Singapore Workshop on Antennas

PARKROYAL on Beach Road, Singapore

03-04 November 2025

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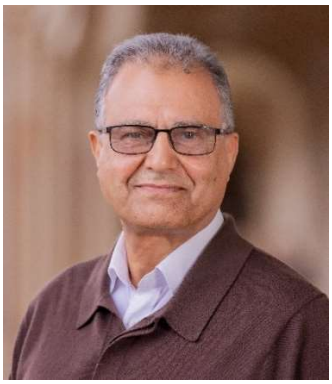

Amin Abbosh


Kwok Wa Leung

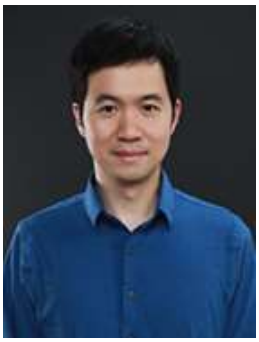

Guy Vandenbosch


Kin-Lu Wong


Weihong Xiao


Richard W. Ziolkowski

Distinguished Lecturers



Changzhan Gu

Ho-Jin Song

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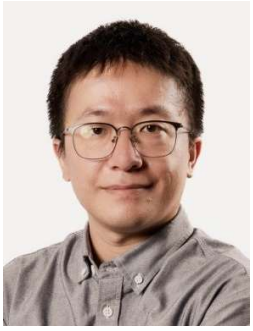
Kin-Fai (Kenneth) Tong

Chung-Tse Michael Wu

Rising Stars



Jian Xu Sun

Pengfei Wang

Zhan Wang

Yiyang Yu

Yongjian Zhang

Workshop Program on 3 November 2025 (Monday), Venue: Grand Ballroom 1

8:30 am	Registration
8:50 am	Opening Ceremony (MC: Theng Huat Gan; Welcome speech by Yueping Zhang)
9:10 am	Keynote Speech From Interconnected to Orthogonal: Redefining Resonator Interaction When Designing Microwave Devices Amin Abbosh, The University of Queensland (Chaired by Theng Huat Gan, National University of Singapore)
10:00 am	Coffee Break
10:30 am	Keynote Speech High-Gain Antennas Integrated with Wideband Metal Lens Kwok Wa Leung, City University of Hong Kong (Chaired by Kin-Fai (Kenneth) Tong, Hong Kong Metropolitan University)
11:20 pm	Keynote Speech Modeling Non-classical Effects in Deep-nanometric Nanoscatterers and Antennas Guy A. E. Vandenbosch, KU Leuven (Chaired by Richard W. Ziolkowski, The University of Arizona)
12:10 pm	Lunch
1:15 pm	Keynote Speech 6G Upper Mid-Band Device MIMO Communications: Extreme Receive Antennas-Aided MIMO Based on Modular MIMO antennas Kin-Lu Wong, National Sun Yat-sen University (Chaired by Chung-Tse Michael Wu, National Taiwan University)
2:05 pm	Distinguished Lecture Microwave Biomedical Radar for Healthcare Applications Changzhan Gu, Shanghai Jiao Tong University (Chaired by Amin Abbosh, The University of Queensland)
2:50 pm	Industry talk Next Generation Electromagnetic Simulation: Path towards 6G Rijin Saseendran, Dassault Systemes (Chaired by Zhenyu Zhao, National University of Singapore)

3:10 pm	Coffee Break
3:40 pm	Distinguished Lecture Terahertz Communications at 300 GHz: Devices, Packages and System Ho-Jin Song, Pohang University of Science and Technology (Chaired by Zhenyu Zhao, National University of Singapore)
4:25 pm	Distinguished Lecture Fundamental Quantity and Equations for Electromagnetics from Classical to Quantum – Replacing 160-Year-Old Maxwell Equations of Fields and Potentials Eng Leong Tan, Nanyang Technological University (Chaired by Yueping Zhang, Nanyang Technological University)
6:30 pm	To board bus for Welcome Reception at RedDot BrewHouse @ Dempsey Hill (25A Dempsey Rd, #01-01, Singapore 247691) (Attendees to wait at hotel lobby by 6:30pm for bus departing to the venue above)

