Prof. Toda, Prof. Ito and Prof. Yoshimoto, Commission D members contributed in its organization and presentations. In the meeting, 4 invited presentations were provided on specific subjects; Control of circularly polarized light electromagnetic field using chiral photonic crystals; IoT Data Analysis Technology; Evolution of optical and mobile communication systems and future integration; and Elastic Optical Path Control Methods for Highly-Reliable Optical Network. 45 contributed paper on the following topics were presented: advanced photonic networks and devices, photonic generation, antenna or radio over fiber devices and

systems for and modulation of microwave, millimeter wave, submillimeter wave, and THz wave.

**IEICE General Conference 2016:** the session of Microwave Photonics (C-14) was held at the IEICE general conference, March 22-25, 2017 (Nagoya); 19 papers were presented, which covered millimeter wave, submillimeter wave, and THz wave signal generation, modulation and antenna devices; electronic and photonic devices for microwave photonics applications; system applications including radio-over-fiber links, and optical wireless communications.

## 2. International Activities related to areas covered by Commission D

**SPIE 2017 Photonics West:** The conference was held on January 28 - February 2, 2017 at Moscone Center, San Francisco USA. At the session of Conference 10128 "Broadband Access Communication Technologies XI" co-chaired by Commission D member, Prof. Tsukamoto, following notable papers were presented; Classical key distribution in optical communication; 3D hybrid integration for active silicon photonics; Integrated microwave photonics: a key enabling technology for radio-over- fiber; Advanced digital-signal processing for short-haul optical-fiber transmission beyond 100G; Data center performance improvement using optical wireless links; FireFly: a reconfigurable optical wireless networking approach in data The role of integrated photonics in datacenter networks; Toward exa-scale optical circuit switch interconnect networks for future datacenter/HPC; Advanced Optical fibers and Amplifiers for SDM and Data Centers; Silicon Photonics and Alternative Technologies for Data Centers and Short Hauls; Millimeter-Wave Components and Technologies and 5G Radio-Over-Fiber (RoF) Systems for Access; Millimeter-Wave Technologies and Advanced MIMO RoF Systems.

# Commission D (Electronics and Photonics) Activity Report

April 2017 - September 2017

Sept. 14, 2017

Katsutoshi Tsukamoto

## 1. Commission Activities

**National Report (November 2013 - October 2016) :** 9 Members contributed to overviewing recent remarkable advances in their specialized areas such as Quantum Cascade Lasers and Optical Antennas (Kenichi Kasahara, Ritsumeikan Univ.); Current-Injection Terahertz Lasing in a Distributed-Feedback Dual-Gate Graphene-Channel Transistor (Taiichi Otsuji, Tohoku University); Terahertz Photonic Crystals (Masayuki Fujita, Osaka University); THz-Wave Emitters and Detectors Based on Diode Technology (Hiroshi Ito, Kitasato University); Millimeter-wave and submillimeter-wave antennas in standard CMOS technology (Eiichi Sano, Hokkaido University); Space-Division-Multiplexed Optical Fiber Transmission (Hiroyuki Toda, Doshisha University); Recent research trends in optical access network technologies (Jun-ichi Kani, NTT Corporation); Optical Access Networks for broadband IoT services (Naoto Yoshimoto, Chitose Institute of Science and Technology); and Construction of resilient cyber physical system based on ICT (Katsumi Iwatsuki, Tohoku University). Total number of pages counts 61.

**URSI GASS 2017:** the members on Japan Commission D contributed on paper presentations as follows: "FEC IMPROVEMENT OF TRANSMISSION PERFORMANCE IN DIGITAL RADIO ON RADIO," K. Tsukamoto, Osaka Institute of Technology, Japan, et. al., and "STUDY ON NON-THERMAL EFFECTS OF

EXPOSURE TO 0.07-0.6 THZ RADIATION TO CULTURED CELLS," K. Kawase, Nagoya University, Japan, et. al.

## 2. Domestic Activities related to areas covered by Commission D

**Technical Committees on Microwave Photonics (IEICE)**:
Following technical meeting was held on May 11, 2017 (Tokyo). Three invited talks were presented, that were entitled on “Current Status and Perspective of R&D in High Capacity FWS using Microwave and Millimeter-wave”, “VHF-band Broadband Fixed Wireless systems to Resolve Digital Divides," and "Optical and Radio Converged Access Network for Accommodating Mobile Services in Beyond-5G Era”. Several regular contributions were also presented related to 60 GHz band Radio-over-Fiber System, systems and functional devices for FM-CW Linear Cell Radar, millimeter-wave mobile terminal localization in 5G mobile, photonic based millimeter-wave radio link. The committee chair, Prof. Yuich Kado, Kyoto Inst. of Tech. and the vice-chair, Prof. Hiroyuki Toda, Doshisha Univ., are members on Japan Commission D.

