The 2nd NUS EM & Microwave Student Workshop 2021 will be hold on 25th February 2021 in NUS! This workshop is organized by Graduate Student Council(GSC) of department of Electric and Computer Engineering and supported by IEEE RFID Singapore Chapter. The objective is to further enhance the quality of graduate seminar as well as providing a platform for undergraduates, graduates students and faculty to exchange the latest research findings and ideas. The workshop also provides a unique networking opportunity for students present their research work in related area shared opinions with mentors from universities, institutes, and industries.

Organizing Committee

Yulong ZHOU (General Chair)
Ruolei XU (Chair)
Bo ZHANG (Chair)

Dr. Wei LIU (IEEE RFID Chapter, National University of Singapore)
Prof. Zhi Ning CHEN (Mentor, National University of Singapore)
Dr. Pui Yi (Anna) LAU (Judge, IEEE RFID Chapter, Laxcen Technology Limited)
Dr. See Terence Shie Ping (Judge, IEEE RFID Chapter, Institute for Infocomm Research, A* STAR, Singapore)

Location:
E3-06-09
Engineering Drive 2, Singapore 117579

Program Schedule

25th February (Thu) 2021

TIME	EVENT	DESCRIPTION
09:20 – 09: 30 AM	Opening	**E3-06-09**
09:30 – 11:45 AM	Technical Session	**E3-06-09**
11:45 – 12:00 AM	Award Announcement	**E3-06-09**

Instructions for Participants

Due to the spread of Covid-19, all participants should follow the following safety measures:

(1) Safe Distancing
(2) No mingling around in group of 8
(3) Contact Tracing conducted (use 2nd attachment)
(4) Temperature taken, green pass for NUS graduate students and staff
(5) Safe Entry for Non-NUS staff or students (use 3rd attachment)
(6) Anyone who is sick should not turn up for this activity.
(7) Changing seats during symposium is not allowed.

TECHNICAL SESSIONS

	Presenters	Topics
1	**Luo Haorui** 09:30 – 09:45 AM	A Resonance Based Method for the Extraction of Series Inductance in GaAs Schottky Diode
2	**Zhang Bo** 09:45 – 10:00 AM	Control of the Radiation Pattern Roundness of a Monopole Antenna Placed Off-center by Modulating Surface Wave
3	**Zeng Qihang** 10:00 – 10:15 AM	Wireless Propagation and Radiation Control using Wearable Metamaterial Textiles
4	**Zhou Yulong** 10:15 – 10:30 AM	Improved DL Scheme for Solving 2D Inverse Scattering Problems
5	**Li Huagen** 10:30 – 10:45 AM	Tunable Analog Thermal Metadevice
6	**Zhang Jingyuan** 10:45 – 11:00 AM	Doherty Power Amplifier MMIC Design
7	**Li Chenhui** 11:00 – 11:15 AM	Loss-induced stochastic resonance in nonlinear PT symmetric system
8	**Yan Xu** 11:15 – 11:30 AM	Analysis and Design of Ultra-wideband Distributed Power Amplifier
9	**Xu Ruolei** 11:30 – 11:45 AM	A Compact Beamsteering Metasurface Lens Array Antenna With Low-cost Phased Array

Instructions for Speakers

(1) For each presentation slot: 15 minutes (12 minutes for presentation and 3 minutes for Q&A).

The chair will give you a reminder at 2 minutes before the presentation time ends.

(2) Your presentation will be followed by Question & Answer (Q&A) session. The length of your Q&A session will be determined by the chair, depending on the progress of the presentations in the session. Generally, the Q&A session for each paper will not exceed 3 minutes.

(3) You may find your presentation section, date & time in the Program Book.

(4) Please prepare your presentation materials for the online presentation. We prefer using Microsoft PowerPoint or Adobe Acrobat as the presentation tool. Collection of presentation materials is needed.

(5) Presenters should wear face shields in addition to face masks.

A Resonance Based Method for the Extraction of Series Inductance in GaAs Schottky Diode

PRESENTER: **Luo Haorui**

Abstract:

The series inductance can significantly influence the RF performance of gallium arsenide (GaAs) Schottky diode. In this report, a novel extraction method for series inductance (Lf) in the Schottky diodes based on the resonance will be introduced, which can easily and analytically extract Lf without the need for complicated iteration algorithms. This method shows good accuracy under different biases. Good agreement between simulation and measurement proves its validity and potential for the construction of the Schottky diode models.

Improving Radiation Pattern Roundness of a Monopole Antenna Placed Off-center by Modulating Surface Wave

PRESENTER: **Zhang Bo**

Abstract:

The radiation pattern of a quarter-wavelength monopole antenna placed off-center above a square ground plane is seriously distorted due to asymmetric discontinuity encountered at the edge of the ground plane. A modulated impedance surface on the ground plane to control the surface wave and the radiation pattern of the leaky wave is introduced to localize most currents with an enforced circular symmetric discontinuity. The simulated results show roundness improvements for the upper half space.

Wireless Propagation and Radiation Control using Wearable Metamaterial Textiles

PRESENTER: **Zeng Qihang**

Abstract:

Radio-frequency technologies are crucial for wirelessly connected wearable devices, but their performance is hindered by obstruction of wireless signal waves propagation by the human body. Clothing integrated with spoof plasmonic metamaterial structures is demonstrated to overcome this obstruction by inducing propagation of coupled wireless signals around the surface of the body and radiation into the surrounding space in all directions.

