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1. Introduction

The 2020 International Symposium on Antennas and Propagation (ISAP2020) was held virtually in Osaka from January 25th to 28th, 2021. Due to the travel restrictions imposed in light of the COVID-19 pandemic, we have to organize the ISAP2020 in Osaka as an online conference. This Symposium, the 25th ISAP, returned back to Japan after the ISAP2016 at Okinawa. ISAP2020 was organized and sponsored by the Communications Society of the Institute of Electronics, Information and Communications Engineers (IEICE), and in cooperation with the Antenna Measurement Techniques Association (AMTA), the Antennas and Propagation Society of the Institute of Electrical and Electronics Engineers (IEEE/AP-S), the Antennas Society of the Chinese Institute of Electronics (AS-CIE), the Electrical Engineering/Electronics, Computer, Communications, Information Technology Association of Thailand (ECTI), the European Association on Antennas and Propagation (EurAAP), the Institute of Antenna Engineers of Taiwan, the International Union of Radio Science (URSI), the Korean Institute of Electromagnetic Engineering and Science (KIEES), and the Taiwan Microwave Association. The conference features 4 plenary talks, 6 invited talks, 5 technical workshops, 78 technical sessions including 25 organized sessions and 13 short presentation sessions instead of the poster sessions. It was attended by 563 researchers and engineers from 36 countries and regions. In addition, the on-line competitions of the ISAP2020 Student Design Contest (SDC) and the special sessions of the Women in Engineering (WIE) were held for the first time in the history of ISAPs.

2. Conference History

The ISAP is intended to provide an international forum for the exchange of information on the progress of research and development in antennas, propagation and electromagnetic wave theory. The first ISAP was held at Sendai, Japan in 1971 and it had been held nine times in Japan until 2004. From 2005, ISAP expanded the conference venues to Asia and Pacific areas and became annual conferences. The host cities from 2005 to 2019 were Seoul, Singapore, Niigata, Taipei, Bangkok, Macao, Jeju, Nagoya, Nanjin, Kaohsiung, Hobart, Okinawa, Phuket, Busan, and Xi’an, respectively. This symposium is now recognized as one of major conferences in this technical field.

3. Topics of the ISAP2020

Opening Ceremony and Plenary Talks

The symposium started with opening address by the general chair, Prof. Hiroyuki Arai, and was followed by brief complimentary addresses from the representatives of technical co-sponsors, IEEE/AP-S, URSI, EurAAP, AS-CIE, and KIEES.

Four plenary talks were organized in this symposium. In the first plenary talk, Dr. Hiroshi Koyama from Mitsubishi Electric Corporation in Japan talked about “Perspectives of Future Space Business and Technologies.” In this talk, the latest technological trends for communication, observation, and positioning satellites have been introduced, including the flexible satellite, the data science of a high-frequency observation using AI, and the Centimeter Level Augmentation Service using the Quasi-Zenith Satellite System for autonomous driving and IT agriculture.

In the second plenary talk, Prof. Sangwook Nam from Seoul National University in Korea talked about “The Past, Present, and Future of Wireless Power Transfer Technology: EM point of view.” In this talk, he explained a history of research and development for a typical wireless power transfer system from the viewpoint of electromagnetism. He also introduced future technology “Simultaneous wireless information and power transfer.”

In the third plenary talk, Prof. Thomas Kürner from Technische Universität Braunschweig in Germany talked about “THz Communications — A candidate for the next Generation of Wireless Systems?.” In this talk, he introduced the latest terahertz communications systems in IEEE 802 activities. The requirement for terahertz band antenna development and subjects for channel characterization were mentioned.

Fig. 1 Opening address from Prof. Hiroyuki Arai
In the fourth plenary talk, Dr. Hanyang Wang from Huawei Technologies in U.K. talked about “Antenna Design for Mobile Terminals.” In this talk, he introduced design methods for basic small antennas and the latest 5G millimeter-wave antennas.

