1st International Workshop on

Global Research Initiative for Wireless Tehnology

(IGROW)

7th February

Higashi-hiroshima campus, Hiroshima University

11th and 12th February

Koganei campus, Tokyo University of Agriculture and Technology

Co-sponsored by IEEE MTT-S Japan/Kansai Chapters

Preface for the 1st International Workshop on Global Research Initiative for Wireless Technology (IGROW)

It is my great pleasure to welcome you to the 1st International Workshop on Global Research Initiative for Wireless Technology (IGROW), an event jointly hosted by Hiroshima University and Tokyo University of Agriculture and Technology. The workshop will take place on February 7 at Hiroshima University's Higashi-Hiroshima campus, followed by sessions on February 11 and 12 at Tokyo University of Agriculture and Technology's Koganei campus. This inaugural event features 15 invited talks, 8 general presentations, and 26 poster sessions, promising to deliver a diverse and vibrant exchange of ideas.

IGROW is an integral activity of the Global Research Initiative on Wireless Terahertz (GROW-THz) project, an international research initiative focused on ultra-high-speed wireless communication using terahertz frequencies, particularly around the 300 GHz band. GROW-THz unites researchers from the fields of communication and device technologies, with a primary mission to advance cutting-edge wireless communication technologies toward practical applications. Central to this effort is the cultivation of a global network through international brain circulation, emphasizing the development and collaboration of young researchers. The name "GROW-THz" reflects our aspiration for all participants to experience growth through their involvement in the project.

The IGROW workshop expands upon this vision by providing a platform not only for the exchange of the latest research in terahertz technology but also for broadening the scope to include a wide array of advancements in wireless technologies. We hope that every "I" attending IGROW—whether a seasoned researcher or a student—will find opportunities to grow through intellectual discussions, new collaborations, and shared inspiration.

I would like to extend my heartfelt gratitude to all the speakers, presenters, and participants for their contributions to this workshop. Let us take this opportunity to strengthen our networks and push the boundaries of innovation in wireless technology.

Welcome to IGROW, and may this workshop be a stepping stone for our collective growth.

Sincerely,

Minoru Fujishima
Professor, Hiroshima University
Principal Investigator, GROW-THz Project

Day 1 Friday, 7th February

IGROW Opening Session
Time: 10:00-10:15
Room: Main Conference Room, Phoenix International Center MIRAI CREA

Welcoming Remarks and GROW-THz Overview

Minoru Fujishima

Hiroshima University

Session 1: Advances in Terahertz and Millimeter-Wave Technologies for 6G Networks

Time: 10:15-13:25

Room: Main Conference Room, Phoenix International Center MIRAI CREA

Chair: Minoru Fujishima (Hiroshima University)

10:15-10:40

(Invited) Future directions for terahertz communications R&D for the 6G era

Iwao Hosako

National Institute of Information and Communications Technology (NICT), Japan

Following WRC-23, terahertz bands won't be used for 6G until 2031. This presentation covers future terahertz development, including Beyond 5G/6G R&D grants, NICT's efforts, standardization trends (e.g., ITU, IEEE802), and Society 5.0 use cases. It concludes with a five-year R&D direction.

10:40-11:05

(Invited) Open and Programmable Wireless PHY for mmWave and THz Bands

Firooz Saghezchi, Haris Gacanin

Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen), Germany

As the bandwidth of modern wireless communication systems increases, with the invent of mmWave and THz band systems, there is a vital need for ultra-high-speed baseband signal processing to perform OFDM flow chain (from channel estimation and time/frequency synchronization to demodulation and equalization) intime. In this presentation, we look at different challenges and strategies for baseband signal processing for software-define radios operating at mmWave or THz bands.

11:05-11:30

(Invited) Millimeter-wave and sub-THz RF research in 6GFlagship

Nuutti Tervo, Sumit Singh, Mikko Hietanen, Kimmo Rasilainen, Marko E. Leinonen, Sami Myllymäki, Timo Rahkonen, Aarno Pärssinen

University of Oulu, Finland

The University of Oulu's 6G Flagship program, running since 2018, explores hardware-related research, from materials and antennas to RFIC design, transceiver architectures, and radio channel modeling. This talk highlights key advancements and insights into the program's contributions to next-generation wireless technologies.

11:30-11:55

(Invited) Low-Resolution Interference Alignment for Low THz High Density Nano-Networks

Morriel Kasher, Predrag Spasojevic

Rutgers University, United States

Wideband Receivers at Low-THz frequencies will require significant advancements to handle very large front end bandwidth technologies. We propose strategies that represent critical Low-Resolution technological Advancements which will enable such processing. Proposed technologies adapt and ensure that low-resolution receiver strategies have minimum performance loss even at significant processing speed required for real time processing of such wideband and multi-antenna systems.

13:15-13:25

ASPIRE in Communications: Strategic Research Funding for Global Innovation

Naoaki Yamanaka

Keio University, Japan

The communications field within the ASPIRE program, initiated by JST, is one of several focus areas in this strategic initiative. It selects distinguished Japanese researchers who are actively engaged in leading global research circles and aims to encourage and enhance their activities. A significant portion of the program’s budget is allocated to establishing and strengthening international networks.

Session 2: Advanced Terahertz Communication and Mobility Solutions: From Hardware to System Integration

Time: 13:25-14:50

Room: Main Conference Room, Phoenix International Center MIRAI CREA

Chair: Shuhei Amakawa (Hiroshima University)

13:25-13:50

(Invited) A 300-GHz-Band 36-Gb/s Scalable 2×2 2D Phased-Array CMOS Transmitter and Receiver

Satoshi Tanaka

Hiroshima University, Japan

Two-dimensional beamforming is a significant challenge for sub-terahertz transceivers. In this paper, we propose a two-dimensional beamforming transmitter (TX) and receiver (RX) circuit that can be expanded to n×n, and report the results of its 2×2 prototype implemented using 40 nm CMOS technology.

13:50-14:10

Ultra-spot-based Terahertz Large-file-transfer applications for Autonomous Mobility using IEEE802.15.3d compliant system

Yozo Shoji

National Institute of Information and Communications Technology (NICT), Japan

The feasibility of ultra-spot-based terahertz applications with large file transfer for autonomous mobility is discussed. Demonstration results of inter-drone communication using a 60 GHz IEEE802.15.3e compliant device and the feasibility of an IEEE802.15.3d compliant wireless mobile system using the same 60 GHz device and a 300 GHz CMOS frequency converter device are discussed.