Workshop Program on 4 November 2025 (Tuesday), Venue: Grand Ballroom 1

9:05 am	Keynote Speech Antenna Digitalization for Intelligent Network: From Vision to Reality Weihong Xiao, Huawei Technologies (Chaired by Richard, Xian-Ke Gao, Institute of High Performance Computing, A*STAR)
9:55 am	Coffee Break
10:25 am	Keynote Speech Electromagnetic Multipole Physics and Engineering Richard W. Ziolkowski, The University of Arizona (Chaired by Guy A. E. Vandenbosch, KU Leuven)
11:15 am	Distinguished Lecture Fluid Antennas or Fluidic Antennas, What Are the Differences? Kin-Fai (Kenneth) Tong, Hong Kong Metropolitan University (Chaired by Kwok Wa Leung, City University of Hong Kong)
12:00 pm	Lunch
1:15 pm	Distinguished Lecture Sensing, Tracking, and Secured Communication with Artificial Electromagnetic Materials Chung-Tse Michael Wu, National Taiwan University (Chaired by Kin-Lu Wong, National Sun Yat-sen University)
2:00 pm	Rising Star Talk Ultra-Wideband Phased Array Antenna Technology for Multi-Functional Integrated Applications Jian Xu Sun, University of Electronic Science and Technology of China (Chaired by Ho-Jin Song, Pohang University of Science and Technology)

2:30 pm	Rising Star Talk Integrated Control of Radiation and Scattering Characteristics for Circularly Polarized Antenna Arrays Pengfei Wang, Aerospace Information Research Institute, Chinese Academy of Sciences (Chaired by Ho-Jin Song, Pohang University of Science and Technology)
3:00 pm	Coffee Break
3:30 pm	Rising Star Talk Novel Pattern Reconfigurable Antennas Based on Multi-Mode Manipulation Method Zhan Wang, University of Electronic Science and Technology of China (Chaired by Changzhan Gu, Shanghai Jiao Tong University)
4:00 pm	Rising Star Talk Efficient Antenna-on-Chip with Optimized Artificial Magnetic Conductor Performance for 6G mm-Wave Applications Yiyang Yu, Chongqing University (Chaired by Changzhan Gu, Shanghai Jiao Tong University)
4:30 pm	Rising Star Talk Near-Zero-Index Metamaterials Empower High-Performance Terminal Antennas Yongjian Zhang, Northwestern Polytechnical University (Chaired by Changzhan Gu, Shanghai Jiao Tong University)
6:30 pm	Banquet at Sky Ballroom 1 (Prize presentation, Eng Leong Tan, Nanyang Technological University)

Keynote Speech

From Interconnected to Orthogonal: Redefining Resonator Interaction When Designing Microwave Devices

Amin Abbosh, The University of Queensland

Abstract:
As wireless communication systems continue to evolve, the demand for microwave components that are smaller, more efficient, and capable of delivering superior performance has never been greater. This keynote introduces a transformative design philosophy for resonator-based microwave devices, such as filters and antennas, that challenges the long-standing assumption of interconnected resonators. Traditionally, these devices are modeled as chains of coupled resonators, where inter-resonator coupling defines the overall response. In contrast, our approach reinterprets resonant modes as orthogonal eigenmodes that couple exclusively in parallel to external ports.
This paradigm shift offers unprecedented flexibility in shaping frequency responses, enabling designers to achieve compact, cost-effective solutions without compromising performance. By leveraging this concept, we unlock new opportunities for enhanced transmission zero control, improved isolation, and superior ratios of quality factor to volume. Through several innovative implementations, including ultra-compact cavity filters, high-isolation duplexers, and multi-mode antennas, we demonstrate how this approach can dramatically reduce size and cost while expanding functionality. These advancements pave the way for the next generation of wireless technology, where performance and miniaturization coexist without trade-offs.