Another meeting was held on July 20-21, 2016 (Obihiro). (jointly held with related technical committees referring to light-wave and radio-wave workshop). Four invited talks were presented, that were entitled on “Application of RoF technique in V/UHF band and some problems for next generation wireless communications”, “Layer2 technologies in Optical Wireless Convergence Platform for IoT Services", “Precision Inspection of Dielectric Constant Measurement Using Terahertz Time-domain Spectroscopy System and Its Application”, and “Scattering and Guiding Problem of Electromagnetic Waves in Inhomogeneous Media by Improved Fourier series Expansion Method - The Application of Photonic Crystal and Metamaterial -". Several papers related to following technical topics were presented: heterogeneous wireless communication systems utilizing photonic technologies for 5G mobile systems, phased array laser system, optical frequency comb generation, RoF-based millimeter-wave radar system, millimeter and terahertz wave integrated circuits, photonic technology for microwave and millimeter-wave heterogeneous network, etc. One of members on Japan Commission D, Prof. Naoto Yoshimoto (Chitose Inst. of Science and Tech.) was contributed in the organization.

**IEICE Society Conference**: Following technical meeting was held in the session of Microwave Photonics (C-14) at the IEICE society conference: September 12-15, 2017 (Tokyo); 19 papers were presented, which cover IF over Fiber system for 5G mobile, optical wave and THz wave conversion, photonic detection of THz wave, THz imaging system, photonic MMW and THz wave generation, linear optical modulator, photonic beam steering in MMW and THz wave.

# Commission D (Electronics and Photonics) Activity Report

October 2017 - June 2018

June 30, 2018

Hiroyuki Toda

## 1. Commission Activities

The 24th committee members were approved. The members are Dr. Hiroshi Ishihara, Honorary Professor of Tokyo Institute of Technology, Prof. Yasuo Kokubun, Yokohama National University, Prof. Kazuo Hotate, Toyota Technological Institute, Prof. Naoki Shinohara, Kyoto University, Prof. Masayuki Izutsu, Waseda

University, Prof. Hiroshi Ito, Kitazato University, Prof. Katsumi Iwatsuki, Tohoku University, Prof. Yohtaro Umeda, Tokyo University of Science, Prof. Taiichi Otsuji, Tohoku University, Prof. Kenichi Kasahara, Ritsumeikan University, Prof. Yuichi Kado, Kyoto Institute of Technology, Prof. Katsutoshi Tsukamoto, Osaka Institute of Technology, Prof. Hiroyuki Toda, Doshisha University (Chair), Prof. Tadao Nagatsuma, Osaka University, Prof. Masayuki Fujita, Osaka University, Dr. Masamichi Fujiwara, NTT Corp., and Prof. Naoto Yoshimoto, Chitose Institute of Science and Technology.

## 2. International Activities related to areas covered by Commission D

**PIERS 2018 Toyama**: 6 members contribute to organizing the conference. Prof. Yasuo Kokubun and Prof. Kazuo Hotate are Local Organizing Committee members. Prof. Naoki Shinohara is a Local Steering Committee member. Prof. Hiroyuki Toda is a Local Technical Program Committee member, and a Co-Chair of Subcommittee SC3: Optics and Photonics. Prof. Tadao Nagatsuma is a Co-Chair of Technical Program Committee, Chair of Local Technical Program Committee, Secretary: Technical Program of Local Steering Committee, a Co-Chair of Young Scientist Program Committee, and a Subcommittee member of SC3: Optics and Photonics. Prof. Masayuki Fujita is a Secretary of Local Technical Program Committee, and a Subcommittee member of SC3: Optics and Photonics

## 3. Domestic Activities related to areas covered by Commission D

**Technical Committees on Microwave Photonics (IEICE)**:

The following technical meetings were held. On November 9 at Tokyo, two invited talks related on surface acoustic wave optomechanics, and low-temperature solid-state bonding for high-density $LiNbO_3$ optical device packaging, and four regular talks were presented. On January 25 and 26 at Himeji, three invited talks related on radio-over-fiber technologies: ITU-T standard activities, railway applications, and 60-GHz mobile terminal localization, and seven regular talks were presented. On May 18 at Tokyo, two invited talks related on assessment for radio protection for advanced wireless systems, and THz-vector network analyzers, and three regular talks were presented. Prof. Naoto Yoshimoto is a Co-Chair. Prof. Masayuki Izutsu, Prof. Hiroshi Ito, and Prof. Hiroyuki Toda are members. Prof. Tadao Nagatsuma, Prof. Katsumi Iwatsuki, Prof. Katsutoshi Tsukamoto, and Prof. Yuichi Kado are Advisory members.