14:10-14:30

Adaptive Guiding Technique for Autonomous Mobilities to pass through the Ultra-spot of mmW/Terahertz

Phuc Duc Nguyen, Yozo Shoji

National Institute of Information and Communications Technology (NICT), Japan

The problem of mmWave/THz spot prediction, specifically detecting high-speed communication zones of mmWave/THz signals, is becoming increasingly challenging in beyond-5G networks. This is particularly true for mobilities such as UAVs, which must search for, detect, and adaptively adjust their flight paths to establish high-speed communication with other UAVs, ground stations, or hovering stations. In this study, we present our proposals, research ideas, and recent experimental results related to addressing this issue.

14:30-14:50

Interference Suppression for User-Cluster-Centric Cell-Free Massive MIMO Systems

Sijie Xia[1], Suguru Kameda[1], Qiang Chen[2], Fumiyuki Adachi[2]

[1]Hiroshima University, Japan; [2]Tohoku University, Japan

This study proposes a user-cluster-centric cell-free massive MIMO (UCC-CF-mMIMO) system that serves neighboring users in each cluster by the surrounding antennas. To further improve link capacity limited by inter-cluster interference, a dynamic partial interference suppression zero-forcing (DPIS-ZF) transmission method and a graph coloring (GC)-based pilot assignment method are introduced.

Session 3: Innovations in Measurement Techniques for High-Frequency PCB and Transmission Line Systems

Time: 15:20-16:25

Room: Main Conference Room, Phoenix International Center MIRAI CREA

Chair: Suguru Kameda (Hiroshima University)

15:20-15:45

(Invited) Recent Advancements in PCB Measurement Techniques up to Millimeter-wave Frequencies

Michael Gadringer, Ziad Hatab

Graz University of Technology, Austria

Printed Circuit Boards (PCBs) are a key component of the electronic industry. As new chip technologies operate at higher frequencies, the traditional interconnects established on a PCB are operated over wider bandwidths and have to take over multiple tasks at once. Comprehensive characterization of the PCBs is required to provide the parameters for state-of-the-art interconnect designs. This talk focuses on conducting wideband PCB measurements up to the mw-Wave regime achieved on a probe station. These measurements provide the basis for parameter extraction in various design processes. The properties of different PCB manufacturing technologies in the measurement process are highlighted in this context.

15:45-16:05

Establishing S-parameter measurement reference planes on coupled transmission lines

Shuhei Amakawa

Hiroshima University, Japan

This talk will discuss how 50-ohm-referenced S-parameter measurement reference planes can be established on coupled transmission lines.

16:05-16:25

In-situ automatic adjustment of probe positions and tilt angles for GSGSG probe

Ryo Sakamaki

Hiroshima University, Japan

A new technique for the precise adjustment of probe positions, including the tilt angle of a radio-frequency (RF) probe, is introduced in this presentation. The technique is demonstrated for a ground-signal-ground-signal-ground (GSGSG) probe. It can be applied not only to filled-conductor but also to commonly used coplanar-waveguide contact pads for GSGSG probes. The proposed method significantly reduces variation in the probe tilt angle compared to conventional manual techniques. This unique feature results in improved measurement repeatability within the frequency range up to 110 GHz.

Poster Session
Time: 17:00-18:30
Room: Reception hall, Hiroshima University

P1: Measurement of time-synchronization offset of wireless two-way interferometry (Wi-Wi): Automating the measurement process

Hiroto Kita[1], Masataka Miyake[1], Suguru Kameda[1], Satoshi Yasuda[2], Nobuyasu Shiga[2]
[1]Hiroshima University, Japan; [2]National Institute of Information and Communications Technology (NICT), Japan

Wireless two-way interferometry (Wi-Wi) enables high-precision time synchronization in wireless systems. Previous studies measured the time-synchronization offset manually, limiting measurements count and to dynamic environments. This study automates the measurement process to increase measurement count and evaluate in a static environment.

P2: Free-space reflectivity measurements

Yuto Shimogaki, Shuhei Amakawa
Hiroshima University, Japan

This poster reports on reflectivity of objects based on S11 measurements.

P3: Investigation of Antenna Deployment Strategies for Cluster-Centric Cell-Free Massive MIMO Systems

Kazuya Ogata[1], Sijie Xia[1], Masataka Miyake[1], Suguru Kameda[1], Fumiyuki Adachi[2]
[1]Hiroshima University, Japan; [2]Tohoku University, Japan

Cluster-centric cell-free massive MIMO is a key technology for beyond 5G and 6G systems. It overcomes blockage in high-frequency and reduces computational complexity, but produces inter-cluster interference, degrading link capacity. This study investigates the impact of antenna deployment strategies on ICI and link capacity.

P4: USRP Implementation of Synchronized SS-CDMA Communication Function Using Wi-Wi: Evaluation of Timing Offset in a Wideband Condition

Toshiki Ouchi, Serena Akasaka, Masataka Miyake, Suguru Kameda
Hiroshima University, Japan

Synchronized SS-CDMA, using Wi-Wi for accurate timing synchronization, enables high-capacity IoT connections. A 100-terminal uplink setup using USRPs evaluated BER performance at chip rates up to 100Mchip/s, showing more noticeable BER degradation as timing offset increased from 3 ns to 20 ns.

P5: Analytic applications of polyharmonic distortion modeling

Itsuki Mitsuhashi[1], Ryoko Kishikawa[2], Shuhei Amakawa[1]
[1]Hiroshima University, Japan; [2]National Institute of Advanced Industrial Science and Technology, Japan

This work concerns analytic uses of polyharmonic distortion modeling of nonlinear networks.

P6: Impulse response based Modeling of Input-Output Characteristics of Quantum Cascade Lasers

Haruma Minami[1], Kenta Umebayashi[1], Ya Zhang[1], Hua Li[2]

[1]Tokyo University of Agriculture and Technology, Japan; [2]Shanghai Institute of Microsystem and Information Technology, China

To design an optimal terahertz wireless communication scheme leveraging quantum cascade lasers, it is essential to establish a mathematical model that accurately captures their input-output characteristics. This study demonstrates that a portion of these characteristics can be effectively represented using impulse response modeling.