Invited Talks
Six speakers were invited for the first presentations in the sessions with each related topic.
(i) Prof. Toru Sato, Kyoto University
“Development of an Antarctic Atmospheric Radar”
(ii) Prof. Seong-Ook Park, Korea Advanced Institute of Science and Technology
“Improved Drone Detection in FMCW Radar using SPC Technique”
(iii) Prof. Qing-Xin Chu, South China University of Technology
“Dual-polarized Antenna Loaded with Ferrite Cores for Decoupling in Multi-band Multi-array Antennas”
(iv) Prof. Chow-Yen-Desmond Sim, Feng Chia University
“Recent Designs to Achieving Wideband MIMO Antenna for 5G NR Sub-6GHz Smartphone Applications”
(v) Dr. Daniël J Janse van Rensburg, NSI-MI Technologies & Nearfield Systems Inc
“Near-Field Test Challenges of High Frequency Digital Phased Array Antennas”
(vi) Prof. Vittorio Degli-Esposti, University of Bologna
“Ray Tracing: Techniques, Applications and Prospect”

Technical Sessions
There were 428 papers presented in ISAP2020 from 33 countries and regions. In this symposium, the following topics were highlighted:
- Advanced Millimeter-Wave Array Antennas
- Recent Advances in Time Domain Method
- Antenna Arrays for Radar Applications
- Massive MIMO and its Related Techniques for 5G Beyond/6G Systems
- Biomedical Applications of Electromagnetic Field
- Metasurfaces/Metamaterials for Radiation and Scattering Control
- Novel Antennas and Propagation Modelling for the 5G Millimeter Wave Bands
- Circularly Polarized Antennas
- Advanced Radar Technology Related to Radar Signal and Image Processing Including Antennas
- Emerging Technologies for the New 5G Antenna Systems
- Recent Advances in Computational Electromagnetics
- WPT Technologies for Mobile Devices
- Orbital Angular Momentum (OAM) Multiplexing Transmission
- Recent Developments for Next-Generation Terrestrial and Space Communication Systems
- Millimeter-Wave and Terahertz-Wave Systems for Infrastructures and Their Standardization Activities
- Antennas and Propagation Technologies for Satellite Applications
- Thinned and Sparse Arrays
- Millimeter-Wave and Terahertz-Wave Propagation
- Studies on Radio Wave Propagation in ITU-R SG3

In addition to the above topics, three special sessions were organized.
- EurAAP Session: Recent Advances in European Antennas and Propagation Research I, II
- Recent Advances in Antennas and Propagation in ASEAN countries I, II
- Leading Technologies over Diversity

In order to easily participate in the live sessions, a portal site for limiting access was prepared with a short lead-time. The portal site contributed to the smooth operation of the online conference.

Fig. 2 Portal site for live sessions

4. Technical Workshop
The following technical workshops about recent hot topics were organized with free of charge for the attendees.
1. Dr. Lars J. Foged (Microwave Vision Group) and Prof. M. Sierra Castañer (Technical Univ. of Madrid): Post Processing Techniques in 5G, Automotive & Space Antenna Measurements
2. Prof. Yang Miao (Univ. of Twente), Prof. Minseok Kim (Niigata Univ.), Prof. Jorg Schafer (Frankfurt Univ.), Prof. Stefano Savazzi (Politecnico di Milano): Passive Human Detection, Localization, and Posture Identification, Using Radio Technologies
3. Prof. Wonbin Hong (Pohang Univ. of Science and Technology): Advancements in 5G Antennas and Emerging 6G Antenna Technologies
4. Prof. Ying Liu (Xidian Univ.): The Design of Millimeter-Wave Wideband Multi-Polarization Antenna Array
5. Prof. Takeshi Fukusako (Kumamoto Univ.): Circularly Polarized Antennas: Design and Measurement Techniques
5. Exhibition

Twenty-two exhibitors and two technical seminars joined and demonstrated their works and products such as electromagnetic simulators, measurement instruments, antennas and microwave components and equipment in the virtual exhibition area.

