

The 17<sup>th</sup> IEEE VTS  
Asia Pacific Wireless Communications Symposium

Final Program

# IEEE VTS APWCS 2021

August 30-31, 2021

Virtual Edition

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## Program at a Glance (JST)

Monday 30 August	
09:00 - 12:00	<b><u>S1: Wireless Communication</u></b>
12:00 - 13:50	Lunch Break
13:50 - 14:00	Opening Ceremony: Welcome Message from the General Chair
14:00 - 15:40	<b><u>&lt;Live&gt; Keynote Speech:</u></b> Mr. Takehiro Nakamura SVP and General Manager of the 6G-IOWN Promotion Department NTT DOCOMO, INC., Japan
	<b><u>&lt;Live&gt; Invited Speech 1:</u></b> Prof. Seong-Lyun Kim Professor and Head of the School of Electrical & Electronic Engineering Yonsei University, Korea
15:40 - 16:00	Break
16:00 - 19:00	<b><u>S2: [Special Session] Activities toward Beyond 5G/6G:</u></b> Organizers: Assoc. Prof. Toshihiko Nishimura, Hokkaido University, Japan Dr. Satoshi Suyama, NTT DOCOMO, INC., Japan
Tuesday 31 August	
09:00 - 12:00	<b><u>S3: 5G and Beyond</u></b>
12:00 - 14:00	Lunch Break
14:00 - 15:40	<b><u>&lt;Live&gt; Invited Speech 2:</u></b> Prof. Yi-Bing Lin Chair Professor NYCU, NCKU, CMU, THU, and Asia University, Taiwan
	<b><u>&lt;Live&gt; Invited Speech 3:</u></b> Prof. Yuen Chau Associate Professor, Singapore University of Technology and Design, Singapore
15:40 – 15:50	Message from the General Chair of IEEE VTS APWCS 2022
15:50 - 16:00	Break
16:00 - 19:00	<b><u>S4: Network, System and Applications</u></b>

## Welcome Message from the General Chairs

On behalf of the organizing committee of the 17<sup>th</sup> IEEE Vehicular Technology Society Asia Pacific Wireless Communications Symposium (IEEE VTS APWCS 2021), we welcome all of you to Osaka University in Osaka, Japan. IEEE VTS APWCS 2021 is technically sponsored by the IEEE VTS, IEICE Communications Society, and jointly sponsored by the IEEE VTS Tokyo/Japan Chapter, Seoul Chapter, Taipei Chapter, and Singapore Chapter.

APWCS conference was started in 2004, and after that it has been held every year except for APWCS2020 due to COVID-19. APWCS2020 in Osaka was postponed to APWCS2021. In APWCS2021, because it is still impossible to operate face-to-face conference, we have decided to operate virtual APWCS2021. However, virtual conference is also one of very important use cases for fifth generation cellular system (5G) and next generation system (6G). Thus, we believe, it is very important to continuously stimulate to exchange our ideas for our future wireless world through virtual APWCS2021 symposium.

APWCS has been aimed to promote the exchange of technical information and improve collaboration among researchers, scholars, engineers, and leaders who are working in the mobile and wireless communication fields, particularly in the Asia Pacific region. Thus, APWCS2021 offers high level keynote and invited talks as well as general and invited papers of up-to-date wireless communication technologies including 5G and 6G technologies.

One more important issue is that APWCS2021 is financially supported by the Telecommunications Advancement Foundation and KDDI Foundation. We would like to give sincere thanks to these two foundations for success of APWCS2021.

Finally, we would like to show our appreciation to the Organizing Committee Members, the keynote and invited speakers, the paper reviewers, the APWCS Board of Governors, and, last but not least, the authors for their great contribution and support. We hope you will enjoy the technical programs in APWCS 2021, and hope all of you will enjoy this virtual conference.

**Seichi Sampei** (General Chair)

*Osaka University, Japan*

**Jae-Hyun Kim** (General Co-Chair)

*Ajou University, Korea*

**Borching Su** (General Co-Chair)

*National Taiwan University, Taiwan*

**Ernest Kurniawan** (General Co-Chair)

*Institute for Infocomm Research (I2R), A\*STAR, Singapore*

## Welcome Message from the Technical Program Committee Chairs

On behalf of the Technical Program Committee (TPC), it is our great pleasure to welcome you to the 17th IEEE VTS Asia Pacific Wireless Communications Symposium (IEEE VTS APWCS 2021), which is held online in the wake of the coronavirus outbreak.

