2025 2nd IEEE Antennas and Propagation Society (AP-S)

Member and Geographic Activity (MGA) Lecture Event in Japan

Recent Trends and Challenges in Antennas and Propagation Technologies by IEEE AP-S Representatives

Book of Abstract

September 16th, 2025

Organizer：IEEE AP-S Tokyo Chapter

Co-organizers：IEEE AP-S Fukuoka, Kansai-Joint, and Nagoya Chapters

IEEE AP-S Technical Committee 1: Antennas

IEICE Technical Committee on Antennas and Propagation

Venue: The 140th Year Commemorative Building (Ellipse), Koganei Campus,

Tokyo University of Agriculture and Technology, Tokyo, Japan

Program (September 16th, Tuesday)

Start	End	Invited speakers and titles
10:00	10:15	Opening remarks
10:15	10:50	Christophe Fumeaux (The University of Queensland, Australia): "Beamforming with Multi-Mode Antennas"
10:50	11:25	Paolo Rocca (University of Trento, Italy): "Advancing Smart EM Environments Through the System-by-Design: The SEME@Trentino Initiative"
11:25	12:00	Jawad Siddiqui (Royal Military College of Canada, Canada) "IEEE Antennas and Propagation SIGHT Committee Activities: Empowering"
12:00	13:30	Lunch and Chapter Chair Meeting
13:30	14:05	Debatosh Guha (University of Calcutta, India): "Machine Learning-assisted Antenna Design: An Amazing Experience"
14:05	14:40	Thomas Kürner (Technische Universität Braunschweig, Germany): "Channel Characterization for THz Communications"
14:40	15:05	Takashi Tomura (Institute of Science Tokyo, Japan): "Origami Deployable Reflectarray Antennas for Small Satellites"
15:05	15:25	Break
15:25	15:50	Keisuke Konno (Tohoku University, Japan): "Frontiers on Electromagnetic Periodic Structures -Modeling, Analysis, Design, and Diagnosis-"
15:50	16:15	Miyuki Hirose (Kyushu Institute of Technology, Japan): "Outdoor Propagation Prediction Based on Generative AI Model"
16:15	16:40	Kentaro Murata (Iwate University, Japan): "Multi-disciplinary Wireless Applications Connected by Multi-Antenna Technologies"
16:40		Closing remarks

Beamforming with Multi-Mode Antennas

Christophe Fumeaux

The University of Queensland, Australia

Abstract- The growing requirements of wireless communications technologies place unique challenges on antenna design. Antenna systems with increasing complexity and multiple dynamically accessible functionalities are required to enhance capacity and/or serve various purposes, such as simultaneous communications and sensing.

This presentation will focus on the concept of multi-port multi-mode antennas, where several independent radiating modes operating in the same frequency band are generated in a shared aperture (or a shared volume). Such uncorrelated modes packed in a compact form factor can be exploited to enhance the agility and capacity of a communications link, either through pattern diversity or Multiple-Input Multiple-Output operation (MIMO).

In this context, this presentation will describe various techniques for packing multiple independent modes in a limited volume. It will then demonstrate how a large number of collocated radiating modes can enable beam-steering and nulling in a full hemisphere, with high consistency and in any polarization. Experimental results of beamforming with an 18-port antenna fitting in a ~λ3 volume will validate the approach. The presented concept opens new perspectives for future distributed sensing and communications systems.

Biography of the Speaker

Christophe Fumeaux received his Ph.D. degree from ETH Zurich, Switzerland, in 1997. From 1998 to 2008, he held various positions at the University of Central Florida, the Swiss Federal Office of Metrology, and ETH Zurich. From 2008 to 2023, he was a Professor with The University of Adelaide. In 2023, he joined the School of Electrical Engineering and Computer Science at The University of Queensland, as Chair Professor in Optical and Microwave Engineering. His main research interests concern applied electromagnetics, antenna engineering, and the application of RF design principles across the electromagnetic spectrum.

Prof. Fumeaux was the recipient of the ETH Medal for his doctoral dissertation. He was the recipient of the 2018 Edward E. Altshuler Prize, the 2014 IEEE Sensors Journal and the 2004 ACES Journal best paper awards. He was the recipient of the University of Adelaide 2018 Stephen Cole the Elder Award for Excellence in PhD Supervision. From 2017 to early 2023, he served as the Editor-in-Chief for the IEEE Antennas and Wireless Propagation Letters. He is a Fellow of the IEEE and the 2025 President of the IEEE Antennas and Propagation Society.