P7: Threshold tuning in 1-bit ADCs for SIMO system

Rina Takagi[1], Umebayashi Kenta[1], Antti Tölli[2], Bikshapathi Gouda[2], Janne Lehtomäki[2]

[1]Tokyo University of Agriculture and Technology, Japan; [2]University of Oulu, Finland

This research explores the optimization of quantization thresholds in 1-bit analog-to-digital converters (ADCs) for single-input multiple-output (SIMO) communication systems. Specifically, 1-bit ADCs are utilized at the base station (BS), equipped with multiple antennas, in conjunction with high-order modulation schemes. Numerical simulations reveal that the proposed threshold configuration significantly improves the symbol error rate (SER) performance, achieving notable gains over conventional threshold designs.

P8: Space-Time Synchronized Multi-view Recording Applications with Ultra-fast Passing Communications Using mmW/Terahertz - (1) Technical Requirements and Issues -

Megumi Fukuma, Phuc Duc Nguyen, Yozo Shoji, Aire Suzuki

National Institute of Information and Communications Technology (NICT), Japan

Space-time Synchronized Multi-view recording applications with Ultra-fast Passing Communications using mmW/Terahertz is discussed. Technical requirements and Issues will be focused on in the presentation.

P9: Space-Time Synchronized Multi-view Recording Applications with Ultra-fast Passing Communications Using mmW/Terahertz - (2) Demonstration of the Concept -

Aire Suzuki, Megumi Fukuma, Phuc Duc Nguyen, Yozo Shoji

National Institute of Information and Communications Technology (NICT), Japan

Space-time Synchronized Multi-view recording applications with Ultra-fast Passing Communications using mmW/Terahertz is discussed. The demonstration of the concept we have performed will be focused on in the presentation.

P10: Highly efficient power supply layout design with decoupling function and ESD protection

Yudai Miyoshi, Takeshi Yoshida, Satoshi Tanaka, Minoru Fujishima

Hiroshima University, Japan

In this study, we present a highly efficient power supply layout technique that achieves low DC resistance, small-area decoupling, as well as ESD and latch-up protection within a limited area.

P11: Design and Simulation of an Active Leaky Wave Antenna for 300 GHz Band Phased Array Applications

Koki Mochida, Satoshi Tanaka, Takeshi Yoshida, Shuhei Amakawa, Minoru Fujishima
Hiroshima University, Japan

This paper introduces the design and simulation of a 125 GHz active leaky wave antenna tailored for use in 300 GHz band phased array systems. By employing cascaded active power dividers, the design achieves uniform power distribution and enhanced radiation efficiency. The proposed architecture is validated through circuit simulations using a 40 nm CMOS process.

P12: A 31-69-GHz Ultra-Wide Bandwidth Tunable Frequency Response Amplifier Using 40nm CMOS

Zhen Yan, Saotoshi Tanaka, Takeshi Yoshida, Minoru Fujishima
Hiroshima University, Japan

This study implements a tunable frequency-response ultra-wideband intermediate frequency amplifier for 300 GHz band wireless communication. Using 40nm CMOS technology, the gain is adjusted by controlling the gate bias of MOS transistors, which function as variable resistors in the inter-stage circuit. This allows for the independent tuning of the frequency response of a total of three amplifier stages, achieving a 10 dB variable gain at the two endpoint frequencies and the center frequency within the 3 dB bandwidth range.

P13: A coplanar waveguide cross junction with low loss and low coupling by multi-layer ground shield

Leshan Xu, Satoshi Tanaka, Takeshi Yoshida, Minoru Fujishima
Hiroshima University, Japan

In this study, a coplanar waveguide cross junction applied to phased array power distribution network for 300-GHz wireless transceivers is proposed. The characteristic impedance of the cross junction is tuned to 50 ohms and the isolation is improved by using multi-layer grounding shields.

Day 2 Tuesday, 11th February

Special Talk

Time: 16:00-16:30

Room: Co-op Store and Cafeteria, Koganei-Campus, Tokyo University of Agriculture and Technology

Chair: Kenta Umebayashi (Tokyo University of Agriculture and Technology)

16:00-16:30

(Invited) Terahertz Communications: From the Near-field to Space Networks

Josep Jornet

Northeastern University, United States

Terahertz (THz) communication is poised to revolutionize high-speed connectivity. This talk explores two exciting frontiers in THz technology. First, we delve into wavefront engineering for near-field THz links, showcasing novel beam types like Bessel and Airy beams and comparing their performance against traditional far-field beamforming. We discuss the unique opportunities these beams offer for short-range, high-capacity networks. Second, we demonstrate the advantageous role of THz frequencies in satellite communication networks, highlighting their potential for high-speed access links. This talk aims to provide insights into the transformative potential of THz for diverse communication applications.

Poster Session
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P14: Path Power Prediction Scheme for Millimeter-wave using LSTM under Indoor Environments

Takato Yamazaki, Taiyo Tenma, Kohei Ohno
Meiji University, Japan

This presentation proposes the received power prediction of the first arriving path in millimeter-wave indoors using LSTM. The received power at the position ahead of the current position is predicted from the power obtained from the point where the user was previously located.

P15: A Study on Transmission-Line Transitions Integrating Antennas with Feeding Circuits in Multi-layer Substrate at Sub-THz Band

Azuki Iwamoto, Yoshiki Sugimoto, Kunio Sakakibara, Nobuyoshi Kikuma
Nagoya Institute of Technology, Japan

Various transmission line transitions in multilayer substrates have been developed at the 300-GHz band. The loss of transmission lines is a significant issue in this band. Therefore, it is advantageous to integrate antennas with the feeding circuits in the substrate on which RF chips are mounted by using transitions.

P16: Design of Parallel Differential-line Fed Planar Aperture Antenna Excited by X-shaped Patch Using Slot Coupling

Taisuke Uemura, Atsuya Yamazaki, Yoshiki Sugimoto, Kunio Sakakibara, Nobuyoshi Kikuma
Nagoya Institute of Technology, Japan

A planar aperture antenna with parallel-differential line excited by X-shaped patch using slot coupling is developed in 300-GHz band. The occupied area of the antenna on the bottom layer can be reduced by coupling parallel differential transmission lines and an X-shaped patch via a slot.