Keynote Speech

High-Gain Antennas Integrated with Wideband Metal Lens

Kwok Wa Leung, City University of Hong Kong

Abstract:
High-gain antennas are useful for modern wireless communication systems. In this talk, two novel high-gain open-horn antennas integrated with metal lenses are presented.
The first design is a compact open-horn antenna for point-to-point applications. It incorporates a spatial power divider and an H-plane lens composed of sub-channels that satisfy the equal-path-length condition, enabling wideband and high-gain performance. The magnitude and phase distributions are independently controlled by different antenna sections to achieve a uniform E-field at the aperture. This antenna demonstrates a gain improvement of approximately 6 dB over a conventional horn. To reduce sidelobe levels, an improved version is developed using a tapered E-field magnitude distribution at the lens input. Both the original and improved designs were fabricated and measured. The improved version achieves a sidelobe level reduction from –9 dB to –15 dB. For both designs, the measured –10 dB impedance bandwidth and 3 dB gain bandwidth exceed 46% (11.5–18 GHz).
The second design is a wideband biconical antenna integrated with a metal lens for omnidirectional applications. It offers full azimuthal coverage, which is good for remote area communications and point-to-multipoint systems such as portable base stations and wireless LANs. At millimeter-wave frequencies, high gain is crucial to compensate for path loss. To enhance gain, the biconical antenna is loaded with an annular metal lens comprising rotationally symmetric plates, producing a quasi-uniform E-field. A Ka-band, vertically polarized prototype was fabricated and tested. It achieved –10 dB impedance and 3 dB gain bandwidths of 43.9% (25.6–40.0 GHz), with a measured peak gain of 9.2 dBi, approximately 4 dB higher than the gain of a conventional biconical antenna.
For both designs, excellent agreement was observed between simulated and measured results. Detailed results and design insights will be presented in the talk.

Keynote Speech

Modeling Non-classical Effects in Deep-nanometric Nanoscatterers and Antennas

Guy A. E. Vandenbosch, KU Leuven

Abstract:
Modern nanofabrication technologies have allowed us to enter the deep-nanometric (nm) regime. At this scale nonclassical effects emerge in metal-based nanoscatterers and nanoantennas, devices which hold a prominent role in modern nanophotonics, a field that has a great application potential in e.g., sensing, energy harvesting, precision chemistry, etc.. These nonclassical effects are deeply rooted in the quantum dynamics of free electrons in metals. Fundametally, the classical picture where the free electron polarization current, i.e., the flow of free electrons, is linked with the total electric field at the same spatial position via a macroscopic parameter, e.g., permittivity, has to be upgraded. This leads to a nonlocal constitutive relation that is encoded in an additional partial differential equation alongside with Maxwell's equations. This drastic change results in a computational gap between quantum physics and macroscopic computational electromagnetics (CEM). This talk will cover our most recent efforts to bridge this gap. We will review relevant physical models, propose very efficient computational techniques, and demonstrate numerical examples and their comparisons with more advanced full-quantum simulations. All of these open a path for a rising research domain, named mesoscopic computational electromagnetics, which will definitely facilitate future explorations of extreme optics and provide efficient and effective computational tools for the next generation of practical opto-electronic devices.

Keynote Speech

6G Upper Mid-Band Device MIMO Communications: Extreme Receive Antennas-Aided MIMO Based on Modular MIMO antennas

