2019 Asian Wireless Power Transfer Workshop (AWPT2019)

Technical Program

AWPT2019

October 31- November 2, 2019
Xidian University
Xi'an, China

2019 Asian Wireless Power Transfer Workshop (AWPT 2019) Program at a Glance

October 30 (Wednesday)	14:00 - 20:00	AWPT 2019 Registration (Lobby, Long March International Hotel)	
October 31 (Thursday)	08:30 - 09:00	Opening Ceremony and Photo Session (Xidian University South Campus)	
	09:00 - 09:45	Keynote Speech 1	"The Updated SSPS-OMEGA Design Project and the Latest Development of China" Baoyan Duan (Xidian University)
	09:45 - 10:10	Invited Talk 1	"Cut-off Parallel Plate Waveguide for Near-field Wireless Power Transfer" Qiang Chen (Tohoku University)
	10:10 – 10:25	Tea Break	
	10:25 – 10:50	Invited Talk 2	"Towards Automated Rectifier Synthesis: An Improved Rectification Model" Yongxin Guo (National University of Singapore)
	10:50 – 11:15	Invited Talk 3	"RF Input Impedance Formula on Single-Series Diode Rectifier Featuring Flow-Angle Equation" Shinji Abe (Toyohashi University of Technology)
	11:15–11:40	Invited Talk4	"Wireless Power Harvesting and Transfer -Progress and Challenge-" Zhizhang Chen (Fuzhou University / Dalhousie University)
	11:40 – 13:30	Lunch	
	13:30 – 14:15	Keynote Speech 2	"Ambient Energy Harvesting for Wireless Internet of Things and Smart Environment" Ke Wu (University of Montreal)
	14:15 – 14:40	Invited Talk 5	"Boundary of the Near and Far Field Region of Large-Scale Array Antenna" Qiaowei Yuan (National Institute of Technology, Sendai College)
	14:40 – 14:55	Tea Break	
	14:55 – 15:20	Invited Talk 6	"Polarization Agile Active Integrated Antenna and Its Application to Wireless Power Transfer" Ichihiko Toyoda (Saga University)
	15:20 – 15:45	Invited Talk 7	"Retro-reflective Beamforming for Wireless Power Transmission from Satellite to Earth" Xin Wang (Nanjing University of Aeronautics and Astronautics)
	15:45 – 16:10	Invited Talk 8	"A Study on Near Field of Printed Antennas for Wireless Power Transfer" Takafumi Fujimoto (Nagasaki University)
	16:10 – 16:30	Tea Break	
	16:30 – 18:00	Poster Session 1 and Best Student Contest 1 (TP-01~TP-24)	
	18:00 – 19:30	Dinner	
November 01 (Friday)	09:00 - 09:45	Keynote Speech 3	"Recent Standardization of Microwave Power Transfer" Naoki Shinohara (Kyoto University)
	09:45 - 10:10	Invited Talk 9	"A Microwave High Power Rectifier Using GaAs pHENT Schottky Diode" Fei Cheng and Kama Huang (Sichuan University)
	10:10 – 10:25	Tea Break	
	10:25 – 10:50	Invited Talk 10	"A Novel Transmission Line Technique to Realize Broadband Rectenna for WEH and WPT Applications" Yi Huang (University of Liverpool)
	10:50 – 11:15	Invited Talk 11	"Underwater WPT and Cavity Resonance Enabled WPT Focusing on Capacitive Coupling" Masaya Tamura (Toyohashi University of Technology)
	11:15 – 11:40	Invited Talk 12	"Rectifier Design with High Efficiency/Wide Dynamic Range for WPT-- From Chip to Circuit Level Design" Xiuyin Zhang (South China University of Technology)
	11:40 – 13:30	Lunch	
	13:30 – 15:00	Poster Session 2 and Best Student Contest 2 (FP-01~FP-25)	
	15:00 – 15:15	Tea Break	
	15:15 – 15:40	Invited Talk 13	"Near-ideal GaN Schottky Barrier Diode for High-power and High-efficiency Wireless Power Transfer Application" Hong Zhou (Xidian University)
	15:40 – 16:05	Invited Talk 14	"Compact and High Efficiency Wireless Power Transfer System through Biological Tissues for Implant Sensors and Biomedical Implants " Ramesh K. Pokharel (Kyushu University)
	16:05 – 16:30	Invited Talk 15	"Recent Advances of Microwave Rectennas for the SSPS" Changjun Liu (Sichuan University)
	16:30 – 16:45	Tea Break	
	16:45 – 17:10	Invited Talk 16	"Complex Impedance Matching Filtering Antenna for Rectenna in MPT" Yazhou Dong (CAST-Xi'an Institute of Space Radio Technology)
	17:10 – 17:35	Invited Talk 17	"Laser Wireless Power Transmission Technology for UAVs" Dele Shi (CAST-Shandong Institute of Space Electronic Technology)
	17:35 – 18:00	Invited Talk 18	"High Power Microwave Energy Transmission" Huaiqing Zhang (Chongqing University)
	18:30 – 20:30	Banquet and Awards	
November 02 (Saturday)	09:00 - 09:25	Invited Talk 19	"Simulated Limitations on Rectification Efficiency of 5.8 GHz Band Bridge Rectifiers" Naoki Sakai (Kanazawa Institute of Technology)
	09:25 - 09:50	Invited Talk 20	"Illustration of Energy Flows in IPT Systems with Multiple Transmitters and/or Multiple Receivers" Quang-Thang Duong (Nara Institute of Science and Technology)
	09:50 – 10:15	Invited Talk 21	"Metasurfaces for Harvesting Electromagnetic Energy" Xuexia Yang (Shanghai University)
	10:15 – 10:30	Tea Break	
	10:30 – 10:55	Invited Talk 22	" Wavefront Regulation for Microwave Power Transmission" Long Xiao (China Ship Development and Design Center)
	10:55 – 11:20	Invited Talk 23	"Efficiency Enhancement Technology of Electromagnetic Power Transmission in Space" Xianqi Lin (University of Electronic Science and Technology of China)
	11:20 – 11:45	Invited Talk 24	"Wireless Power Interface for Launch Vehicles: Technical Challenges and Applications" Kai Xie (Xidian University)
	11:45 – 13:30	Lunch	