P17: Multibeam Microstrip Array Antenna Fed by Low-Loss and Compact Rotman-Lens in 300-GHz Band

Kenta Nishimura, Yoshiki Sugimoto, Kunio Sakakibara, Motoko Sakamoto, Nobuyoshi Kikuma
Nagoya Institute of Technology, Japan

A multibeam antenna fed by a microstrip Rotman lens was designed in 300-GHz band. The Rotman lens was minimized for the required number of beams and array elements to minimize transmission losses. The proposed multibeam antenna achieves a gain of over 20 dBi across a 60-degree range at 274 GHz.

P18: Low Scan-Loss Multi-Beam Lens Antenna Fed by Horns with Separated Phase Centers in E/H-Planes

Shota Takada, Yoshiki Sugimoto, Kunio Sakakibara, Nobuyoshi Kikuma
Nagoya Institute of Technology, Japan

This study proposes a wide-angle beam-scanning multi-beam lens antenna fed by horns with separated phase centers in E/H-planes by different wall heights. In the proposed antenna, these phase centers are aligned at the focus position of the lens separated by astigmatism. The proposed antenna improves the directivity in wide-angle directions.

P19: Measurement Characteristic of Endfire Antenna with Step Horn Structure in Multilayer Substrate at 300 GHz Band

Daisuke Sakai[1], Yoshiki Sugimoto[1], Kunio Sakakibara[1], Ken Takahashi[2], Nobuyoshi Kikuma[1]
[1]Nagoya Institute of Technology, Japan; [2]Panasonic System Networks R&D Lab. Co., Ltd., Japan

In this study, we measured the performance of an antenna designed to improve reflection characteristics by expanding the SIW into a horn shape toward the aperture in a multilayer substrate. The characteristics of this antenna are presented.

P20: Low-Profile Phased Lens Array Antenna With Anti-Reflection Structure Fed by Circular-Arc Arranged Horns in 300 GHz Band

Hideaki Sugiyama, Yoshiki Sugimoto, Kunio Sakakibara, Nobuyoshi Kikuma
Nagoya Institute of Technology, Japan

This study proposes a phased lens-array antenna for the 300 GHz band. Using horn antennas arranged in a circular arc and a high-dielectric lens with anti-reflection structures, it achieves high-gain multi-beam scanning and reduces the antenna height. Simulations demonstrate over 30 dBi gain and ±20° scanning with high efficiency.

P21: User Grouping and Hybrid Beamforming Optimization for Energy-Efficient Multi-User Terahertz Communications

Jiali Wang[1], Megumi Kaneko[2]
[1] National Institute of Informatics, Japan; [2]National Institute of Informatics & The University of Tokyo, Japan

In this work, we address the issue of energy efficiency optimization of a Terahertz (THz) wireless communication system based on dynamic Array of SubArray (AoSA) hybrid beamforming. The initial joint optimization problem, which is intractable, is tackled by decomposing it into user clustering, switch network, analog and digital beamforming optimization subproblems. The originality of the proposed approach lies in the activation of the best subset of RF chains, as well as their assignment to optimized user groups, such that the overall energy efficiency is maximized. Numerical results show that the proposed method outperforms the Fully-Connected (FC) and AoSA benchmarks, and provides a well balanced trade-off between sum-rate and energy consumption.

P22: A Study of Mutual Information for 16 QAM Signal Reception using 1bit ADCs

Teppei OYAMA[1], Kenta Umebayashi[2]
[1]Nit, Oita College, Japan; [2]Tokyo University of Agriculture and Technology, Japan

We calculate the mutual information and achievable rate where 1 bit analog-to-digital converters (ADCs) are utilized at the base station and the UE adopts 16 QAM for data transmission. We confirm that 1 bit ADCs are beneficial for low SNR region, where noise and signal power are comparable.

P23: A study on data driven based football kicking analysis

Rion Takahashi, Kenta Umebayashi
Tokyo University of Agriculture and Technology, Japan

2D pose estimation of kicking motions in football from videos captured with a single RGB camera is prone to estimation errors. Validation of the estimation results from multiple kick videos confirmed that misidentification of the left and right feet is predominant. Based on this finding, an algorithm for error detection and correction is developed, and its accuracy is evaluated.

P24: Study on antenna spacing control for adaptive array antenna using deep learning

Junya Miura, Kenta Umebayashi
Tokyo University of Agriculture and Technology, Japan

An adaptive array antenna with optimized spacing can suppress more than two interference signals using only two antennas. However, optimizing the antenna spacing remains a challenging task. To address this issue, we employ deep learning to optimize the antenna spacing. Numerical evaluations will demonstrate the performance of the deep learning-based approach.

P25: Design of a 275-GHz Up-Conversion Mixer for a Self-Heterodyne Transceiver in 130-nm SiGe BiCMOS

Taiga Noguchi, Kyoya Takano
Tokyo University of Science, Japan

A self-heterodyne transceiver has been proposed to reduce the effects of phase noise in carrier signals for 300-GHz-band communications. We propose an up-conversion mixer for the transceiver. The proposed circuit can output both RF and LO signals, and the LO signal power can be varied.

P26: Design of a 28-GHz-Band Voltage-Controlled Oscillator in 180-nm CMOS Technology for 5G Communications

Yuto Hirayama, Kyoya Takano
Tokyo University of Science, Japan

In this presentation, we propose two voltage-controlled oscillator topologies that support the 28-GHz band for 5G and compare their specifications.
Simulation results show that these oscillators can oscillate at 30 GHz, and the oscillation frequency can be tuned up to 1 GHz using the power supply voltage.