6. Award

The ISAP2020 established two awards namely the Best Paper Award from all papers and the Student Paper Award from student presentations.

Following five papers received the Best Paper Award.

b. SIW Cavity-Fed Filtenna Arrays for 5G Millimeter Wave Applications, R. Lu, C. Yu and W. Hong (Southeast Univ., China)
c. Retrieval of Debye Parameters from Cole-Cole Model for Broadband FDTD Analyses, J. Chakarothai and K. Fujii (NICT, Japan)
d. 300 GHz Link Enabled by Yagi-Uda Antenna, G. Ducournau (IEMN - Lille Univ., France)
e. Radio Environment Measurement over the Urban Area for UAV Communications, M. Taniguchi, E. Sasaki, M. Ueba and S. Kitazawa (Muroran Institute of Technology, Japan)

Following six papers were awarded the Student Paper Award.

a. Efficient Optimization for Bandwidth of the Element of a Multilayer Parallel-plate Slot Array, S. Ji, T. Tomura and J. Hirokawa (Tokyo Institute of Technology, Japan)
b. Electric Field Reconstruction of Antenna inside Phantom for Non-invasive SAR Measurement, R. Baharim, T. Uno and T. Arima (Tokyo Univ. of Agriculture and Technology, Japan), S. Omi (NICT, Japan)
c. A Highly Efficient Rectifier with a Wide Dynamic Range Based on Variable Self-Bias Voltage, J. Zhang, Y. Huang and J. Zhou (Univ. of Liverpool, United Kingdom (Great Britain))
d. Experimental Study on Resolution Enhancement in Height for Automotive MW-3D-SAR, Y. Mukaide and H. Yamada (Niigata Univ., Japan)
e. A W-Band Corporate-Fed Hollow-Waveguide Slot Array Antenna by Glass Micromachining, Y. Wu, T. Yu, M. Zhang and D. Yu (Xiamen Univ., China), J. Hirokawa (Tokyo Institute of Technology, Japan), Q. Huo Liu (Duke Univ., USA)
f. Cost Effective Wideband Ka Flat Lens Antenna, J. M Poyanco and F. Pizarro (Pontificia Univ. Catolica de Valparaiso, Chile), E. Rajo-Iglesias (Univ. Carlos III of Madrid, Spain)

7. Student Design Contest

The ISAP2020 held the Student Design Contest. Following teams received the Best Design Award for each category.

Category A. Antenna Design: A-17, BOHDAI-NISHI, Takumi Nishime (National Defense Academy, Japan)
Category B. Localization of RF Sources: B-01, Team Aoba for ISAP2020 SDC, Changyu Zhou and Tomohiro Kondo (Tohoku Univ., Japan)
Category C. Inverse Problem: C-05, The EMMA Team, You Wu, Songlin Zhou, and Zhichao Lin (Tsinghua Univ., China)

8. ISAP-ISC Meeting

An ISAP International Steering Committee (ISAP-ISC) meeting was held during the symposium. The ISAP-ISC is organized by the researchers of mainly contributed countries and regions in Asia and Pacific areas to ISAP. The operation of the symposium was discussed and future ISAP venue has been decided in the meeting. In this meeting, the representatives from Australia, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Singapore, Taiwan, and Thailand attended. ISAP-ISC has decided that the venue of ISAP2023 will be Kuala Lumpur, Malaysia in this meeting. Thus, the venues up to 2023 has been decided as Taipei Taiwan in 2021 and Sydney Australia in 2022.

9. Conclusion

The ISAP2020 steering committee thanks to all attendees and related people for the contribution organizing the ISAP2020. All the papers of past ISAP can be referred in the web page “ISAP archives” [1] with free of charge during the trial service. The papers of ISAP2020 will appear in ISAP archives in August 2021. In addition, the papers of ISAP2020 have been included in IEEE Xplore. The symposium web page of ISAP2021 has been available [2].

10. References