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Xi'an, China

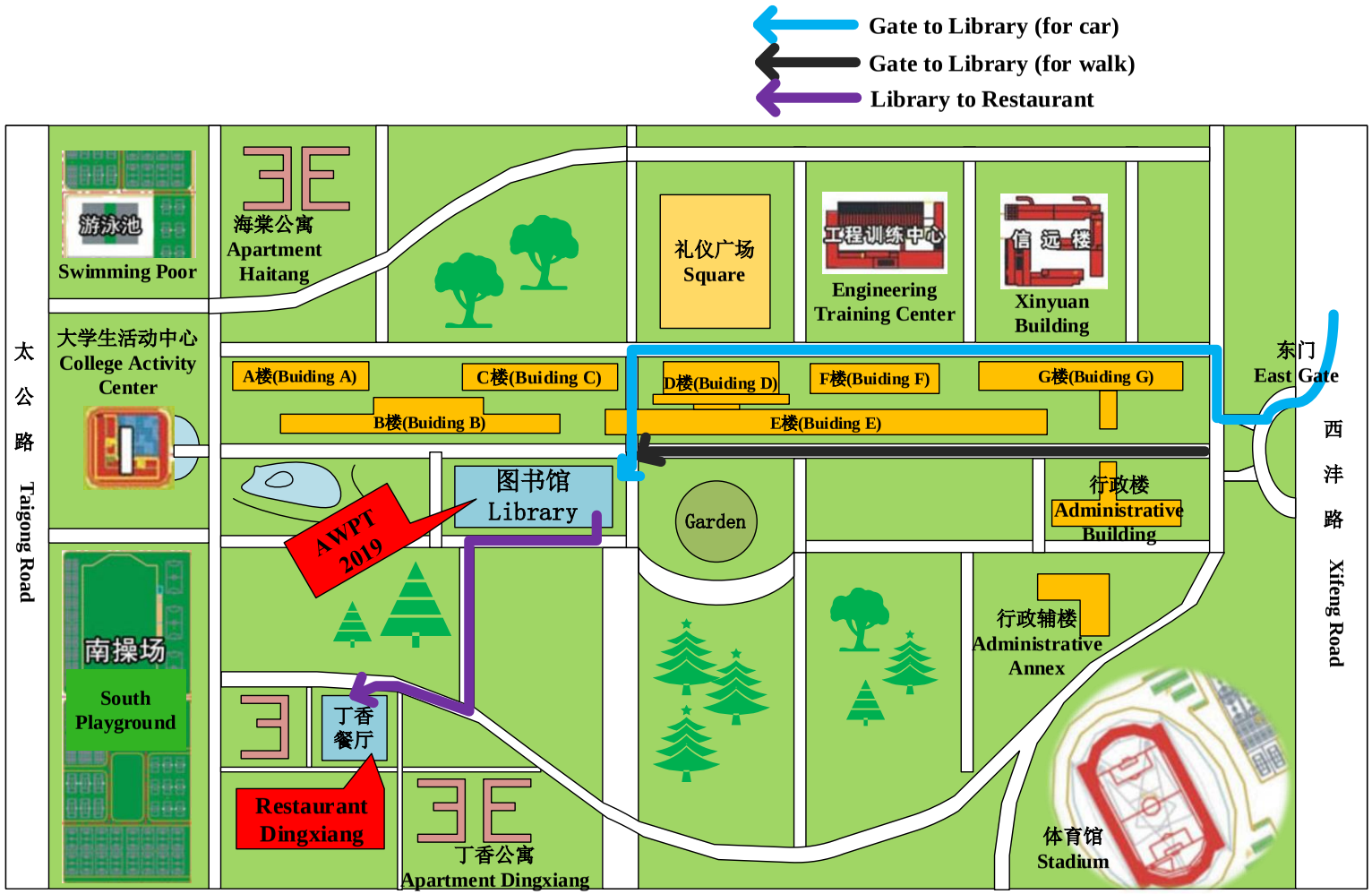
西安電子科技大學
XIDIAN UNIVERSITY

IEICE
Communications
Society

IEEE
XI'AN 西安

钱学森实验室
Qian Xuesen Laboratory, CAST

Map of a Part of Xidian University South Campus



AWPT 2019 Sponsorships

Co-Organizers

Xidian University

The Technical Committee on Wireless Power Transfer of IEICE Communication Society

The MTT and AP Chapters of IEEE Xi'an Section

Qian Xuesen Space Technology Laboratory, CAST, China

China Promotion Committee for Space Solar Power Station (SSPS)

Sponsors

Key Laboratory of High-Speed Circuit Design and EMC, Ministry of Education

Wireless Power Transfer Consortium for Practical Applications (WiPoT)

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GD Midea Small Domestic Appliances Division

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Welcome Message from the General Co-Chairs

On behalf of the organizing committee, and with great pleasure, we cordially invite you to attend the 2019 Asian Wireless Power Transfer Workshop (AWPT 2019) in Xi'an, which is the fifth of the consecutive series inaugurated in Taiwan, China in 2015 and held in Chengdu, China in 2016 and in Singapore in 2017 and Sendai, Japan in 2018. AWPT 2019 will offer a rich scientific program of the highest quality with keynote and invited speakers from all over the world and provide a broad forum of exchange for the progress and advancements of wireless power technologies in consumable, biomedical and industrial applications.