Day 3 Wednesday, 12th February

Session 4: Frontiers in 6G and Terahertz Communication Systems: Challenges and Innovations

Time: 9:00-10:35

Room: Room L1321 (2nd Floor), Building 13, Tokyo University of Agriculture and Technology

Chair: Kenta Umebayashi (Tokyo University of Agriculture and Technology)

9:00-9:25

(Invited) RF impairments in 6G Systems: Impact of bandwidth, frequency and spatial combining

Nuutti Tervo, Bilal Khan, Dedar Rashid, Marko E. Leinonen, Aarno Pärssinen

University of Oulu, Finland

Understanding nonideal RF hardware is vital for 6G design, requiring collaboration between hardware and signal processing. This talk examines RF impairments, their scalability with frequency and bandwidth, and mitigation strategies using antenna arrays, offering insights into advancing 6G performance through integrated approaches across system design and signal optimization

9:25-9:50

(Invited) Exploiting Beam Split-based Multi-User Diversity in Terahertz MIMO-OFDM Systems

Megumi Kaneko[1], Jiali Wang[2]

[1]National Institute of Informatics & The University of Tokyo, Japan; [2]National Institute of Informatics, Japan

The wide availability of TeraHertz (THz) bands, in conjunction with hybrid beamforming based Multi-Input Multi-Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM) technologies, promises unprecedented capabilities for future 6G networks. However, these systems are degraded by the beam split effect, a THz-specific issue where the frequency independent phase shifters of hybrid beamforming lead to the deviation of the intended beam depending on subcarrier frequencies. Instead of mitigating this effect as in usual approaches, we propose to exploit it as an opportunity to enhance global multiuser THz MIMO-OFDM performances. Our proposed approach jointly exploits user grouping and beam split multiplexing across users for optimizing key multi-user objectives, giving rise to Beam split-based multi-user diversity. Numerical results show that the proposed methods outperform benchmarks and demonstrate that our beam split-tailored resource allocation methods enable to improve the performance of dense multi-user THz systems.

9:50-10:15

(Invited) Enabling Low-THz Receivers via Low-Resolution Techniques

Morriel Kasher, Predrag Spasojevic

Rutgers University, United States

Wideband Receivers at Low-THZ frequencies will require significant advancements to handle very large front end bandwidth technologies. We propose strategies that represent critical Low-Resolution technological Advancements which will enable such processing. Proposed technologies adapt and ensure that low-resolution receiver strategies have minimum performance loss even at significant processing speed required for real time processing of such wideband and multi-antenna systems.

10:15-10:35

Advancement of Wireless Communication Systems Using Space-Time Synchronization

Suguru Kameda

Hiroshima University, Japan

Space-time synchronization is crucial for 6G and beyond, ensuring all nodes in a region are synchronized and aware of their distances from neighbors. Advances in device technologies have improved its accuracy. This presentation covers R&D trends, wireless communication systems using space-time synchronization, and expectations for future 6G applications.

Session 5: Innovative Signal Processing and Receiver Technologies for Terahertz Wireless Communications

Time: 11:05-12:40

Room: Room L1321 (2nd Floor), Building 13, Tokyo University of Agriculture and Technology

Chair: Yozo Shoji (NICT)

11:05-11:30

(Invited) A 260-GHz Hybrid 2D Beam-Steerable CMOS Receiver

Shinsuke Hara[1], Mohamed H. Mubarak[1], Akifumi Kasamatsu[1], Yoshiki Sugimoto[2], Kunio Sakakibara[2], Takeshi Yoshida[3], Shuhei Amakawa[3], Minoru Fujishima[3]

[1]National Institute of Information and Communications Technology, Japan; [2]Nagoya Institute of Technology, Japan; [3]Hiroshima University, Japan

A beam steerable CMOS receiver module operating at around 260GHz is presented. It combines a mechanically steered antenna with a 1-D phased array fabricated on a PCB on which CMOS receiver chips are mounted, and achieved a wireless data rate of 25.9 Gb/s with a steering range of 28˚.

11:30-11:55

(Invited) Power-Efficient Baseband Design for Wireless THz Communication

Shunichi Kubo

THine Electronics, Inc., Japan

Wireless terahertz (THz) communication has the potential to enable high-speed links exceeding 10 Gbps. However, conventional baseband architectures for such high-speed links rely on high-performance analog-to-digital converters (ADCs) and large-scale digital signal processing (DSP), which significantly reduce power efficiency. This paper introduces a mixed-signal baseband circuit that employs low-resolution ADCs and compact DSP to enhance power efficiency while maintaining high-speed performance.

11:55-12:20

(Invited) New Signal Processing Techniques for Near-Field Communications

Koji Ishibashi

The University of Electro-Communications, Japan

In this talk, we introduce new signal processing technologies such as robust beam-focusing and efficient channel estimation in near-field communications.

12:20-12:40

Integration of Digital and Analog Signal Processing for THz Wireless Communications

Kenta Umebayashi, Shun Ishihara

Tokyo university of agriculture and technology, Japan

In this presentation, we introduce an innovative approach based on the integration of multiple digital and analog signal processing techniques. Traditionally, digital and analog signal processing have often been studied independently. However, we demonstrate that combining these two paradigms has the potential to efficiently achieve ultra-high-speed wireless communications.

Session 6: Advancements in Antenna Design and Sensing Techniques for Millimeter-Wave and Terahertz Applications

Time: 14:10-15:45

Room: Room L1321 (2nd Floor), Building 13, Tokyo University of Agriculture and Technology

Chair: Kunio Sakakibara (Nagoya Institute of Technology)

14:10-14:35

(Invited) Terahertz Sensing Using an Array Antenna with CMOS-RFIC – Feasibility Study for Short-Range Tomographic Imaging –

Ichiro Somada, Akihito Hirai, Akinori Taira, Ryo Ueda, Takuma Nishimura, Koji Yamanaka, Koji Yamanaka

Mitsubishi Electric Corporation, Japan

This letter introduces the overview of a short-distance sensing system based on the full digital MIMO radar concept, the design and fundamental evaluation results of 300 GHz RFIC using CMOS technology, as well as the achievements of imaging using 300 GHz terahertz wave based on actual measurements.

14:35-15:00

(Invited) Advanced Calibration Techniques enabling PCB Measurements up to Millimeter-wave Frequencies

Michael Gadringer, Ziad Hatab

Graz University of Technology, Austria

Interconnects established by Printed Circuit Boards (PCBs) are a traditional technology enabling electronic systems. With the evolution of communication standards, a strong tendency to higher frequencies and broader bandwidths is recognizable. These developments must be supported by comprehensive characterization techniques, verifying the demanded behavior. To enable these characterization tasks, robust and versatile calibration techniques are needed. This talk will present the evolution of different VNA auto-calibration approaches and how they support the mentioned developments. At the beginning, an updated mTRL calibration is introduced, and then the thru-less variant is discussed. Thereafter, the recently announced SRM calibration is summarized, and its advantages are presented.