This year, we have organized plenary sessions, a special session, and regular oral sessions for the symposium. In the plenary sessions, following the symposium traditions, we have invited Mr. Takehiro Nakamura, SVP and General Manager of the 6G-IOWN Promotion Department in NTT DOCOMO, INC. as a keynote speaker from VTS Tokyo/Japan Chapter, and three speakers for the invited talks: Prof. Seong-Lyun Kim of Yonsei University from Seoul Chapter, Prof. Yi-Bing Lin of National Yang Ming Chiao Tung University in Taiwan from Taipei Chapter, and Prof. Chau Yuen of Singapore University of Technology and Design from Singapore Chapter. The plenary speakers will give us exciting and inspiring presentations on wide views of the technical front and the next wave of our technical society.

From the Technical Committee on Radio Communication Systems (RCS), IEICE as a technical co-sponsor Prof. Toshihiko Nishimura of Hokkaido University and Dr. Satoshi Suyama of NTT DOCOMO, INC. have also organized the special session entitled “Activities toward Beyond 5G/6G” comprising nine invited papers aiming at sharing the ideas of new technical trends among all the participants in this symposium. The regular oral sessions have also been successfully organized. This year, we have received 39 paper submissions (including withdrawn paper). After extensive and strict peer-reviews, we have accepted 31 high-quality papers that cover a broad range of important and timely issues related to state-of-art wireless communications technologies. These papers have been categorized into three sessions: “Wireless Communication”, “5G and Beyond”, and “Network, System, and Applications.”

This impressive technical program would not be finalized without voluntary supports from an outstanding team of colleagues that we would like to thank strongly. Special thanks go to the TPC members for their professional and timely reviews. Also, we would appreciate special session organizers devoting themselves to every necessary management for the session, including the invitation of speakers and the review process.

Of course, making a successful symposium under the serious COVID-19 pandemic is not possible without the active participation of the paper authors. We would like to express our gratitude to the paper authors for presenting and sharing their valuable ideas and contributions to our community. Finally, we would like to thank the IEEE VTS APWCS 2021 Organizing Committee members for their full supports.

**Shinsuke Ibi** (TPC Chair)

*Doshisha University, Japan*

**Seung-Hoon Hwang** (TPC Co-Chair)

*Dongguk University, Korea*

**Chun-Lin Liu** (TPC Co-Chair)

*National Taiwan University, Taiwan*

**Boon Hee Soong** (TPC Co-Chair)

*Nanyang Technological University, Singapore*

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# Keynote Speech

## 5G Evolution and 6G

(Monday 30 August, 14:00 - 14:50 (JST) <Live>)



### **Mr. Takehiro Nakamura**

SVP and General Manager of the 6G-IOWN Promotion Department in NTT DOCOMO, INC.

### **Abstract**

Commercial 5G services have been launched globally. Study and development for technologies toward the evolution of 5G are ongoing, taking into account issues in early 5G services and emerging market needs. In parallel, research focused on technologies and services beyond 5G and 6G is accelerating throughout the world. NTT DOCOMO published a white paper on 5G evolution and 6G in January 2020 and updated it in February 2021. This presentation will explain NTT DOCOMO's views described in the white paper as well as our latest activities on 5G evolution and 6G.

### **Biography**

Mr. Takehiro Nakamura joined NTT Laboratories in 1990. He is now SVP and General Manager of the 6G-IOWN Promotion Department in NTT DOCOMO, INC. Mr. Nakamura has been engaged in R&D and the standardization activities for advanced radio and network technologies of W-CDMA, HSPA, LTE/LTE-Advanced, 5G and 6G. He has been the Acting Chairman of Strategy & Planning Committee of 5G Mobile Communications Promotion Forum (5GMF) since October 2014, the leader of Cellular System Task Group of ITS Info-communications Forum since 2016, and the leader of White Paper Subcommittee in Beyond 5G Promotion Consortium in Japan since February 2021. Mr. Nakamura has also been contributing to standardization activities in 3GPP since 1999, including as chairman of 3GPP TSG-RAN from April 2009 to March 2013.