**IEICE General Conference**:

IEICE General Conference was held on March 20 - 23, 2018 at Tokyo. A Symposium on THz technology and its system applications was held. 8 invited talks related on THz electric field detection using ultra-short laser pulses, traveling wave tube for THz source, THz imaging systems, Si CMOS ICs for 300-GHz band wireless communication, broadband and low noise THz detection by Fermi-level managed barrier diode, influence investigation of THz waves to living organisms by using THz gyrotron and THz time-domain spectroscopy, THz down converter by electro-optic sampling, and radio regulations on spectrum in 275-450 GHz were presented. Prof. Hiroshi Ito was presented in the symposium. Microwave and mm-wave photonics session (C-14) was held and 14 regular talks related on radio-over-fiber, 300-GHz and 600-GHz wireless communication and imaging technology, optical modulators, and other topics were presented.

## 1. Commission Activities

The 1st meeting was held on October 30, 2018 at Doshisha University. Prof. Hiroyuki Toda, Doshisha University was approved as a chair of the 24th committee.

## 2. International Activities related to areas covered by Commission D

**PIERS 2018 Toyama**: 5 members contribute to organizing and chairing sessions and to making invited presentations. Prof. Naoki Shinohara made a general lecture entitled "Electromagnetic Wave Theory for Wireless Power Transfer." Prof. Taiichi Otsuji organized and co-chaired a session "Emerging Electromagnetic Functionalization of Graphene and 2D Materials for Terahertz Device Applications" and co-authored two invited presentations entitled "Terahertz Detection with Asymmetric Dual Grating Gate Bilayer Graphene Field-effect-transistor" and "Comparison of Infrared and Terahertz Photodetectors Based on Graphene, CdHgTe, and $A_3B_5$ Quantum-well Heterostructures." Prof. Tadao Nagatsuma co-organized and co-chaired a session "Recent Advances in Devices and System Technologies for Terahertz Wireless Communications," chaired a session "General Lecture 3" and co-chaired a session "Oral Presentations for Best Student Paper Awards — SC2: Metamaterials, Plasmonics and Complex Media," and co-authored an invited presentation entitled "Progress of 350 GHz-band Corporate-feed Plate-laminated Waveguide Slot Array Antennas." Prof. Masayuki Fujita made an invited presentation entitled "Photonic Crystal Slab for Terahertz Applications." Prof. Hiroyuki Toda co-organized and chaired a session "Future Wireless Communication Systems for Railways," co-authored an invited presentation entitled "Output Power Enhancement in Photonic-based RF Generation by Optical Pulse Compression with Fiber," and co-chaired a session "Oral Presentations for Best Student Paper Awards — SC3: Optics and Photonics."

**URSI AP-RASC 2019:** 4 members contribute to organizing and making invited presentations. Prof. Naoki Shinohara was a member of Scientific Program Committee, chaired a session "General Lecture 2," was one of conveners of a session "Electronic Systems, Wireless Devices, Wireless Power Transfer and Energy Harvesting," and made two invited presentations entitled "Wireless Charging System of Electric Bicycle via Microwave" and "Development of Battery-less Sensor for Maintenance of Infrastructures with Microwave Power Transfer." Prof. Tadao Nagatsuma made a Commission Keynote Lecture entitled "Terahertz-wave Applications Enabled by Photonics and Electronics." Prof. Masayuki Fujita was one of conveners of a session "Microwave, Millimeter Wave & THz Devices, Circuits and Systems. Prof. Hiroyuki Toda was one of conveners of a session "Photonic Signal Processing, Real-time Instruments and Biomedical Imaging."

**URSI JRSM 2019:** 2 members contribute to organizing the conference. Prof. Naoki Shinohara is a member of Organizing Committee and Technical Program Committee. Prof. Hiroyuki Toda is a member of Technical Program Committee.

## 3. Domestic Activities related to areas covered by Commission D

**Technical Committees on Microwave Photonics (IEICE)**:

The following technical meetings were held. On July 19 and 20 at Toya, one invited talk related on a long-range and high-resolution LiDAR system, and 7 regular talks were presented. On November 26 at Tokyo, 6 regular talks related on transportation systems were presented. On Jan 17 and 18 at Osaka, 6 regular talks were presented. On August 6 and 7 at Matsue, MWP Symposium was held. 14 invited talks related on radio and optical technologies, future wireless services, and vehicle applications, and 22 regular poster presentations were presented. Prof. Naoto Yoshimoto is a Co-Chair. Prof. Masayuki Izutsu, Prof. Hiroshi Ito, and Prof. Hiroyuki Toda are members. Prof. Tadao Nagatsuma, Prof. Katsumi Iwatsuki, Prof. Katsutoshi

Tsukamoto, and Prof. Yuichi Kado are Advisory members.