15:00-15:25

(Invited) An inverted-L monopole array antenna for D-band antenna-in-package modules

Takashi Tomura[1], Alberto Hernández-Escobar[1], Kenichi Okada[1], Issei Watanabe[2]

[1]Institute of Science Tokyo, Japan, [2]National Institute of Information and Communications Technology (NICT), Japan

An inverted-L monopole array antenna for D-band antenna-in-pakage modules is presented to realize wide coverage with high gain by phased array configuration.

15:25-15:45

Mechanical/Electrical Hybrid Two-dimensional Beam Scanning Cylindrical Dielectric Lens Antenna Fed by a Phased Array Primary Radiator

Yoshiki Sugimoto, Kunio Sakakibara, Kikuma Nobuyoshi

Nagoya Institute of Technology, Japan

A hybrid two-dimensional (2D) beam-scanning lens antenna through the combination of a mechanical lens slide and a phased array primary radiator is developed. We have shown the capability of the proposed antenna to perform 2D beam scanning with a scan loss of approximately 3 dB between ±10° angular range.

IGROW Closing Session
Time: 15:45-16:00
Room: Room L1321 (2nd Floor), Building 13, Tokyo University of Agriculture and Technology

Award Ceremony and Announcement of 2nd IGROW

Minoru Fujishima

Hiroshima University

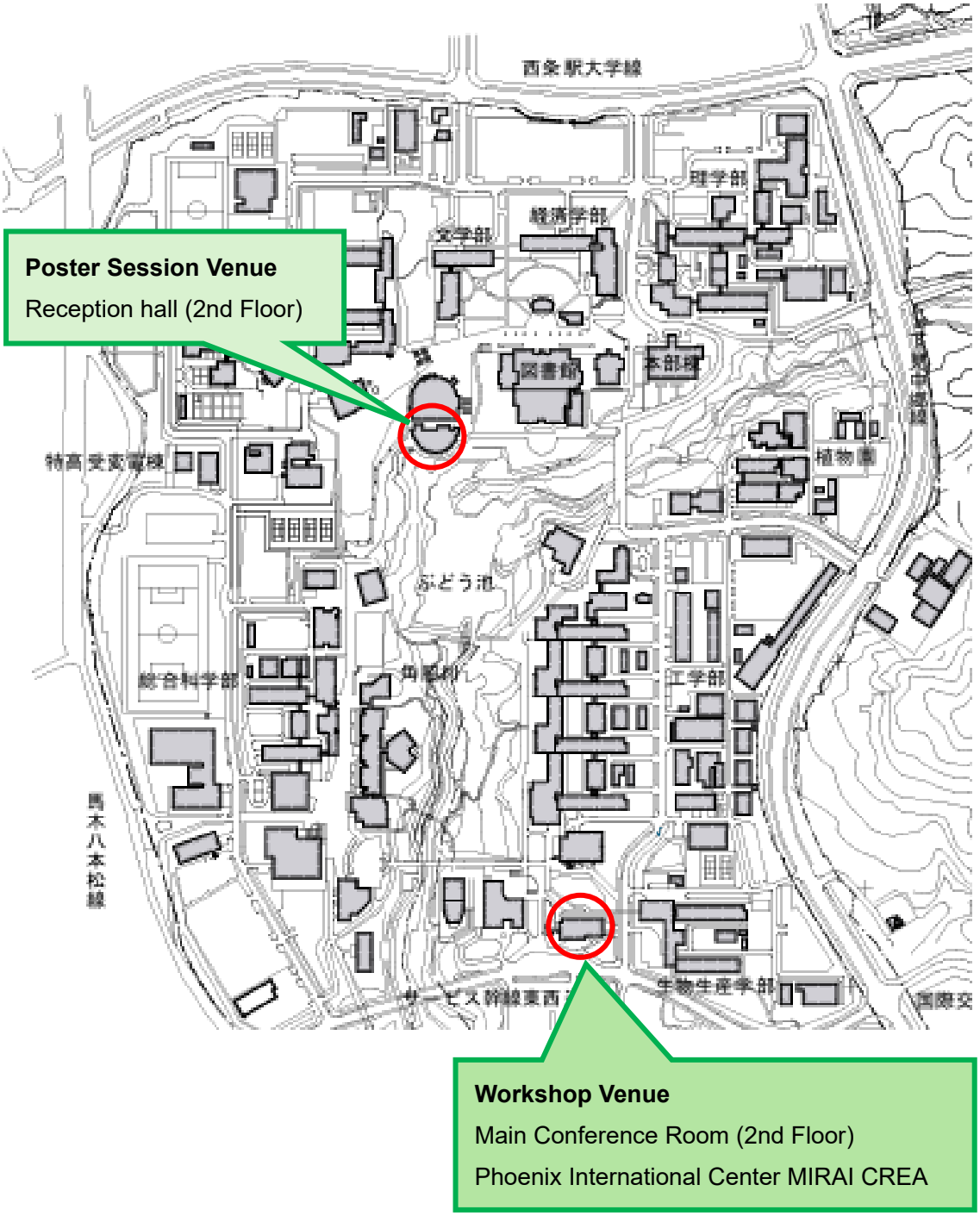
Venue for 7th of February

Higashi-hiroshima campus of Hiroshima University (https://www.hiroshima-u.ac.jp/en)

