15th April 2019
24th URSI-C Chair
Makoto Taromaru

Activity Report of URSI-C Committee

Since the 24th committee started, we have held scientific workshops four times as the followings.

- The 1st scientific workshop of the 24th URSI-C in Japan -

1. Session title: “Wireless Access TechnologiesTowards the 5th Generation Mobile Communication”
2. Convener: Prof. Satoshi Denno (Okayama University)
3. Date/time: 14:00 - 17:00, June 29th, 2018
4. Venue: 16th Building, Yagami Campus (Yokohama city, Kanagawa pref.)
5. Registration fee: Free
6. Listed attendees: 28 persons
7. Local arrangement: Prof. Yukitoshi Sanada (Keio University)
8. Presentations:

- 14:00 - 14:10 Opening Remarks
  Prof. Makoto Taromaru, Chair, Commission C of URSI-JNC (Fukuoka Univ.)
- 14:10 - 14:50 "Docomo's 5G Trial for 5G Realization"
  Dr. Satoshi Suyama (NTT Docomo)
- 14:50 - 15:30 "Advancement of Non-Linear Precoding Technology for Multi-User MIMO Systems"
  Dr. Manabu Mikami (Softbank)
- 15:30 - 15:40 Coffee Break (10 min.)
- 15:40 - 16:20 "Indoor and Outdoor Field Experimental Results of Low-SHF-Band Multi-UserC-RAN Massive MIMO Systems for 5G"
  Mr. Kenichiro Yamazaki (NEC), et al.
- 16:20 - 17:00 "Standardization activities for high speed train scenarios in 3GPP 5G NR"
  Dr. Fumihiro Hasegawa (Mitsubishi Electric), et al.
- 17:00 Closing

9. Reception: held from 17:30 to 19:30 at Yagami faculty lounge, Yagami Campus Keio University, Yokohama. The number of attendees was 14 persons.
10. The Steering committee meeting took place from 11:30 to 12:00 on June 29th, 2018.

11. Concluding Remarks

There are 5 requirements for the 5th generation mobile communication (5G) such as "Massive connection", "Low cost and low power consumption", "Low latency", "High transmission speed", "High capacity". We listened to the talk mainly on research and development for the latter three requirements.

The convener has used mobile phones since the second generation systems was launched and it is felt that the LTE is enough high from the viewpoint of transmission speed. Actually, the presentation by the researcher of NTT Docomo impressed me that more high speed and low latency wireless networks are truly needed in some business scenes. In addition, such high speed wireless networks are made possible by some emerging technologies such as precoding that have been investigated intensively. The 5G testbed based on such emerging technologies and the measurement campaign results with the testbed make me feel sure that the 5G will be really commercialized in 2020. The 5G network will be spreading over the world, for instance, receivers on high speed trains, which is very impressive.



- The 2nd scientific workshop of the 24th URSI-C in Japan -

1. Session title: "OAM radio transmission technologies"
2. Convener: Yasunori Suzuki (NTT DOCOMO, INC.)
3. Date/time: 14:00 - 17:00, October 12th, 2018
4. Venue: Setsunan University, Neyagawa-shi, Osaka Pref.
5. Registration fee: Free
6. Listed attendees: 22 persons
7. Local arrangement: Prof. Shoichi Narahashi (Setsunan University)
8. Presentations:

- 14:10 - 14:20 Opening Remarks
  Prof. Makoto Taromaru, Chair, Commission C of URSI-JNC (Fukuoka University)
- 14:20 - 15:10 "Analog OAM Multiplexing and Related Technologies"
  Prof. Atsushi Sanada (Osaka University)
- 15:10 - 16:00 "Development of Millimeter-wave OAM Mode Multiplexing System for High Capacity Backhaul"
  Mr. Eisaku Sasaki (NEC)
- 16:00 - 16:10 Coffee Break
- 16:10 - 17:00 "An experiment of 100 Gbps wireless transmission using OAM-MIMO multiplexing technology using 28 GHz frequency band"
  Dr. Doohwan Lee (NTT Network Innovation Laboratories)
- 17:00Closing

9. Reception:
   It held from 17:30 to 19:30 at Kogannko restaurant in Neyagawa-shi, Osaka pref.
   The number of attendees was 14 persons.
10. The steering committee meeting:
    It took place from 13:00 to 13:30 on October 12th, 2018, at Setsunan University.
11. Concluding Remarks

    OAM (Orbital Angular Momentum) method is expected to be applicable for new radio transmission technology for beyond fifth-generation mobile communications system. This workshop was aimed to present and discuss OAM radio transmission technologies by the presenters. We deeply discussed on wide aspects of the technological subjects, bottlenecks, solutions and practical timelines in relation to the presentations given by three renowned leading researchers and questions, and deepened common understanding of future prospects.