Kin-Lu Wong, National Sun Yat-sen University

Abstract:
This talk addresses future six-generation (6G) upper mid-band mobile communications based on applying the extreme receive antennas (ERA) in the form of modular MIMO antennas embedded in the mobile device or smartphone. The ERA-aided MIMO communication is especially promising for applications in the lower frequency portion of the upper mid-band such as 7.125-8.4 GHz and the upper 6 GHz (6.425-7.125 GHz) for achieving stable high speeds for the users. By applying the modular MIMO antennas, we can conveniently embed many MIMO antennas in the mobile device to be at least twice the spatial streams in the MIMO communication. In this case, with the same transmit power at the base station like the current 5G 4 x 4 MIMO, the mobile device with 8 or 12 MIMO antennas can support a higher signal modulation to achieve a spectral efficiency up to 32 or 37 bps/Hz, at least about twice that of the 5G 4 x 4 MIMO. This is because the extra MIMO antennas in the mobile device can function like virtual power amplifiers to increase the received signal noise ratio (SNR) and furthermore like virtual external elements such as RIS elements added in the environment to increase the multipath signals toward the device. Additionally, it can lead to simple 6G system complexity, 5G/6G base station co-location, and high energy efficiency for increased user-experienced data rates, which meet the 6G industry priorities. Moreover, the 8 x 4 MIMO can also outperform the 8 x 8 MIMO communications to have a larger spectral efficiency for the user. The principle of the ERA-aided MIMO communication with the modular MIMO antennas will be introduced. The 4 x 4, 8 x 4, and 8 x 8 MIMO performance field test conducted in the NSYSU campus outdoor scenario will also be presented and analyzed.

Keynote Speech

Antenna Digitalization for Intelligent Network: From Vision to Reality

Weihong Xiao, Huawei Technologies

Abstract:
With the evolution of intelligent networks, the antenna industry is undergoing a paradigm shift from static to digitalization. The antenna digitalization has become crucial to support intelligent architecture for ensuring deterministic user experience in the mobile AI era. In the past years, we have proposed the featuring functionalities and design approaches of digitalized antennas with advanced sensing, analysis, and execution capabilities. This talk introduces an integrated antenna solution capable of manageable engineering parameters, fully adjustable beams, and automatic self-optimization. The great vision of antenna digitalization has been turned into reality in base stations for the first time. Moreover, the filed test results are also provided to validate the superior performance owing to the real-time dynamic network optimization.

Keynote Speech

Electromagnetic Multipole Physics and Engineering

Richard W. Ziolkowski, The University of Arizona

Abstract:
Highly directive antenna systems are being sought to address the perceived needs of FutureG wireless systems and their applications. Practical alternatives to complex, power-hungry phased arrays for space-limited applications are truly desired. A potential approach is to develop and employ compact superdirective systems.

The concept of “needle” radiation was introduced by Oseen over 100 years ago. A number of theoretical papers then followed over the last half of the last century that discussed the interesting attributes of unlimited directivity, i.e., superdirectivity, from arbitrarily small source regions. Recent explicit solutions of Maxwell’s equations based upon vector spherical wave expansions confirm this notion. Unfortunately, the consensus in the electromagnetics (EM) community generally has been that superdirective systems are impractical for reasons such as very low radiation resistance/efficiency; very large sensitivity to fabrication and component tolerances; and extremely narrow bandwidths. Nevertheless, a turning point in the history of superdirectivity occurred early this century with a set of successes in which electrically small, superdirective two-element endfire arrays of electric elements were demonstrated. Several superdirective multi-element endfire arrays of a similar nature have been demonstrated using electric or magnetic dipoles in the last decade. Their basic approaches follow from the theoretical demonstration that a densely packed linear array of M isotropic radiators can yield a directivity of M 2 in its endfire direction.

A more recent strategy to achieve superdirective performance has been to exploit mixtures of electric and magnetic multipoles. This multipole engineering paradigm has yielded unidirectional mixed-multipole antennas (MMAs) consisting of combinations of near-field resonant parasitic (NFRP) elements that are excited by simple driven dipoles and that exhibit multipole performance yielding directivities that exceed known bounds. Their practical realizations address the concerns of efficiency, bandwidth, and fabrication/assembly tolerances. Superdirective endfire and broadside radiating systems have been demonstrated. Most recently, highly efficient, superdirective uniform circular arrays of unidirectional MMAs and MMA-excited multilayered-spherical dielectric lens antennas have also been realized.

The historical aspects of superdirective systems from the 20th century and the electromagnetics – both physics and engineering features – of the 21st century innovative realizations of practical superdirective systems will be reviewed. They encourage further superdirective research activities since they demonstrate that practical superdirective radiating systems are, in fact, achievable.