# Invited Speech 1

## Federation and Split in Wireless AI: 5G Smart Factory Use Case Perspective

(Monday 30 August, 14:50 - 15:40 (JST) <Live>)



### Prof. Seong-Lyun Kim

Professor and Head of the School of Electrical & Electronic Engineering, Yonsei University

#### Abstract

The 5G system is under its way toward successful deployments, bridging between wireless communications and vertical applications (e.g., city, factory, vehicles, etc). On the other hand, the research community launched B5G or 6G research, wherein key white papers are talking about service scenarios in 2030. AI/Machine Learning is to be an important ingredient, known as either "AI for Wireless" or "Wireless for AI." The talk will give insights on how federation and split computation needs to be merged into AI algorithms for future wireless systems. The key performance indices include accuracy, delay, reliability and energy-channel-efficiency. The talk introduces an example from a 5G smart factory, to see how such distributed computation and communications make impact on future wireless systems.

#### Biography

Seong-Lyun Kim is a Professor and Head of the School of Electrical & Electronic Engineering, Yonsei University, Seoul, Korea, heading the Robotic & Mobile Networks Laboratory (RAMO) and the Center for Flexible Radio (CFR+). He is co-directing H2020 EUK PriMO-5G project, and leading Smart Factory Committee of 5G Forum, Korea. He was an Assistant Professor of Radio Communication Systems at the Department of Signals, Sensors & Systems, Royal Institute of Technology (KTH), Stockholm, Sweden. He was a Visiting Professor at the Control Engineering Group, Helsinki University of Technology (now Aalto), Finland, the KTH Center for Wireless Systems, and the Graduate School of Informatics, Kyoto University, Japan. He served as a technical committee member or a chair for various conferences, and an editorial board member of *IEEE Transactions on Vehicular Technology*, *IEEE Communications Letters*, *Elsevier Control Engineering Practice*, *Elsevier ICT Express*, and *Journal of Communications and Network*. He served as the leading guest editor of *IEEE Wireless Communications* and *IEEE Network* for wireless communications in networked robotics, and *IEEE Journal on Selected Areas in Communications*. He also consulted various companies in the area of wireless systems both in Korea and abroad. His research interest includes radio resource management, information theory in wireless networks, collective intelligence, and robotic networks. He published numerous papers, including the co-authored book (with Prof. Jens Zander), *Radio Resource Management for Wireless Networks*. His degrees include BS in economics (Seoul National University), and MS & PhD in operations research (with application to wireless networks, Korea Advanced Institute of Science & Technology).

## Invited Speech 2

# Zero-Touch Pervasive Computing: The IoTtalk Demonstration

(Tuesday 31 August, 14:00 - 14:50 (JST) <Live>)



### **Prof. Yi-Bing Lin**

Chair Professor, NYCU, NCKU, CMU, THU, and Asia University

### **Abstract**

Due to COVID-19, human social behavior has been permanently changed. Such change offers new opportunities for pervasive computing based on Internet of Things (IoT) technology. An example is IoTtalk, an IoT application development platform for pervasive computing. IoTtalk provides zero-touch interactions between human and the environments using smartphones without any mobile app. In this article, we describe the IoTtalk architecture focusing 6 issues: application code verification, big data management, AI tool provisioning, IoT device development environment, sensor calibration, and security and privacy. We emphasize that IoTtalk is an environment for developing “platforms of applications”. Every developed platform for X-type applications is called X-Talk. We develop several X-Talk systems to address the above 6 issues. Finally, we use two zero-touch applications to demonstrate how anti-COVID-19 pervasive computing can be achieved.

### **Biography**

Yi-Bing Lin is Chair Professor of National Yang Ming Chiao Tung University (NYCU), China Medical University, National Cheng Kung University and Asia University. He received his Ph.D. degree of Computer Science from the University of Washington, Seattle, USA, in 1990. From 1990 to 1995 he was a Research Scientist with Bellcore. He then joined National Chiao Tung University (NCTU) in Taiwan, where he remains. In 2011-2013, Lin was the Senior Vice President of NCTU. During 2014 - 2016, Lin was Deputy Minister, Ministry of Science and Technology, Taiwan. Lin is an Adjunct Research Fellow, Information Technology Innovation, Academia Sinica. He serves on the boards of directors in several companies including Information Technology Total Services and National Applied Research Laboratories. He serves on the editorial board of *IEEE Trans. on Vehicular Technology*. Lin is the author of the books *Wireless and Mobile Network Architecture* (Wiley, 2001), *Wireless and Mobile All-IP Networks* (John Wiley, 2005), and *Charging for Mobile All-IP Telecommunications* (Wiley, 2008). Lin received numerous research awards including 2005

NSC Distinguished Researcher, 2006 Academic Award of Ministry of Education and 2008 Award for Outstanding contributions in Science and Technology, Executive Yuen, 2011 National Chair Award, and TWAS Prize in Engineering Sciences, 2011 (The World Academy of Sciences). He is in the advisory boards or the review boards of various government organizations including Ministry of Economic Affairs, Ministry of Education, and Ministry of Transportation and Communications. Lin is AAAS Fellow, ACM Fellow, IEEE Fellow, and IET Fellow.