The AWPT 2019 is organized by Xidian University and technically co-organized by IEICE communication society, IEEE Xi'an Section, Qian Xuesen Space Technology Laboratory, CAST, China, and China Promotion Committee for Space Solar Power Station (SSPS). This workshop received a total submission of 75 submissions, among which there are 24 excellent invited talks. In addition, we are honored to have three renowned experts as keynote speakers. The technical program committee is very pleased with the high quality of the submissions. Besides, we would like to take this opportunity to express our sincere appreciation to the leading scientists, organizers and all contributors for their great help and valuable supports to AWPT 2019. Many thanks also to the Technical Program Committee, the Organizing Committee and the International Steering Committee as well as the sponsors and the technical sponsors for their efforts to bring all the participants an excellent technical program and an opportunity to spend a pleasant time at the conference.

Moreover, the IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology (J-ERM), sponsored by IEEE MTT-S, APS, and EMBS societies, will publish a special Issue devoted to the 2019 Asian Wireless Power Transfer Workshop (AWPT2019). The presentations of this conference will be accessible to a wider range of readers and will have continual impact to this research field.

Xi'an is one of the Four Great Ancient Capitals of China for it has been the capital of 13 dynasties, including the Zhou, Qin, Han, and the Tang. Xi'an is also renowned for being the eastern terminus of the Silk Road and for the location of the Terracotta Army from Qin Dynasty. We hope all of attendees an enjoyable and memorable stay in Xi'an, China.