Campus Map: https://archive2.hiroshima-u.ac.jp/access/higashi-hiroshima3.pdf

Access

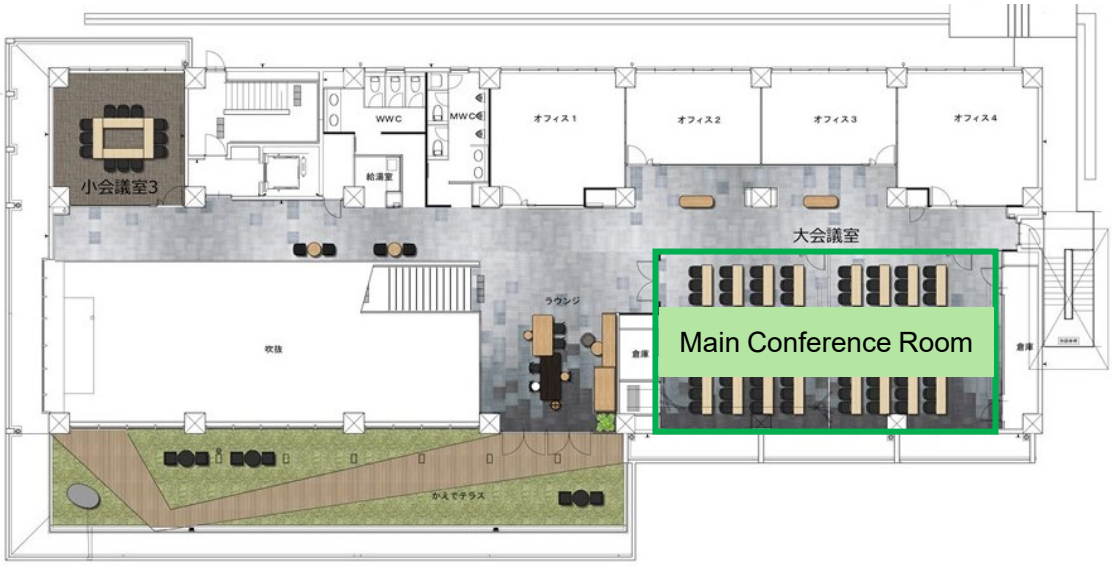
Higashi-Hiroshima Campus, Hiroshima University


Poster Session Venue
Reception hall (2nd Floor)
西条駅大学線
理学部
経済学部
文学部
図書館
本部棟
植物園
ぶどう池
総合科学部
工学部
馬本八本松線
生物生産学部
Workshop Venue
Main Conference Room (2nd Floor)
Phoenix International Center MIRAI CREA

Phoenix International Center MIRAI CREA

2nd Floor of Conference Venue

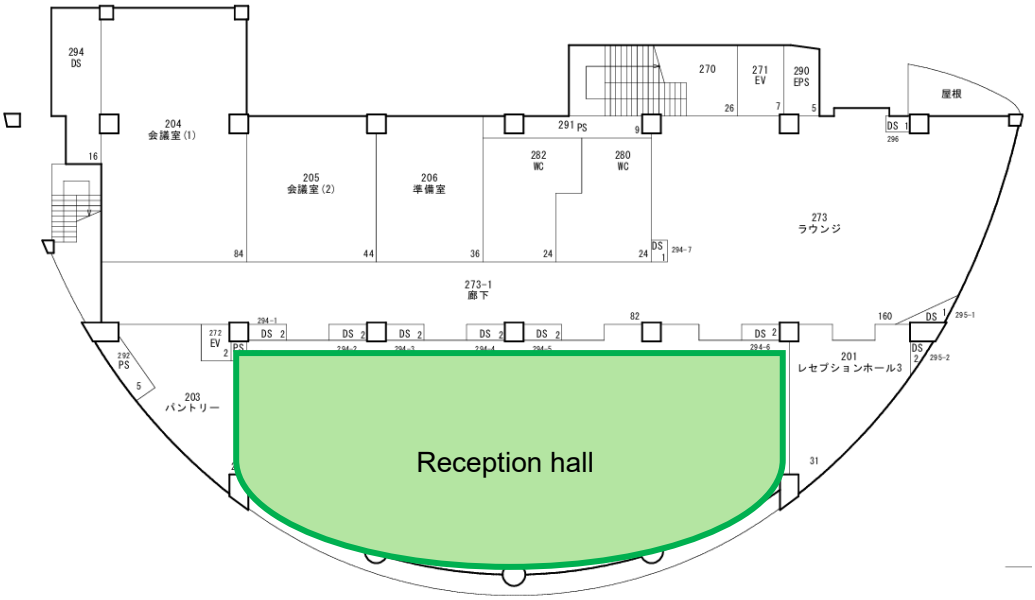
Main Conference Room



Hiroshima University Bachelor's Hall

2nd Floor of Conference Venue

Reception hall



Venue for 11th and 12th of February

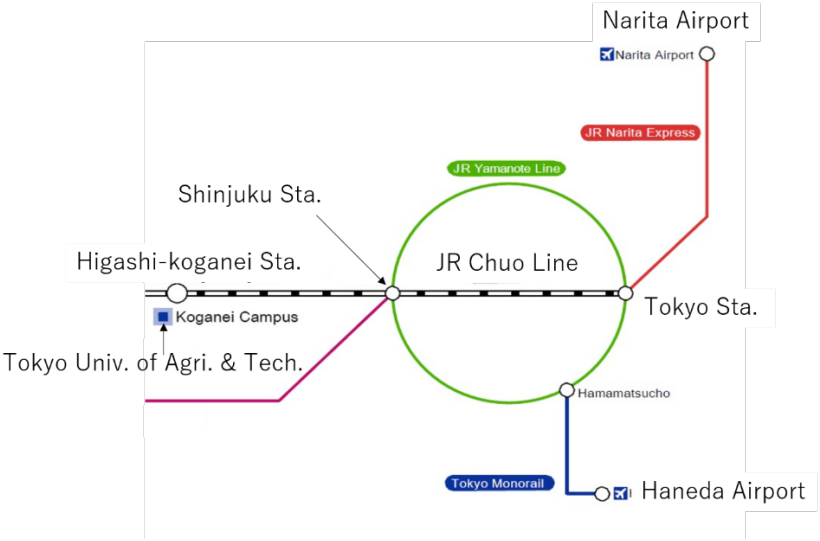
Koganei campus of Tokyo University of Agriculture and Technology (https://www.tuat.ac.jp/en/)

