SmartCom Virtual Workshop #02

Emerging Technology Trends for Smart Radio in Japan and Singapore

IEICE Technical Committee on Smart Radio is hosting a SmartCom Virtual Workshop #02 entitled "**Emerging Technology Trends for Smart Radio in Japan and Singapore**" on 24 May 2022 at 10:30 JST.

Date: 24 May 2022
Time: 10:30 (JST) - 13:00 (JST)
(Online, Zoom)
Organized by IEICE Technical Committee on Smart Radio
Contact: sr_ac-com-tuto@mail.ieice.org

Workshop Chair Prof. Koji Ishibashi (The University of Electro-Communications, Japan)

Program:

(1) Opening Remarks

10:30-10:40 Prof. Kei Sakaguchi (Tokyo Tech, Japan)

10:40-10:50 Dr. Sumei Sun (I2R, Singapore)

(2) Technical Session

10:50-11:20 AI-Assisted Reconfigurable Intelligent Surfaces (RIS) Wireless Networks
Prof. Yuen Chau
(Singapore University of Technology and Design, Singapore)

11:20-11:50 RIS-assisted Wireless Channel Control for Intelligent Radio-wave Design
Mr. Masashi Iwabuchi (NTT, Japan)

11:50-12:20 Joint Radar and Communication for Future Wireless Systems
Dr. Zeng Yonghong (I2R, Singapore)

12:20-12:50 Fundamentals of Quantum Speedup for Wireless Communications
Prof. Naoki Ishikawa (Yokohama National University, Japan)

(3) Closing Session

12:50-13:00 Prof. Koji Ishibashi (The University of Electro-Communications, Japan)

Registration link:

https://forms.gle/StVGoVt8C2gLJ9gi9

FREE ADMISSION. Registration can be made through the link above not later than 23 May 2022. (NOTICE: If the registrations are over the acceptable capacity of Zoom, the registration site will have been closed before the deadline of registration.)

Detail of lectures:

1. Prof. Kei Sakaguchi (Tokyo Tech, Japan)

Opening Remarks

Time: 10:30 to 10:40 (JST: Japan Time)

2. Dr. Sumei Sun (I2R, Singapore)

Opening Remarks

Time: 10:40 to 10:50 (JST: Japan Time)

3. Prof. Yuen Chau (Singapore University of Technology and Design, Singapore)

Title: AI-Assisted Reconfigurable Intelligent Surfaces (RIS) Wireless Networks

Time: 10:50 to 11:20 (JST: Japan Time)

Abstract: In this talk, we will present some recent results on the reconfigurable intelligent surfaces (RIS) wireless network empowered by AI, in particular a deep-learning-based hybrid beamforming for RIS-empowered multi-hop teraherz communications, intelligent spectrum learning with RIS, and AI-assisted MAC. Such AI-based solution is particular of important when the network involves multiple users, as the signals impinging upon an RIS can be contaminated by interfering signals which are usually dynamic and unknown. To address this issue, 'learning' the properties of the surrounding spectral environment is a promising solution. Motivated by the convergence of artificial intelligence and spectrum sensing, we termed here as spectrum learning, where the RIS controller becomes capable of intelligently 'think-and-decide' whether to reflect or not the incident signals.

Biography: Chau Yuen received the B.Eng. and Ph.D. degrees from Nanyang Technological University (NTU), Singapore, in 2000 and 2004, respectively. He was a Post-Doctoral Fellow with Lucent Technologies Bell Labs, Murray Hill, in 2005. From 2006 to 2010, he was with the Institute for Infocomm Research (I2R). Since 2010, he has been with the Singapore University of Technology and Design. He received the IEEE Marconi Prize Paper Award in Wireless Communications 2021, IEEE Asia-Pacific Outstanding Young Researcher Award in 2012, and the IEEE VTS Singapore Chapter Outstanding Service Award in 2019. He serves as an Editor for the IEEE TRANSACTIONS ON COMMUNICATIONS and the IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY. He is a Distinguished Lecturer of the IEEE Vehicular Technology Society and IEEE Fellow.

4. Mr. Masashi Iwabuchi (NTT, Japan)
Title: RIS-assisted Wireless Channel Control for Intelligent Radio-wave Design
Time: 10:50 to 11:20 (JST: Japan Time)

Abstract: We have proposed a concept of intelligent radio-wave design that has potential to enhance various performances on wireless communication and non-communication functions by dynamically controlling wireless channels. In order to achieve extremely high performances, millimeter-wave (mmWave) and higher-frequency bands are expected to be utilized in future wireless access, such as 5G evolution and 6G. For pursuing extremely high data rate and high capacity wireless communication with improved reliability, it is ideal to communicate in a shorter distance with a Line of Sight environment and increase the number of communication paths to provide more redundancy. In particular, for mmWave and higher-frequency bands, improving wireless channel is important to take advantage of the wider bandwidth because these bands greatly depends on the actual wireless channels. Satisfying such conditions will require a network topology distributed in the space domain. Therefore, making new communication paths is very important for these bands. In order to generate wireless paths and provide better communication quality in mmWave communications, we have studied a channel control method utilizing relay solutions such as smart repeater, reconfigurable intelligent surface (RIS) and IAB, so far. In this talk, we will introduce the technical concept and our activities related to RIS.