**IEICE Society Conference**:

IEICE Society Conference was held on Sept. 11 - 14, 2018 at Kanazawa. Microwave and mm-wave photonics session (C-14) was held and 14 regular talks were presented.

**IEICE General Conference**:

IEICE General Conference was held on March 19 - 21, 2019 at Tokyo. Microwave and mm-wave photonics session (C-14) was held and 21 regular talks were presented.

## Commission D (Electronics and Photonics) Activity Report

April 2019 - August 2020

September 16, 2020

Hiroyuki Toda

### 1. International Activities related to areas covered by Commission D

**URSI JRSM 2019:** 2 members contributed to organizing the conference. Prof. Naoki Shinohara is a member of Organizing Committee and Technical Program Committee. Prof. Hiroyuki Toda is a member of Technical Program Committee.

**URSI GASS 2020:** 3 members contributed to organizing the conference. Prof. Tadao Nagatsuma is a converner of session D09 Integrated terahertz electronic and photonic devices and systems. Prof. Naoki Shinohara is a convener of session D03 Far-field wireless power transfer and energy harvesting, and assigned conveners to session DK1 Bio effects and EM interference of wireless power transfer. Prof. Hiroyuki Toda assigned conveners to session D01 Photonic signal processing real-time instrument and biomedical imaging, session D10 Microwave and photonic subsystems and antennas for 5G communications, and session DA1 Measurement and instrument technologies for mm- and THz waves.

**URSI Centenary Book:** A report written by Prof. Tadao Nagatsuma and Prof. Hiroyuki Toda was submitted on August 24, 2019.

**Other activities:** Prof. Yasuichi Otsuji organized a session entitled "Metamaterials/Metasurfaces in Dirac/Kane Plasmons" in the 10th International Conference on Metamaterials, Photonic Crystals and Plasmonics on July 23-26, 2019. Prof. Y. Otsuji made 20 invited presentations at international conferences related on terahertz wave technology.

### 2. Domestic Activities related to areas covered by Commission D

**Technical Committees on Microwave Photonics (IEICE)**:

The following technical meetings were held. On May 22, 2019 at Tokyo, one invited talk related on a spin-controlled vertical-cavity surface-emitting lasers for low-power and high-speed data communication, and 4 regular talks were presented. On July 18 and 19, 2019 at Hakodate, one invited talk related on prototype of millimeter wave radar system connected by optical fiber for bi-static scattering measurement, and 7 regular talks were presented. On November 27, 2019 at Tokyo, two invited talks related on flight demonstration of airborne coherent Doppler lidar, and quantum cascade lasers for sensing applications, and 4 regular talks were presented. On Jan 30 and 31, 2020 at Kyoto, one invited talk related on IEEE802.3 plenary meeting for automotive ethernet standardization, and 6 regular talks were presented. On May 28, 2020, one invited talk related on fabrication process of InP-HEMT-based sub-millimeter wave ICs for beyond 5G application, and

4 regular talks were presented in virtual format. On July 16 and 17, 2020, one invited talk related on standardization activities of terahertz spectrum towards 6G, and 2 regular talks were presented in virtual format. Prof. Naoto Yoshimoto is a Chair. Prof. Masayuki Izutsu, Prof. Hiroshi Ito, and Prof. Hiroyuki Toda are members. Prof. Tadao Nagatsuma, Prof. Katsumi Iwatsuki, Prof. Katsutoshi Tsukamoto, and Prof. Yuichi Kado are Advisory members.

**2019 IEICE Society Conference**:

IEICE Society Conference was held on Sept. 10 - 13, 2018 at Osaka. Microwave and mm-wave photonics session (C-14) was held and 20 regular talks were presented. A symposium (CI-2) on ultra-high speed device technology for next generation seemless wired and wireless communications, co-sponsored with Technical Committee on Lasers and Quantum Electronics, was held and 6 invited talks were presented.

**2020 IEICE General Conference**:

IEICE General Conference was planned on March 17 - 20, 2020 at Tokyo, however due to COVID-19, on-site conference was cancelled. 19 regular presentation were programmed on Microwave and mm-wave photonics session (C-14).

**Technical Committees on Terahertz Application Systems (IEICE)**:

The following technical meetings were held. On December 23 and 24, 2019 at Sendai, four invited talk and 13 regular talks were presented with co-sponsored with Technical Committees on Electron Devices. The technical committees co-sponsored two technical meetings on July 18 and 19, 2019 at Hakodate and on July 16 and 17, 2020 in a virtual format. Prof. Masayuki Fujita is a Chair. Prof. Hiroshi Ito is a member.

(Revised for this national report on 2021.)

## 3. References

### Books


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