Distinguished Lecture

Microwave Biomedical Radar for Healthcare Applications

Changzhan Gu, Shanghai Jiao Tong University

Abstract:
Microwave biomedical radar has achieved significant advancements, enabling transformative applications in home healthcare. Unlike conventional medical instruments that rely on contact electrodes and cause discomfort, this non-invasive technology offers unique advantages for continuous home-based monitoring. The presentation will first detail hardware innovations, particularly radar miniaturization, accuracy enhancement, and sensitivity optimization—critical for deploying portable devices in residential settings. It will then explore specialized RF processing and machine learning techniques for interpreting physiological data from radar signals. Finally, the talk will highlight breakthrough applications in home health management, demonstrating the technology's potential to revolutionize remote patient monitoring, elderly fall detection, and chronic disease tracking for proactive home care.

Distinguished Lecture

Terahertz Communications at 300 GHz: Devices, Packages and System

Ho-Jin Song, Pohang University of Science and Technology

Abstract:
Recent progress in semiconductor devices on compound semiconductor or silicon substrates has made it possible to produce more power and receive a signal with less noise at THz frequencies. Various integrated circuits for the THz radio front-end functional blocks, including power and low-noise amplifiers, modulators and demodulators, and oscillators, have been demonstrated in the last decade. In the first experimental demonstration conducted in 2004, bulky instruments originally developed for THz spectroscopy were used to transmit pulsed THz signals carrying a 7-kHz bandwidth audio signal across a short free space. However, recently, there have been several successful demonstrations of multi-Gbps data transmissions at THz frequencies with state-of-the art devices and components. In this talk, the first prototype of a THz wireless communications system designed under the ‘touch-and-go’ scenario will be presented. I clarify the concept of the KIOSK data downloading system, cover some considerations in this work, and present a brief link-budget plan. We will then overview technologies for implementing THz components operating at 300 GHz and their performance, followed by preliminary investigation of the channel responses and the experimental demonstration results. At the end of the presentation, we will discuss several issues that need to be addressed for the future of the THz communications systems, in terms of system architectures, packaging and potential applications.

Distinguished Lecture

Fundamental Quantity and Equations for Electromagnetics from Classical to Quantum – Replacing 160-Year-Old Maxwell Equations of Fields and Potentials

Eng Leong Tan, Nanyang Technological University

Abstract:
It has been 160 years now since Maxwell published his equations of electromagnetics (EM) in 1865. Today, these equations have been written in our familiar beautiful form, in terms of fields (E and B) typically and potentials (A and phi) occasionally. However, since Maxwell-Hertz-Heaviside era, there have been longstanding dilemma to use either fields or potentials (or both) for EM, and for the potentials, which gauge condition should be imposed, e.g. Lorenz gauge, Coulomb gauge, etc. The present talk will introduce new gauge-invariant physical quantity of field-impulses for new fundamental equations of electromagnetics. Unlike the potentials that are gauge-dependent and may not be physical nor causal, the field-impulses are like fields being gauge-independent, physically real, causal and measurable. Using single wave equation in terms of electric field-impulse can provide the complete description of all electromagnetics. The electric field-impulse is the single physical quantity that can unify not only electrodynamics but also electrostatics and magnetostatics, which otherwise remain uncoupled and separated all this while. It can completely embed all fields and potentials attributed to static/dynamic and steady/nonsteady charge and/or current distributions. The field-impulse equations facilitate the development of finite-difference time-domain (FDTD) method for simulating all electromagnetic phenomena, even including electrostatics (recall that traditional FDTD has no charge but calls for Poisson/Laplace equation!). Moreover, unlike the fields that are inadequate to describe quantum-EM, the field-impulse can explain fully the Aharonov-Bohm (AB) effect and appear naturally in Schrodinger equation. The field-impulse not only resolves the century-old field-potential/gauge dilemma, but also aptly describes quantum-EM interactions. It constitutes the fundamental physical quantity for replacing fields, potentials, and ultimately Maxwell equations from classical to quantum. Several mobile apps for technology-enhanced-learning of electromagnetics and circuits may also be demonstrated (if time permits).

Distinguished Lecture

Fluid Antennas or Fluidic Antennas, What Are the Differences?