Advancing Smart EM Environments Through the System-by-Design: The SEME@Trentino Initiative

Paolo Rocca

The University of Trento, Italy

Abstract-The Smart Electromagnetic Environment (SEME) is a revolutionizing concept envisioning the future of wireless connectivity for next-generation/6G mobile systems and applications. It is based on the idea that the objects in the environment are not considered, like in the past, as impairments to the propagation of the electromagnetic (EM) signals but they are key enablers. The environment becomes the fundamental and necessary degree-of-freedom for tailoring the propagation of the EM waves and enhancing the coverage, the data throughput, the quality of service, and thus the users experience toward the implementation of the Metaverse.

The SEME implementation will unavoidably require the development and use of novel hardware and software technology and their smart integration into practical solutions. In this framework, there is nowadays a wide research interest towards reconfigurable intelligent surfaces (RIS) and static passive EM skins (SP-EMS) to be installed or integrated in the walls of building and/or along the streets for improving the propagation of the EM waves in complex urban scenarios. The design, optimization, and planning of such hybrid and complex wireless networks and of the technology therein will not be possible without the use of innovative methods such as the System-by-Design (SbD).

In this talk, the recent advances carried out within the SEME@Trentino initiative on the use of the SbD for developing novel SEME technology and solutions will be presented and future trends envisaged.

Biography of the Speaker

Paolo Rocca (IEEE Fellow, 2023) received the MS degree in Telecommunications Engineering (summa cum laude) in 2005 and the PhD Degree in Information and Communication Technologies in 2008 from the University of Trento, Italy. Since 2015, he is Associate Professor at the Department of Civil, Environmental, and Mechanical Engineering (University of Trento) and a member of the ELEDIA Research Center. Moreover, he is Huashan Scholar Chair Professor at the Xidian University (Xi'an, China), Adjunct Professor at the University of Electronic Science and Technology of China (Chengdu, China), and Member of the Big Data and AI Working Group for the Committee on Engineering for Innovative Technologies (CEIT) of the World Federation of Engineering Organizations (WFEO). Since 2023, Prof. Rocca is the Director of the SEME@Trentino (Smart EM Environment in Trentino) laboratory, a joint initiative between the University of Trento and the Bruno Kessler Foundation.

Prof. Rocca received the National Scientific Qualification for the position of Full Professor in Italy and France in April 2017 and January 2020, respectively. He has been awarded from the IEEE Geoscience and Remote Sensing Society and the Italy Section with the best PhD thesis award IEEE-GRS Central Italy Chapter. His main interests are in the framework of the analysis and design of antennas and unconventional antenna arrays, electromagnetic inverse scattering, and methodologies for EM inversion and advanced EM design with a focus on artificial intelligence and quantum computing.

Prof. Rocca has co-authored 6 book chapters and more than 530 scientific publications among which more than 185 on international journals. He is/has been the PI of several technological projects (>20) with national, EU, and international agencies as well as leading industrial partners in the area of ICT.

IEEE Antennas and Propagation SIGHT Committee Activities: Empowering Communities Through Technology

Jawad Y. Siddiqui

Royal Military College of Canada, Canada

Chair of AP-S SIGHT Committee 2025

Abstract-This presentation offers an overview of the key initiatives led by the IEEE Antennas and Propagation Society (AP-S) SIGHT Committee, with a particular focus on its collaborative efforts with other IEEE Organizational Units (OUs). The committee's primary objectives include strengthening AP-S membership, fostering strategic partnerships, and promoting global awareness of humanitarian activities aligned with sustainable development goals.

Key areas of the committee's charter include:

- Supporting humanitarian projects to tackle persistent issues such as access to food, clean water, communications aligned with United Nations sustainable development goals (SDGs).
- Promoting humanitarian-focused technical sessions, capacity-building workshops, and knowledge exchange.
- Support AP-S Chapters/Jt. Chapters and SIGHT Groups in delivering meaningful local impact projects.
- Leveraging AP-S local chapters and student branches for community engagement, volunteer development, and membership growth

These themes and activities will be elaborated upon in the presentation.