Prof. Atushi Sanada (Osaka University) presented the analog OAM radio transmission technology which includes the experimental result of the radio transmission in the center frequency of 10 GHz and the bandwidth of 2 GHz. He also presented the principle of the analog OAM radio transmission technology.

Mr. Eisaku Sasaki (NEC) presented the development of millimeter-wave OAM mode multiplexing system. He provided the experimental results of the development system in 5GHz and E bands, while he also presented the technical solution for degrading the performance of the development system.

Dr. Doohwam Lee (NTT Network Innovation Laboratories) presented the experimental results of 100 Gbps radio transmission technology which employ the OAM-MIMO multiplexing technology at 28 GHz band.

This workshop had a great merit for contributing to the research and development of the OAM radio transmission technology on the future ultrahigh-speed wireless communications towards beyond 6G on the way via post 5G followed by the next generation 6G. This workshop gave us very useful opportunity to understand the state-of-the-art research and development situation and to share common recognitions about technical issues and future outlooks against the independent future image of each participant envisioned. Convener: Prof. Satoshi Nishimori, Niigata University

- The 3rd scientific workshop of the 24th URSI-C in Japan -

1. Session title: "Millimeter / Terahertz Wave Devices and Circuits their Applications for Ultra-High Speed Wireless Communication Systems"
2. Convener: Prof. Taiichi Otsuji (Tohoku University)
3. Date/time: 13:30 - 17:20, December 14th, 2018
4. Venue: Room "Hourai", Hotel Ryokusui-Tei in Akiu-Onsen (Sendai, Miyagi pref.)
5. Registration fee: Free
6. Listed attendees: 18 persons
7. Local arrangement: Prof. Taiichi Otsuji (Tohoku University)
8. Presentations:

- 13:30 - 13:40 Opening Remarks
  Prof. Makoto Taromaru, Chair, Commission C of URSI-JNC (Fukuoka University)
- 13:40 - 14:30 "Advances in terahertz wireless communication technology utilizing resonant-tunneling diodes"
  Prof. Safumi Suzuki (Tokyo Institute of Technology), et al.
- 14:30 - 15:20 "Cutting-edge LSI technology for 300-GHz band ultra-high speed wireless communications"
  Prof. Minoru Fujishima, member of the URSI-JNC-C (Hiroshima University)
- 15:20 - 15:40 Coffee Break (10 min.)
- 15:40 - 16:30 "Advances in Ga2O3 power devices"
  Dr. Masataka Higashiwaki (NICT), et al.
- 16:30 - 17:20 "Advances in terahertz lasers and amplifiers utilizing graphene as a gain medium"
  Prof. Taiichi Otsuji, member of the URSI-JNC-C (Tohoku University)
- 17:20 Closing

9. Reception:
   It held from 18:30 to 20:30 at Room Rindou, Hotel Ryokusui-Tei in Akiu-Onsen, Senda city, Miyagi pref. The number of attendees was 13 persons.
10. The Steering committee meeting:
    It took place from 8:30 to 9:15 on December 15th, 2018, at Room 713, Hotel Ryokusui-Tei in Akiu-Onsen.
11. Concluding Remarks

    Terahertz electromagnetic waves, situated in between radio waves and light waves, are expected to be applicable in various industrial applications. In particular, research

and development are accelerating in recent years as a frequency resource indispensable for realizing ultrahigh-speed wireless communication systems.

This workshop was aimed to present and discuss cutting-edge millimeter- and terahertz-wave devices/circuits technologies and their applications to ultrahigh-speed wireless communication systems by researchers who are active at the forefront of a wide range of materials, devices, circuits, and systems research and development, attracting 18 participants. We deeply discussed on wide aspects of the technological subjects, bottlenecks, solutions and practical timelines in relation to the presentations given by four renowned leading researchers and questions, and deepened common understanding of future prospects.

Dr. Safumi Suzuki (Tokyo Inst. of Tech.) presented the experimental works for 300-GHz band 20-Gbit/s class sub-terahertz wave radio transmission experiment using resonant tunnel diodes as sub-terahertz oscillator/detector devices and addressed the prospect for 100-Gbit/s class wireless communications.

Dr. Minoru Fujishima (Hiroshima Univ.) reported on advanced technology and future prospect of a front-end transceiver circuit for 300-GHz band radio communication by using complete silicon CMOS IC technology.

Dr. Masataka Higashiwaki (NICT) presented advances in Ga2O3 power devices including the presenter's pioneering crystal growth technology of Ga2O3 as a next-generation high-power high-speed transistor material and the current status and future prospect of application of Ga2O3 to the transistor devices.