Prof. Long Li

Xidian University

General Co-Chair

Prof. Masaharu Takahashi

Chiba University

General Co-Chair

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Takafumi Fujimoto (Nagasaki University, Japan)

Zhizhang Chen (Fuzhou University / Dalhousie University, Canada)

Qiang Chen (Tohoku University, Japan)

Yongxin Guo (National University of Singapore, Singapore)

Qiaowei Yuan (National Institute of Technology, Sendai College, Japan)

Yi Huang (University of Liverpool, UK)

Naoki Shinohara (Kyoto University, Japan)

Xianqi Lin (University of Electronic Science and Technology of China, China)

Naoki Sakai (Kanazawa Institute of Technology, Japan)

Huiqing Zhai (Xidian University, China)

Akio Wakejima (Nagoya Institute of Technology, Japan)

Conference Site and Office Location

2019 Asian Wireless Power Transfer Workshop (AWPT 2019) will be held on October 31–November 02, 2019 at 4th Floor, Library of Xidian University South Compus, 266 Xinglong Section of Xifeng Road, Xi'an, Shaanxi 710126.

Registration

The 2019 Asian Wireless Power Transfer Workshop (AWPT 2019) Registration begins at 14:00 on October 30, 2019. The registration will be open at lobby, Long March International Hotel. The on-site registration fee is shown in the following table. The on-site student registration requires a valid student ID. If you have pre-registered, your name badge and Technical Program will be ready for you to pick up at the registration desk during the conference. Please wear your name badge throughout the conference. Access will be prohibited to the exhibition, tea break, interactive areas, and technical sessions if a name badge is not visible.

On-site Registration Fee		
	Attendees from P. R. China	Other Attendees
Regular	2,000 CNY	30,000 JPY
Student	1,000 CNY	15,000 JPY

Projection Facilities

Standard LCD projector (connected to a local PC) will be provided in the conference room. The aspect ratio of the screen is **4: 3**.

Guidelines for Presentations

INFORMATION FOR CANDIDATES OF BEST STUDENT PAPERS CONTEST

The Best Student Paper Contest is **Poster Sessions** scheduled during 16:30 – 18:00 pm, October 31 and 13:30 – 15:00 pm, November 01 at 4th Floor, Library of Xidian University South Campus. The awards committee will select the final winners according to the paper quality and the author's presentation. No show means the authors withdraw their papers from the contest.

INFORMATION FOR POSTER SESSION PRESENTATIONS

Presenters are required to put up their papers 15 minutes prior to the beginning of their session. During this time, the presenter must stand by the display board to answer questions and discuss about the contents of the poster informally. The poster display should include a statement of the topic, objectives of the research or project, the methodology used to solve

the problem or implement the program, the major findings or outcomes and their significance and conclusions. There should be a logical sequence ---- introduction, development and conclusion---of your display.

A heading should be prepared for your presentation using lettering at least 3cm high. The heading should include the title of the poster, all author names and institutional affiliations.

One poster board is provided for each presentation, which is **1.2 meter high by 0.8 meter wide**. The background color of the board is usually beige or white. Pins or tapes are provided by conference committee to mount your posters on the boards. All materials to be displayed should be prepared before your arrival. Supplies will not be available at the conference site.

General Information

CONFERENCE VENUE

4th Floor, Library of Xidian University South Campus
Address: 266 Xinglong Section of Xifeng Road, Xi'an, Shaanxi 710126



TRANSPORTATION

The shuttle bus service between the hotel (Long March International Hotel) to the Venue (Library of Xidian University South Campus) is provided. The distance between the hotel and the venue is about 7 km.

Long March International Hotel is located at No.1 Western Avenue, High-Tech Industrial Development Zone, Xi'an, which is about 40 km from Xianyang International Airport, 19 km from Xi'an Railway Station and 44 km from Xi'an North High Speed Railway Station.

Tel: +86-29-89188918
For more details of hotel, please visit: http://www.longmarchhotel.com/

- **Xianyang International Airport to Long March International Hotel**

1. **By Taxi**
   You may take taxi to get to Long March International Hotel.

Fare: about 105 (RMB)

Time: about 1 hour

2. By Bus

You may take airport bus to get to Long March International Hotel.