## Invited Speech 3

### Reconfigurable Intelligent Surface (RIS)-Assisted Wireless Networks

(Tuesday 31 August, 14:50 - 15:40 (JST) <Live>)



#### **Prof. Yuen Chau**

Associate Professor, Singapore University of Technology and Design

#### **Abstract**

In this talk, we will present some recent results on the reconfigurable intelligent surfaces (RIS)-assisted wireless network, including a hybrid beamforming for RIS-empowered multi-hop terahertz communications, intelligent spectrum learning with RIS, RIS-assisted MAC, and RIS-assisted aerial-terrestrial communications. In particular, we design an adaptive RIS-assisted transmission protocol, in which the channel estimation, transmission strategy, and data transmission are independently implemented in a frame. Then formulate an RIS-assisted transmission strategy optimization problem to maximize the overall system throughput.

#### **Biography**

Dr. Chau Yuen received the BEng and PhD degree from Nanyang Technological University (NTU), Singapore, in 2000 and 2004 respectively. He was a Post-Doctoral Fellow with Lucent Technologies Bell Labs at Murray Hill in 2005. From 2006 to 2010, he was with the Institute for Infocomm Research (I2R), Singapore. Since 2010, he has been with the Singapore University of Technology and Design. He received the IEEE Marconi Prize Paper Award in Wireless Communications and EURASIP Best Paper Award for *Journal on Wireless Communications and Networking* on 2021, IEEE Asia Pacific Outstanding Young Researcher Award on 2012, and IEEE VTS Singapore Chapter Outstanding Service Award on 2019. Dr. Yuen serves as an Editor for *IEEE Transactions on Communications* and *IEEE Transactions on Vehicular Technology*. Dr. Yuen is currently an IEEE Fellow and Distinguished Lecturer of IEEE Vehicular Technology Society.

# Technical Program

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## S1: Wireless Communication

Monday 30 August, 9:00 - 12:00 (JST)

- S1-1 A Study on Conversion of NLoS to LoS conditions using Sidelink in Smart Factory Environments**  
*Akihiro Kubota, Seiichi Sampei, and Takumi Takahashi (Osaka University, Japan)*
- S1-2 A Study on MIMO Gain of UAV-to-Ground Channel in Urban Environment**  
*Mohammed Elsagher, Akram Al-Hourani, and Ke Wang (RMIT University, Australia); Jinho Choi (Deakin University, Australia)*
- S1-3 Cooperative Communications Based on Harmonic Means of Channel Responses**  
*Shu-Fan Lin (National Cheng-Kung University, Taiwan)*
- S1-4 Health Secure Radar: Use of Micro Doppler Signatures for Health Care and Security Applications**  
*Muhammad Haris Butt, Muhammad Muqtadir, and Daniyal Qazi (Lahore University of Management Sciences, Pakistan); Faran Awais Butt (University of Management and Technology, Pakistan); Ijaz Haider Naqvi and Naveed Ul Hassan (Lahore University of Management Sciences, Pakistan)*
- S1-5 Influence of Design-SNR on BER Performance under BP Decoder**  
*Kohei Ueda (Kagawa University, Japan); Satoshi Suyama and Takahiro Asai (NTT DOCOMO, INC., Japan); Nobuhiko Miki (Kagawa University, Japan)*
- S1-6 Iterative Demodulation and Decoding with Blind Channel Estimator for LoRa Modulation**  
*Takuya Mihara and Shinsuke Ibi (Doshisha University, Japan); Takumi Takahashi (Osaka University, Japan); Hisato Iwai (Doshisha University, Japan)*
- S1-7 Local ARQ: A New Way for Exploiting Multiple Detection-Terminals**  
*Hokuto Taromaru and Hidekazu Murata (Kyoto University, Japan); Toshiro Nakahira, Motoharu Sasaki, and Takatsune Moriyama (NTT Corporation, Japan)*
- S1-8 Multi-Input Physical Layer Network Coding In Wireless Two-Way Relay Networks**  
*Hideaki Tsugita, Satoshi Denno, and Yafei Hou (Okayama University, Japan)*
- S1-9 Performance Evaluation of Neural Network-based Offset Optimization in Cell Range Expansion for Multiple Frequency Bands**  
*Ryuya Sembo and Nobuhiko Miki (Kagawa University, Japan)*
- S1-10 Research on the Placement Method of UAV Base Stations for Dynamic Users**  
*Masanori Ozasa, Gia Khanh Tran, and Kei Sakaguchi (Tokyo Institute of Technology, Japan)*
- S1-11 UWB-based Multiple UAV Control System for Indoor Ground Vehicle Tracking**  
*Joohyun Lee, Jiseon Moon, and Sunwoo Kim (Hanyang University, South Korea)*
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## **S2: [Special Session] Activities toward Beyond 5G/6G**