Biography of the Speaker

Jawad Yaseen Siddiqui has over two decades of extensive teaching and research experience in applied electromagnetics, RF and microwave circuits, antennas and propagation. He has taught courses at several Universities in Canada and India. Currently, he is a Senior Research Associate at the Royal Military College of Canada. He is also an Adjunct Assistant Professor in the Department of Electrical and Computer Engineering (ECE) at Queen's University, Canada. Previously, he served as an Associate Professor at the Institute of Radio Physics and Electronics, University of Calcutta, India. He has also been a Visiting Professor in the ECE Department at the University of Alberta, Edmonton. Additionally, he has worked as a research associate in the ECE Department at Queen's University and as a postdoctoral fellow and research assistant at the Royal Military College of Canada. He has been actively involved in several research projects funded by the Department of National Defence (DND) and Defence Research and Development Canada (DRDC) in Canada.

He is the Chair of the AP-S SIGHT, a standing committee of the IEEE Antennas and Propagation Society (AP-S) and has serve on several other committees within the Society. He has also been a member of the Meetings and Symposia Committee of the IEEE Microwave Theory and Technology Society (MTT-S) and served as the MTT-S representative on the IEEE Technical Activities Board (CPC) in 2021. He is the recipient of the 2022 Institution of Electronics and Telecommunication Engineers (IETE)–S.N. Mitra Memorial Award for his contributions and leadership in radio broadcast science and technology. He also received the 2015 IEEE AP-S Ulrich L. Rohde Humanitarian Technical Field Project Award for excellence in the humanitarian use of technology. He is a Senior Member of IEEE and a member of IEEE Eta Kappa Nu (HKN). He has authored 150+ publications in peer-reviewed journals and conferences.

Machine Learning-assisted Antenna Design: An Amazing Experience

Debatosh Guha

University of Calcutta, India

Abstract-'Artificial Intelligence (AI)', a common word among the common people, has crossed all boundaries. But very few researchers in the classical domains of science and engineering have had any firsthand experience of its power and beauty in all senses! This talk will address some crucial design aspects in *antenna engineering* where the technique of 'machine learning' (ML) could be of immense help. This will highlight the necessity of ML as an assisting tool in finding out the best possible solution where the traditional full wave analysis or powerful numerical techniques alone fail to do so. *ML for antenna design* is still in its budding stage and we have explored one of the latest algorithms in collaboration with a leading 'AI' group. The final outcome and our experience ensure the marvel of AI or ML in antenna engineering.

Biography of the Speaker

Debatosh Guha is a Professor in Radio Physics and Electronics, University of Calcutta and Dean for the Faculty of Engineering and Technology in the same University. He is a Fellow of IEEE and also a fellow of all four National Academies for Sciences and Engineering in India. He is Abdul Kalam Technology Innovation National Fellow, Govt. of India. He has served IEEE Antennas and Propagation Society as a Distinguished Lecturer, *IEEE Transactions on Antennas and Propagation* and *IEEE Antennas and Wireless Propagation Letters* as an Associate Editor, and *IEEE Antennas and Propagation Magazine* as a Section Editor. His research interests include low-profile antenna techniques. A couple of authored and edited books on antenna engineering published by IEEE Press and Wiley are to his credit. He has been serving IEEE AP Society and URSI Commission-B in various capacities. At present, he is the Chair of IEEE AP-S MGA Committee.

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Channel Characterization for THz Communications

Thomas Kürner

Technische Universität Braunschweig, Germany

Abstract- THz communications is a physical layer candidate, which might be capable of providing future wireless data rates of 1 Tbps. Although the propagation channel at sub-THz frequencies has similarities to those at Millimeter waves, the higher path loss, the required higher antenna gains and the smaller wave lengths and the operational environments coming along with new applications are calling for specific channel models. For the standardization process appropriate channel models for the various applications are required. Corresponding channel modelling activities are ongoing at ITU-R, IEEE 802 .15 SC THz and ETSI ISG THz. In this talk a brief overview on the status of research on propagation and channel models for THz communications will be provided. This includes a review on relevant propagation phenomena, results from measurement campaigns, already existing channel models and a summary of requirements on channel models for future applications focusing also on the needs for standardization bodies.