Biography: Masashi Iwabuchi received the B.S. and M.S. degrees from the Tokyo Institute of Technology, Tokyo, Japan, in 2008 and 2010, respectively. From 2010 to 2016, he joined the NTT Access Network Service Systems Laboratories, Nippon Telegraph and Telephone Corporation (NTT). From 2016 to 2019, he joined NTT DOCOMO, Inc. and contributed research and development for 5G. Since 2019, he has been with NTT Access Network Service Systems Laboratories again. His current research interests are radio access technologies for future wireless networks, such as millimeter-wave relay networks utilizing smart repearters and reconfigurable intelligent surfaces. He received the Young Researcher's Award and Communications Society: Distinguished Contributions Award from the Institute of Electronics, Information and Communication Engineers (IEICE) in 2015 and 2020, respectively. He is a member of the IEICE.

5: Dr. Zeng Yonghong (I2R, Singapore)

Title: Joint Radar and Communication for Future Wireless Systems

Time: 11:50 to 12:20 (JST: Japan Time)

Abstract: Radar sensing and wireless communication are crucial in many applications like autonomous driving, intelligent transportation, virtual/augmented reality (VR/AR), industrial automation, robot coordination and tracking, disaster relief, etc. Both radar and wireless communications use RF signals and have a lot of similarities in hardware and software. However, currently dedicated spectrum, hardware, and software are used separately for them. This separation has caused huge spectrum, hardware and energy waste. With the increasing usage of software defined radio and digital signal processing, the hardware and RF front-end for radar and communication tends to be similar. Thus, in recent years there is a trend to integrate radar sensing and wireless communication as one of the key technologies in future wireless systems.

There are different approaches for joint radar and communication, which have different advantages and problems. In 6G, higher frequency like the THz band will be used and massive antenna arrays will be employed. These not only increase the communication throughput and reliability, but also create opportunities for very high accuracy environment sensing, where millimetre level localization and high resolution imaging can be achieved. However, it is still unclear how to design the joint sensing and communication system and maximize the overall benefit. There are still many issues and difficulties to be addressed.

Biography: Yonghong ZENG he has been working in the Institute for Infocomm Research since 2004, A*STAR, Singapore, and currently is a senior scientist and group leader. His research interests include cognitive network and communication, radar and array signal processing, joint radar and communication, AI for radar and communication, and ultra-reliability and low latency communication (URLLC). Currently he is working on 5G/B5G communication system, time sensitive network for internet of things, and vehicular radar and communication.

He has co-authored six books and more than 80 refereed journal papers. He received the 2007 and 2009 IES (Institute of Engineers Singapore) prestigious engineering achievement award in Singapore, and ministry-level Scientific and Technological Development Awards four times in China. He was the

recipient of a best paper award at IEEE VTC-Spring, 2011. He received the Inaugural IEEE Communications Society Asia-Pacific Best Paper Award in 2012, IEEE TENCON best paper award recently in 2017, and APCC best paper award in 2018. He received the Certificate of Appreciation for outstanding contributions to the IEEE 802.22 standard in 2011. He is a Fellow of IEEE.

6. Prof. Naoki Ishikawa (Yokohama National University, Japan)
Title: Fundamentals of Quantum Speedup for Wireless Communications
Time: 12:50 to 13:00 (JST: Japan Time)

Abstract: In designing wireless communication systems, the trade-off between performance and complexity is a source of concern for engineers and researchers, who pursue a balance between both from a practical perspective. From a long-term perspective, quantum computation is a promising approach that may strike the fundamental trade-off thanks to quantum superposition and entanglement. In particular, the Grover search is a famous quantum algorithm; it can find an element from a list of unsorted N elements with the query complexity of the square root of N, known as quadratic or quantum speedup. This surprising theoretical capability has inspired those who dream of achieving the ultimate performance with reduced complexity.

This tutorial provides the fundamentals of quantum computation. Quantum circuits and wireless communications are mathematically similar in certain aspects. Focusing on this similarity, we study the basics of quantum computation and quantum circuits so that wireless researchers can easily understand. Then, quantum algorithms such as the Grover search, BBHT, DH, and Grover adaptive search are introduced to explain how they provide quadratic speedup to solve a binary optimization problem (including QUBO and HUBO). Finally, state-of-the-art studies in wireless communications that exploit the Grover-type algorithms are briefly reviewed.

Biography: Naoki Ishikawa is an Associate Professor at the Faculty of Engineering, Yokohama National University, Japan. He received the B.E., M.E., and Ph.D. degrees from the Tokyo University of Agriculture and Technology, Tokyo, Japan, in 2014, 2015, and 2017, respectively. In 2015, he was

an academic visitor with the School of Electronics and Computer Science, University of Southampton, UK. In 2017 and 2021, he was certified as an Exemplary Reviewer of IEEE Transactions on Communications. For more information, please visit our website: https://ishikawalab.ynu.ac.jp/index.en.html

7. Prof. Koji Ishibashi (The University of Electro-Communications, Japan)
Closing Session
Time: 12:50 to 13:00 (JST: Japan Time)