**Monday 30 August, 16:00 - 19:00 (JST)**

*Organizer: Assoc. Prof. Toshihiko Nishimura (Hokkaido University, Japan), Dr. Satoshi Suyama (NTT DOCOMO, INC., Japan)*

### **In Asia:**

**S2-1 NICT's R&D Activities on the Future Terrestrial Wireless Communication Systems toward B5G/6G by Harmonizing Requirements with Environments**

*Fumihide Kojima and Takeshi Matsumura (NICT, Japan)*

**S2-2 5G Innovation and 6G Research – Sharing on Some Singapore's Activities and Initiatives**

*Sumei Sun (Institute for Infocomm Research, Singapore)*

**S2-3 Towards 6G Mobile: Vision and Technologies**

*Young Jo Ko and Ilgyu Kim (ETRI, South Korea)*

**S2-4 Bridging the Gap Between Academia and Industry: MOST 6G Research Program in Taiwan**

*Hung-Yu Wei (National Taiwan University, Taiwan); Y.-W. Peter Hong (National Tsing Hua University, Taiwan); Wen-Tron Shay and Tzong-Lin Wu (National Taiwan University, Taiwan)*

### **In Japan:**

**S2-5 R&D of technology for high reliability management in advanced 5G network to meet the various requirements of different communication services**

*Hirofumi Shinbo, Takahide Murakami, Yu Tsukamoto, and Yoji Kishi (KDDI Research, Inc., Japan)*

**S2-6 High power efficiency millimeter-wave network with communication quality prediction technology**

*Hiroaki Asano, Hiroshi Noguchi, Noriyuki Shimizu, Tsutomu Asanuma, Makoto Yasugi, Takeo Ueta, Kosuke Ohno, and Ryota Honda (Panasonic Corporation, Japan)*

**S2-7 Radio-over-Fiber Systems with 1-bit Digital Modulation for 5G/6G Indoor Wireless Communication**

*Shinichi Hori, Yuma Kase, Naoki Oshima, and Kazuaki Kunihiro (NEC Corporation, Japan)*

**S2-8 Development of High Altitude Platform Station Backhaul System Using 38GHz Band Frequency**

*Hirofumi Kitanozono and Jun Suzuki (SKY Perfect JSAT Corporation, Japan); Yoshihisa Kishiyama and Yuki Hokazono (NTT DOCOMO INC., Japan); Takayuki Sotoyama and Mikihiro Ouchi (Panasonic Corporation, Japan); Ryu Miura and Hirofumi Tsuji (NICT, Japan)*

**S2-9 Millimeter-Wave Base Station Cooperation Technologies for High-Mobility Environments**

*Tatsuki Okuyama, Satoshi Suyama, Nobuhide Nonaka, and Takahiro Asai (NTT DOCOMO, INC., Japan)*

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### S3: 5G and Beyond

Tuesday 31 August, 9:00 - 12:00 (JST)