Improved DL Scheme for Solving 2D Inverse Scattering Problems

PRESENTER: **Zhou Yulong**

Abstract:

Reconstructing the exact electromagnetic property of unknown targets from the measured scattered field is challenging due to the intrinsic nonlinearity and ill-posedness. A new scheme, named the modified contrast scheme (MCS), is firstly proposed to reconstruct two-dimensional (2D) target objects with high contrast. Numerical and experimental results show that MCS with the modified contrast input performs well in 2D testing examples in real time after offline training process, even in high relative permittivity cases.

Tunable Analog Thermal Metadevice

PRESENTER: **Li Huagen**

Abstract:

Naturally-occurring thermal materials usually possess specific thermal conductivity (κ), forming a digital set of κ values. Emerging thermal metamaterials have been deployed to realize effective thermal conductivities unattainable in natural materials. However, the effective thermal conductivities of such mixing-based thermal metamaterials are still in digital fashion, i.e., the effective conductivity remains discrete and static. Here, we report an analog thermal material whose effective conductivity can be in-situ tuned from near-zero to near-infinity κ. The proof-of-concept scheme consists of a spinning core made of uncured polydimethylsiloxane (PDMS) and fixed bilayer rings made of silicone grease and steel. Thanks to the spinning PDMS and its induced convective effects, we can mold the heat flow robustly with continuously changing and anisotropic κ. Our work enables a single functional thermal material to meet the challenging demands of flexible thermal manipulation. It also provides platforms to investigate heat transfer in systems with moving components.

Doherty Power Amplifier MMIC Design

PRESENTER: **Zhang Jingyuan**

Abstract:

To deal with high data and video traffic transmission within a limited bandwidth, more complex modulation schemes, where the modulated signal will have a high signal envelope that increases the peak to average power ratio (PAPR), need to be applied. With simple amplifiers, there is inevitably a trade-off between high efficiency and linearity. So, to keep the linearity requirements of any communications standard, the amplifier device has to be backed off from the saturation point (most efficient point) due to high PAPR, into a region where most of the average input signal occurs, because at this region, the efficiency of the amplifier drops sharply.

The most straightforward technique of obtaining good efficiency and linearity concurrently is the Doherty amplifier, where neither signal processing blocks nor additional controlling circuits are needed.

In this presentation, the basics of Doherty PA, design approach, and other relative techniques will be covered.

Loss-induced stochastic resonance in nonlinear PT symmetric system

PRESENTER: **Li Chenhui**

Abstract:

Loss and noise are often unwanted in physical systems and have affected many real-life applications. In PT symmetric systems, adding loss into the system has revealed many counterintuitive features such as single-mode lasing and enhanced sensitivity, while the problem of intrinsic noise in these systems remains much debating recently. Here, we propose loss-induced stochastic resonance (SR) by adding noise and tuning loss to suppress noise in nonlinear PT symmetric system. By switching the system from broken-PT phase to exact-PT phase, we observe the phase transition from the phase without stochastic resonance (non-SR phase) to the phase with stochastic resonance (SR phase). We experimentally show the loss-induced stochastic resonance in two-level system of two wirelessly coupled resonant circuit. Our studies show the beneficial effect of loss and noise，and may provide a new design in electronic and photonic system for sensitive signal detection and robust energy transfer.

Analysis and Design of Ultra-wideband Distributed Power Amplifier

PRESENTER: **Yan Xu**

Abstract:

From the last decade, there is a rapidly increasing need for ultra-wideband applications to develop novel wireless communication systems such as imaging, sensing, instrumentation, and radars. Therefore, both academia and industry invest a lot in the design and implementation for HPA MMICs to cover multi-octave. Meanwhile, to meet the requirements of long battery life, high PAE, and low power consumption are also strongly demanded. To achieve such PA circuit with good overall performance, distributed amplifier (DA) architecture can be a good candidate. In this talk, I will mainly talk about the basic knowledge, design method, and implementation of DA structures. By analyzing the common techniques of DA such as stacked or tapering topology, a full picture of designing a DPA circuit will be given.

A Compact Beamsteering Metasurface Lens Array Antenna With Low-cost Phased Array

PRESENTER: **Xu Ruolei**

Abstract:

A metasurface (MTS) lens array (MLA) fed by a phased array with less phase shifters (PSs) is proposed for compact low-cost beamsteering applications. By dividing a single-large-aperture lens into *N* small-aperture lens elements with the focus-to-diameter ratio of a lens antenna unchanged, the overall thickness of the proposed antenna is reduced by *N* times. The beamsteering is achieved in two steps. First, the main beam direction of MLA antenna is switched over a large angular step by shifting the feeding antennas beneath each lens element. Then, the switched beams are fine steered by a low-cost *N*-element phased array. Theoretical analysis using array theory is performed to work out a general design method with discussion on the taper and spillover effect of feed-power pattern on the lens array. Based on the proposed method, a three-lens linear MLA fed by a phased array is designed to operate at 10 GHz. The proposed antenna achieves the 3-dB beamwidth coverage range of ±30° with a beam crossing-level higher than −3 dB and a gain tolerance of 1.6 dB with a maximum gain of 19.1 dBi. The presented antenna can be used to achieve volumetric beamsteering performance directly. The proposed design features the merits of higher gain, lower cost, simpler feeding network, less phase shifters, and lower profile compared with conventional full phased arrays and single-aperture lens antennas.