Kin-Fai (Kenneth) Tong, Hong Kong Metropolitan University

Abstract:
Many people may know Bruce Lee's famous quote: "Empty your mind, be formless, like water." This philosophy has proven highly effective in martial arts, but can a similar concept be applied to scientific research?
As global efforts intensify to develop sixth-generation (6G) mobile communications, proposing TKμ extreme connectivity, it is logical to explore new technologies that can deliver the next generational leap in performance, particularly under harsh and dynamic environments. One intriguing idea is the Fluid Antenna System (FAS), which leverages flexible antenna architectures—such as liquid-based antennas, reconfigurable RF pixel-based antennas, and stepper motor-based antennas—to enable reconfigurability of the antenna's position and shape. Through this approach, unprecedented spatial and radiation pattern diversity can be achieved in a novel manner. Moreover, the ability to access what is effectively a continuous fading envelope in the spatial domain opens the door to simple yet effective multiple-access schemes, reducing the need for complex optimization and processing.
In this talk, we will share our experience on how fluid antennas could emerge as strong candidates for future mobile communications, and how their formless, adaptive nature may provide solutions to long-standing challenges in wireless systems. While there may be no board-breaking demonstrations, we hope this discussion will spark fresh, groundbreaking ideas.

Distinguished Lecture

Sensing, Tracking, and Secured Communication with Artificial Electromagnetic Materials

Chung-Tse Michael Wu, National Taiwan University

Abstract:
Metamaterials (MTMs) are synthetic electromagnetic materials possessing unique properties not found in natural materials. Their introduction has spurred the creation of innovative circuits with enhanced components. One notable metamaterial-based design is the composite right/left-handed transmission line (CRLH-TL) leaky-wave antennas (LWAs). These antennas offer continuous frequency-dependent beam scanning from backfire to endfire with a true broadside beam. They also ensure excellent impedance matching throughout their operational range, using a straightforward feeding mechanism. The CRLH LWAs' ability to map frequency to space means unknown target locations can simply be pinpointed by analyzing the spectral components of the returning wave. This paves the way for real-time detection, with data acquisition speeds mainly determined by the signal source's frequency sweep rate. The sensor's field-of-view is also expanded thanks to the wide scanning angle of CRLH LWAs. Such features enable applications like swift 2-D beamforming, expansive real-time remote sensing, vital sign monitoring, motion detection, and microwave imaging.
Additionally, applying spatiotemporal modulation to CRLH LWAs can generate harmonic waves and enhance physical layer security, promoting safer wireless communication.

Rising Star Talk

Ultra-Wideband Phased Array Antenna Technology for Multi-Functional Integrated Applications

Jian Xu Sun, University of Electronic Science and Technology of China

Abstract:
Ultra-wideband phased array antenna technology is critically important in fields such as radar and communications. The co-design of multi-domain characteristics (e.g., frequency, polarization, and spatial domains) represents a key challenge. For instance, airborne platforms require antennas with low-profile and miniaturized structures, meaning constrained apertures in either longitudinal or lateral dimensions. Simultaneously, these antennas must meet the performance requirements of integrated multifunctional applications in terms of wide bandwidth, low cross-polarization, and wide beam coverage. However, current technologies often focus on single or limited performance aspects, failing to satisfy the stringent demands of multifunctional integration. This talk thoroughly discusses co-design methods and key technologies for achieving multi-domain performance in ultra-wideband phased arrays under structural constraints.

Rising Star Talk

Integrated Control of Radiation and Scattering Characteristics for Circularly Polarized Antenna Arrays

Pengfei Wang, Aerospace Information Research Institute, Chinese Academy of Sciences

Abstract:
This talk will present an integrated design methodology for the radiation and scattering properties of circularly polarized (CP) antenna arrays. The proposed design directly employs metasurface units as antenna radiators, achieving integration of the metasurface and the antenna, which significantly reduces design complexity. The constructed low radar cross-section (RCS) CP metasurface antenna array exhibits excellent radiation performance as well as broadband low-RCS characteristics. Conventional low-scattering antennas possess fixed scattering properties once fabricated, with their low-RCS effect confined to limited angular regions. This restricts their ability to counter emerging anti-stealth threats such as networked radar detection. To address this challenge, the talk will further present a reconfigurable scattering-beam design for CP antenna arrays. While maintaining desirable CP radiation performance, the proposed array enables flexible control of the scattered beam within a certain range, providing an effective solution against networked detection and other anti-stealth technologies.