Biography of the Speaker

Thomas Kürner (Fellow IEEE) received his Dipl.-Ing. degree in Electrical Engineering in 1990, and his Dr.-Ing. degree in 1993, both from University of Karlsruhe (Germany). From 1990 to 1994 he was with the Institut für Höchstfrequenztechnik und Elektronik (IHE) at the University of Karlsruhe working on wave propagation modelling, radio channel characterization and radio network planning. From 1994 to 2003, he was with the radio network planning department at the headquarters of the GSM 1800 and UMTS operator E-Plus Mobilfunk GmbH & Co KG, Düsseldorf, where he was team manager radio network planning support responsible for radio network planning tools, algorithms, processes and parameters from 1999 to 2003. Since 2003 he is Full University Professor for Mobile Radio Systems at the Technische Universität Braunschweig. In 2012 he was a guest lecturer at Dublin City University within the Telecommunications Graduate Initiative in Ireland. Currently he is chairing the IEEE 802.15 Standing Committee THz and the ETSI Industrial Specification Group THz. He was also the chair of IEEE 802.15.3d TG 100G, which developed the worldwide first wireless communications standard operating at 300 GHz. He is also the inaugural chair o the recently established IEEE AP/S TC Propagation. He was the project coordinator of the H2020-EU-Japan project ThoR (“TeraHertz end-to-end wireless systems supporting ultra-high data Rate applications”) and is Coordinator of the German DFG-Research Unit FOR 2863 Meteracom (“Metrology for THz Communications”). In 2019 and 2022 he received the Neal-Shephard Award of the IEEE Vehicular Technology Society (VTS) also in 2022 the Best Teacher Award of the European School on Antennas and Propagation (ESoA) and in 2023 a publication prize of the German VDE-ITG.

Origami Deployable Reflectarray Antennas for Small Satellites

Takashi Tomura

Institute of Science Tokyo, Japan

Abstract- 6G requires extended coverage over the air, sea, and space, in addition to ultra-high-speed communications and low latency. This talk presents origami deployable reflectarray antennas for small satellites. The antennas can be compactly stowed by origami fold patterns when onboard a rocket and deployed large in space. To further increase the functionality of the antennas, reconfigurable reflectarrays enable non-flatness compensation and beam steering

Biography of the Speaker

Takashi Tomura (S'11–M'14) received the B.E., M.E. and D.E. degrees in electrical and electronic engineering from the Tokyo Institute of Technology, Tokyo, Japan, in 2008, 2011 and 2014, respectively. He was a Research Fellow of the Japan Society for the Promotion of Science (JSPS) in 2013. From 2014 to 2017, he worked at Mitsubishi Electric Corporation, Tokyo and was engaged in research and development of aperture antennas for satellite communications and radar systems. From 2017 to 2019, He was a Specially Appointed Assistant Professor and Assistant Professor at the Tokyo Institute of Technology, Tokyo. He is currently an Associate Professor at Institute of Science Tokyo. His research interests include electromagnetic analysis, aperture, reflectarray, and waveguide slot array antennas. Dr. Tomura received the Best Student Award from Ericsson Japan in 2012, the IEEE AP-S Tokyo Chapter Young Engineer Award in 2015, the Young Researcher Award from IEICE technical committee on antennas and propagation in 2018, and the IEEE MTT-S Japan Chapter Young Engineer Award in 2022. He is a member of the IEICE.

Frontiers on Electromagnetic Periodic Structures

-Modeling, Analysis, Design, and Diagnosis-

Keisuke Konno

Tohoku University, Japan

Abstract- In this talk, series of studies on the electromagnetic periodic structures by authors from viewpoints of modeling, analysis, design, and diagnosis, are reviewed. Topics to be addressed in this lecture are as follows: wireless channel modeling between antennas in the presence of reconfigurable intelligent surfaces (RIS) using method of moments (MoM) formalism, mesh-free modeling of electromagnetic periodic structures using Green's function, design of reconfigurable reflectarrays using electromagnets, and diagnosis of array antennas using eigenmode currents and artificial neural networks (ANN).

Biography of the Speaker

Keisuke Konno received the B.E., M.E., and D.E. degrees from Tohoku University, Sendai, Japan, in 2007, 2009, and 2012, respectively. Since 2012, he has been with the Department of Communications Engineering, Graduate School of Engineering, Tohoku University, where he is an Associate Professor. He received a JSPS Postdoctral Fellowships for Research Abroad and he was staying with the Electro-Science Laboratory, the Ohio State University, as a visiting scholar from 2015 to 2017. His research interests include computational electromagnetics, array antennas, reflectarrays, and source reconstruction. Dr. Konno is a senior member of IEEE and member of IEICE.

He received the Encouragement Award for Young Researcher and Most Frequent Presentations Award in 2010 from the Technical Committee on Antennas and Propagation of Japan, Young Researchers Award in 2011 from the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan, IEEE EMC Society Sendai Chapter Student Brush-up Session & EMC Sendai Seminar Student Best Presentation Award in 2011, JSPS Washington Director Award in 2016, MHz Rectenna Award in 2017, Young Researchers Award for ECEI of Tohoku University in 2018, Minoru Ishida Award in 2018, IEEE AP-S Japan Young Engineer Award in 2018, TOKIN Foundation Research Encouragement Award in 2019, IEICE Communications Society Distinguished Contributions Awards in 2019 and 2021.