Dr. Taiichi Otsuji (Tohoku Univ.) reported the discovery and development status of a new terahertz laser/amplifier devices using graphene, a carbon-atomic monolayer material, as a gain medium. In response to these state-of-the-art research and development works leading the world, the attendees stimulated discussions deeply on issues to be coped with, benchmarking with existing/alternative technologies, as well as future prospect.

Now ITU-T is working in active to extend the frequency allocation beyond the present upper limit at 275 GHz up to 3000 GHz, being scheduled for the next fiscal year. In this situation, This workshop had a great merit for contributing to the materialization of the technology roadmap on the future ultrahigh-speed wireless communications towards beyond 6G on the way via post 5G followed by the next generation 6G. This workshop gave us very useful opportunity to understand the state-of-the-art research and development situation and to share common recognitions about technical issues and future outlooks against the independent future image of each participant envisioned.Session title: "OAM radio transmission technologies"

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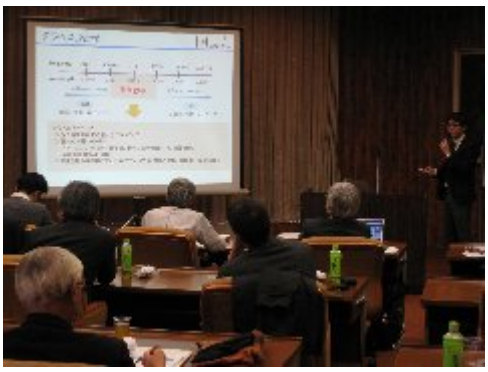

- The 4th scientific workshop of the 24th URSI-C in Japan -

1. Session title: "Wireless Access Technologies Beyond the 5th Generation Mobile Communications"
2. Convener: Prof. Satoshi Denno, Okayama University.
3. Date/time: 13:20 - 17:30, March 1st, 2019
4. Venue: Room "the meeting room in the KKR Kinosaki-Genbu", Kinosaki-cho, Toyooka, Hyogo
5. Registration fee: Free
6. Listed attendees: 19 persons
7. Local arrangement: Prof. Hidekazu Murata, Kyoto University.
8. Presentations:

- 13:20 - 13:30 Opening Remarks
  Prof. Makoto Taromaru, Chair, Commission C of URSI-JNC (Fukuoka University)
- 13:30 - 14:15 "IoT standardization activity in 3GPP"
  Mr. Satoshi Nagata (NTT DOCOMO, Inc.)
- 14:15 - 15:00 "NICT's R&D toward the 5G Era and Experimental Demonstration for Massive MTC"
  Dr. Kentaro Ishizu (NICT)
- 15:00 - 15:45 "5G URLLC field trials as an application to truck platooning"
  Dr. Hitoshi Yoshino (Softbank Corp.)
- 15:45 - 16:00 Coffee Break (15 min.)
- 16:00 - 16:45 "Cellular V2X Evolution for Autonomous Driving Era"
  Mr. Shinpei Yasukawa (NTT DOCOMO, Inc.)
- 16:45 - 17:30 "Edge Computing for connected cars"
  Mr. Takeshi Kitahara (KDDI Research, Inc.)
- 17:30 Closing

9. Reception:
   Held from 18:30 to 20:30 at the restaurant in the Kinosaki-Genbu. The number of attendees is 17 persons.
10. The night session:
    21:00～17:30 "On recent receiver system architecture of USRP: The SDR platforms becoming analog-rich"
    Prof. Makoto Taromaru (Fukuoka University)

11. The Steering committee meeting took place at the meeting room in the KKR Kinosaki-Genbu, from 8:30 to 9:30 on March 2nd, 2019.
12. Concluding Remarks

There are 5 requirements for the 5th generation mobile communication (5G) such as "Massive connection", "Low cost and low power consumption", "Low latency", "High transmission speed", "High capacity". Because we discussed the latter 2 issues at the URSI-C technical meeting held on June 29th, 2018, we had a meeting to discuss about the former three issues, and the technical trend and perspective of the beyond 5th generation cellular communication systems.

The five researchers working on such issues were invited to talk about cutting edge technologies and standardization activities for the IoT network with the 5th generation cellular systems and the beyond 5th generation cellular systems.

Although business models of the IoT have not been established well, wireless assisted car driving, one of the applications of the IoT, was introduced as one of the very promising applications.

The techniques to implement the wireless assisted car driving have been discussed in the third Generation Partnership Project (3GPP) where standardization of the 5th generation cellular system is discussed, and the 5G Automotive Association (5GAA) where the requirement for the wireless car driving is discussed. Although there are still some important issues left, definitely those techniques are interesting.