Rising Star Talk

Novel Pattern Reconfigurable Antennas Based on Multi-Mode Manipulation Method

Zhan Wang, University of Electronic Science and Technology of China

Abstract:
Pattern reconfigurable antennas with multiple switchable beams can effectively improve multi-path effects and enhance channel quality. Therefore, they are considered one of the key technologies for intelligent wireless communication and IoT applications. Most conventional pattern reconfigurable works realize beam switching by introducing multiple reflectors or directors. However, this method usually suffers from large sizes, few beam states, and complex structures.

This talk will introduce a novel multi-mode manipulation method and several pattern reconfigurable designs. By superimposing an odd mode and an even mode, an aperture-shared even-odd mode system is built. The E-field distribution is manipulated by tuning the phase and amplitude states of the odd mode or/and the even mode. Thus, the main-lobe directions and beam shapes of the proposed multi-mode antenna are flexibly controlled. Then, multi-functional pattern reconfigurable antennas are developed, such as multi-beam switching and 360° continuous beam scanning. With the merits of compact sizes, novel working principles, and flexible beam-steering capacity, these proposed pattern reconfigurable antennas are good candidates for intelligent wireless applications.

Rising Star Talk

Efficient Antenna-on-Chip with Optimized Artificial Magnetic Conductor Performance for 6G mm-Wave Applications

Yiyang Yu, Chongqing University

Abstract:
Advances in 6G wireless are pushing communication into the mm-wave bands, enabling compact Antennas-on-Chip (AoC). However, AoC radiation efficiency is limited by lossy silicon substrates. This talk presents new methods to enhance AoC performance using advanced artificial magnetic conductors (AMCs) tailored for ultra-thin CMOS processes.
First, an ultra-thin AMC with CMOS-compatible thickness is introduced. Metallic Posts and an Embedded Guiding Structure are used to reduce AMC thickness by 41% and achieve 5.85 dBi gain and 57% radiation efficiency at 94 GHz. Illumination is improved using electric and magnetic coupling enhancement structures, enhance the gain to 10 dB and the bandwidth by 6 times. Finally, reconfigurability is demonstrated in an AMC-backed AoC with a VO_2-based superstrate, enabling switching between 94 GHz and 106 GHz with end-fire radiation and vertical polarization.
These innovations overcome key limitations in AoC design, supporting more efficient and adaptable antennas for future 6G systems.

Rising Star Talk

Near-Zero-Index Metamaterials Empower High-Performance Terminal Antennas

Yongjian Zhang, Northwestern Polytechnical University

Abstract:
Metamaterials refer to artificial electromagnetic media, featuring flexibly tailorable electromagnetic parameters—permittivity and permeability. In recent years, near-zero-index (NZI) metamaterials with exceptional parameters, i.e., permittivity or permeability approaches zero, have garnered significant attention. Within such media, electromagnetic fields exhibit infinitely large wavelengths and phase velocities, leading to distinct electromagnetic properties, such as tunnel supercoupling, spatial–temporal decoupling, and single-point tuning by photonic doping. On the other hand, the research on terminal antennas remains a focal area in both academia and industry, with their performance enhancement primarily constrained by the compact system size. This talk focuses on introducing the concept of NZI metamaterials into space-limited terminal systems to boost the radiation performance of terminal antennas. Unlike traditional NZI metamaterials constructed by periodically arranging sub-wavelength elements, the NZI metamaterials adopted in this talk is equivalent to non-periodic electromagnetic structures. The design fully leverages the compact space of terminal systems, enabling the realization of three high-performance antenna prototypes: a wideband antenna for tablet with full-metal backcover, a wideband antenna for tablet with small clearance, and a miniaturized circular-polarized antenna for smartphone with ultra-narrow bezel.