Outdoor Propagation Prediction Based on Generative AI Model

Miyuki Hirose

Kyushu Institute of Technology, Japan

Abstract- Machine learning (ML) techniques have been increasingly applied to tasks such as propagation loss estimation and received power map generation. These ML-based approaches offer several advantages in wireless channel modeling, including reduced computational cost during the inference phase. Although training such models can be resource-intensive, once trained, they enable rapid and efficient prediction, making them attractive for large-scale or real-time applications. However, most existing studies focus on prediction within the spatial domain of the training data, limiting the model's applicability in unseen or out-of-distribution areas. In this study, a novel propagation prediction model is proposed based on a generative AI framework. The model utilizes building height information and transmitter-receiver coordinates to generate propagation loss maps. It is trained on data from specific urban environments and evaluated on test areas with different spatial characteristics. Generalization performance introduces multiple test regions that are distinct from the training domain. Experiments with simulated data demonstrate that the GAN (Generative Adversarial Network)- and VAE (Variational Autoencoder)-based approach maintains high prediction accuracy, highlighting its potential as a general-purpose propagation estimator for urban areas.

Biography of the Speaker

Miyuki Hirose received her Doctorate in Engineering from Tokyo Denki University in 2017. From 2017 to 2021, she served as an Assistant Professor at Tokyo Denki University, where she was involved in an educational program focused on cultivating advanced IT professionals. She is currently an Associate Professor at Kyushu Institute of Technology and also holds a concurrent position as a Specially Appointed Associate Professor at Osaka University. Her research interests include mobile communication, physical layer security, and underwater radio communication.

Multi-disciplinary Wireless Applications Connected by Multi-Antenna Technologies

Kentaro Murata

Iwate University, Japan

Abstract- Wireless technologies have traditionally been developed with a primary focus on communication. In recent years, however, research and development efforts have increasingly expanded to encompass non-communication applications such as wireless power transfer and sensing. Although these applications differ in both objectives and implementation, they share a fundamental technical challenge: achieving precise and effective control of radio waves.

This presentation introduces two multi-disciplinary research projects that leverage multi-antenna technology to enable advanced wave manipulation beyond the capabilities of single-antenna systems.

The first project presents a novel beamforming technique that enables simultaneous high-efficiency wireless power transfer and reduced radio wave exposure. This is accomplished through wireless sensing of hard-to-detect targets, such as battery-depleted receivers and device-free human bodies.

The second project proposes a low-cost, high-fidelity, and reproducible over-the-air testing platform for human-sensing radar systems. Inspired by reconfigurable intelligent surfaces, the platform incorporates a reconfigurable electronic phantom that virtually emulates human presence and motion by reconstructing arbitrary radar signals observed in real-world human scenarios.

By showcasing these projects, this presentation aims to foster connections across the antennas and propagation community and to co-create the next generation of wireless applications centered on multi-antenna technology.

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Biography of the Speaker

Kentaro Murata (Member, IEEE) received the B.E. and M.E. degrees in Electrical and Electronic Engineering from Iwate University, Morioka, Japan, in 2011 and 2014, respectively, and the Ph.D. degree from the Graduate School of Science and Engineering, National Defense Academy of Japan, Yokosuka, Japan, in 2016.

He joined the Corporate Research and Development Center, Toshiba Corporation, Kawasaki, Japan, in 2016. He was a Visiting Assistant Professor at Lund University, Lund, Sweden, during 2022-2023. He is currently an Assistant Professor at Iwate University. His research interests include multiantenna systems and signal processing techniques for wireless communication, power transfer, and sensing. He authored Electromagnetic Vortices: Wave Phenomena and Engineering Applications (Wiley-IEEE Press, 2021) in the IEEE Press Series on Electromagnetic Wave Theory.

Dr. Murata received the Best Student Paper Award at ISAP in 2015, the Young Researcher's Award from the IEICE of Japan in 2016, the IEEE AP-S Japan Young Engineer Award from the IEEE AP-S Tokyo Chapter in 2017, the EuMC Microwave Prize at EuMW in 2018, and the URSI AT-RASC Young Scientist Award in 2022. He was recognized as one of the Top Reviewers for the IEEE Transactions on Antennas and Propagation for seven consecutive years from 2018 to 2025.

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