Campus Map: https://www.tuat.ac.jp/en/outline/overview/access/koganei/

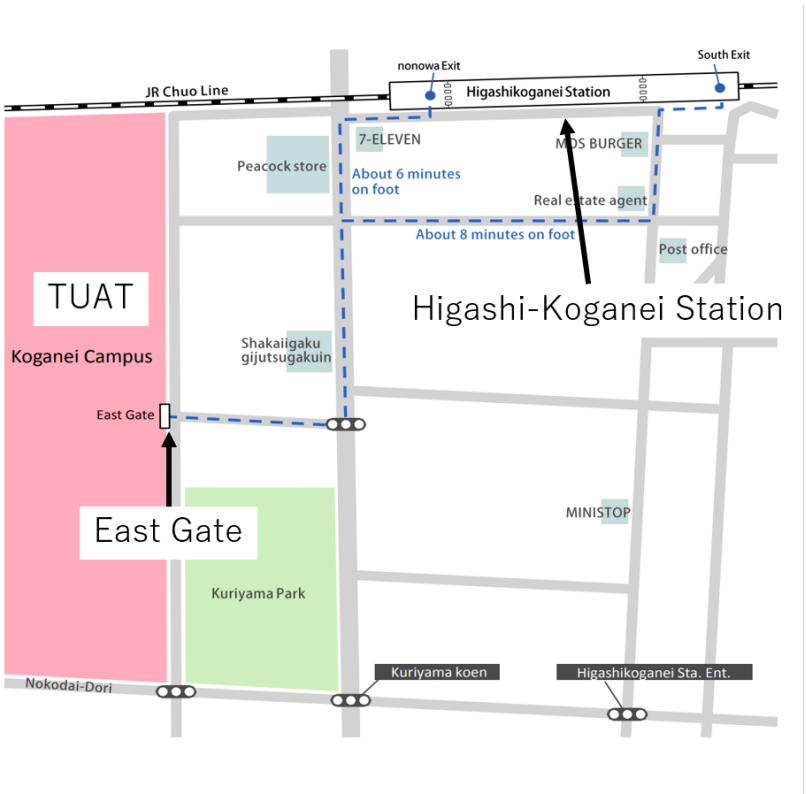
Access

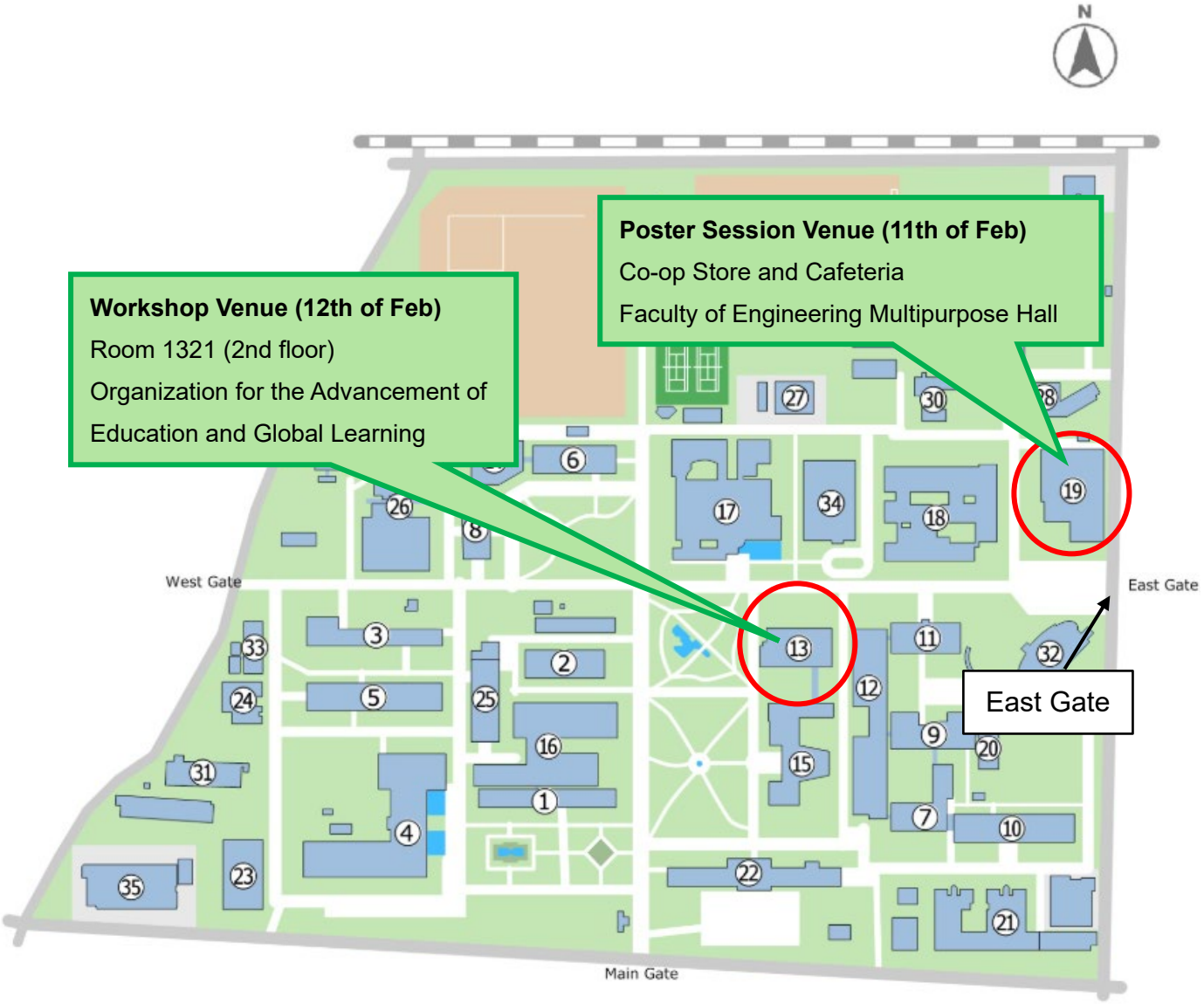
Koganei-campus of TUAT is nearby **Higashi-Koganei station** for **JR Chuo-line**.

Only the Rapid Train stops at this station, while other types of trains, such as the Special Rapid, do not stop.



From the Higashi-Koganei Station, it takes about 6-8 minutes on foot. It is possible to pass through the East Gate.




N
Poster Session Venue (11th of Feb)
Co-op Store and Cafeteria
Faculty of Engineering Multipurpose Hall
Workshop Venue (12th of Feb)
Room 1321 (2nd floor)
Organization for the Advancement of
Education and Global Learning
West Gate
East Gate
East Gate
Main Gate