- S3-1 A Theoretical Study on Suboptimal Joint Transmit-Receive Diversity In Correlated Rayleigh Fading Channels**  
*Fumiyuki Adachi (Tohoku University, Japan)*
- S3-2 BER of LDPC-Coded Single-Carrier LOS-MIMO Using FDE in 3GPP TDL Channel Models**  
*Aiki Hara, Kana Aono, and Mamoru Sawahashi (Tokyo City University, Japan); Norifumi Kamiya (NEC Corporation, Japan)*
- S3-3 BLER of Turbo SIC Multiplying Weighting Factor to Symbol Estimates for OFDM Using FTN Signaling**  
*Toshiharu Obara, Tsubasa Shobudani, and Mamoru Sawahashi (Tokyo City University, Japan); Yoshihisa Kishiyama (NTT DOCOMO INC., Japan)*
- S3-4 BLER Performance of Circular 256QAM Schemes Considering Cubic Metric for DFT-Precoded OFDM**  
*Yugo Sasaki and Mamoru Sawahashi (Tokyo City University, Japan); Yoshihisa Kishiyama (NTT DOCOMO INC., Japan)*
- S3-5 Design and Experimental Validation of Digital Pre-distortion Techniques for mmWave OTA with Multiple Nonlinear Power Amplifiers**  
*Juinn Horng Deng (Yuan Ze University, Taiwan)*
- S3-6 Design of Millimeter Wave Active Array Antenna Module with Embedded System and Calibration of Software Defined Radio Platform**  
*Juinn Horng Deng (Yuan Ze University, Taiwan)*
- S3-7 Detection Probability of PRACH Preamble for NR in 3GPP TDL Channel Models**  
*Kosuke Kamata and Mamoru Sawahashi (Tokyo City University, Japan); Yoshihisa Kishiyama (NTT DOCOMO INC., Japan)*
- S3-8 Downlink Channel Estimation Based on Multipath Separation in an FDD MIMO System**  
*Shiori Tosaka, Toshihiko Nishimura, Yasutaka Ogawa, Takeo Ohgane, Junichiro Hagiwara, and Takanori Sato (Hokkaido University, Japan)*
- S3-9 Round Trip Time for Control Channel Multiplexing Using In-Band Full Duplex with Synchronous Orthogonal Sequence Assignment**  
*Mamoru Sawahashi and Fumiya Makishi (Tokyo City University, Japan); Yoshihisa Kishiyama (NTT DOCOMO INC., Japan)*
- S3-10 Throughput Performance of HetNets using Sectorized Picocells with 3D Beamforming at 28 GHz Band in Multipath Fading Channels**  
*Shoko Nishimura (Kogakuin University, Japan); Satoshi Suyama and Takahiro Asai (NTT DOCOMO, Japan); Hiroyuki Otsuka (Kogakuin University, Japan)*
- S3-11 Transmission Performance of OFDM-based 1024-QAM under Different Types of Multipath Fading Channels**  
*Daisuke Kosuge and Hiroyuki Otsuka (Kogakuin University, Japan)*
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## S4: Network, System, and Applications

Tuesday 31 August, 16:00 - 19:00 (JST)

- S4-1 Accurate and Stable Wi-Fi based Indoor Localization and Classification Using Convolutional Neural Network**  
*Aisha Javed and Naveed UL Hassan (Lahore University of Management Sciences, Pakistan); Chau Yuen (Singapore University of Technology and Design, Singapore)*
- S4-2 An Unsupervised TCN-based Outlier Detection for Time Series with Seasonality and Trend**  
*Ronghong Mo, Yiyang Pei, Neelakantam Venkatarayalu, Pereira Nathaniel, A. B. Premkumar, and Sumei Sun (Singapore Institute of Technology, Singapore)*
- S4-3 Application of random forest to classify weather observation into rainfall using GNSS receiver**  
*Yutaka Nakagawa, Taiki Miyauchi, Takeshi Higashino, and Minoru Okada (NAIST, Japan)*
- S4-4 Design of CycleGAN model for SAR image colorization**  
*Jung-Hoon Lee, Kyeongrok Kim, and Jae-Hyun Kim (Ajou University, South Korea)*
- S4-5 Distributed and Autonomous Aerial Data Collection in Smart City Surveillance Applications**  
*Haemin Lee, Soyi Jung, and Joongheon Kim (Korea University, South Korea)*
- S4-6 Game-Theoretic Cloud-Edge Resource Allocation for Video Analytics in the Factory of the Future**  
*Yi-Yun Li, Ta-Sheng Lin, and Hung-Yu Wei (National Taiwan University, Taiwan)*
- S4-7 Improved Belief-Propagation Decoding with Virtual Channel Outputs for LDPC Convolutional Codes with Rational Parity-Check Matrices**  
*Chung-Hsuan Wang and Jo-Han Lu (National Yang Ming Chiao Tung University, Taiwan)*
- S4-8 Performance of CRC-Aided Erasure Demodulation for M-ary Chirp Spread Spectrum Signal**  
*Yukitoshi Sanada and Takumi Ono (Keio University, Japan)*
- S4-9 Quantum Scheduling for Millimeter-Wave Observation Satellite Constellation**  
*Joongheon Kim, Yunseok Kwak, and Soyi Jung (Korea University, South Korea); Jae-Hyun Kim (Ajou University, South Korea)*
-