Fare: 27 (RMB)

Time: about 1 hour 50 minutes

➢ **Xi'an Railway Station to Long March International Hotel**

1. By Taxi

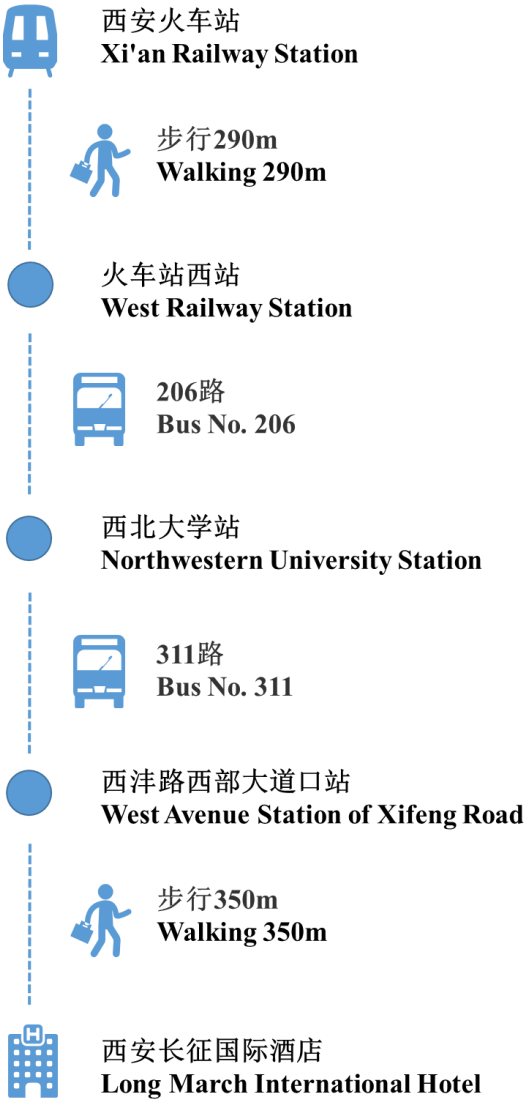
You may take taxi to get to Long March International Hotel.

Fare: about 42 (RMB)

Time: about 45 minutes

2. By Bus

You may take bus to get to Long March International Hotel.



Fare: 4 (RMB)

Time: about 1hour 15 minutes

➢ **Xi'an North High Speed Railway Station to Long March International Hotel**

1. By Taxi

You may take taxi to get to Long March International Hotel.

Fare: about 70 (RMB)

Time: about 45 minutes

2. By Metro

You may take metro to get to Long March International Hotel.

Fare: 8 (RMB)
Time: about 1hour 25 minutes

ABOUT XI'AN

Xi'an is the capital of Shaanxi Province. Xi'an was once called "Chang'an" in the Han Dynasty. The connotation of this name is "permanent peace". Xi'an is one of the Four Great

Ancient Capitals of China for it has been the capital of 13 dynasties, including the Zhou, Qin, Han, and the Tang. Xi’an is also renowned for being the eastern terminus of the Silk Road and for the location of the Terracotta Army from Qin Dynasty. Xi’an was regarded as one of the "Four Ancient Civilizations of the World", the other three being Rome, Athens, and Istanbul.

Tour Options

Terra-cotta Warriors and Horses Museum Terracotta warriors and horses is the only imperial tombs from the mass grave, located on the eastern side of Qin Shi Huang Mausoleum of about 1 kilometer and a half, was found in 1974, is one of the most important archaeological discoveries, this 16,300-square-meter excavation reveals more than 7,000 life-size terracotta figures of warriors and horses arranged in battle formations. (3 pits) The terracotta warriors and horses, created about 2,200 years ago, were found in 1974 on the east side of the tomb of the First Emperor Qin Shihuang (259 BC - 210 BC) near Xi'an.

Big Wild Goose Pagoda As the symbol of the old-line Xian, Big Wild Goose Pagoda is a well preserved ancient building and a holy place for Buddhists. It is located in the southern suburb of Xian City, about 4 kilometers (2.49 miles) from the downtown of the city. Standing in the Da Ci'en Temple complex, it attracts numerous visitors for its fame in the Buddhist religion, its simple but appealing style of construction, and its new square in front of the temple. It is rated as a National Key Cultural Relic Preserve as well as an AAAAA Tourist Attraction.

LANGUAGE

The official language for the Conference is English. However, in the public society, Chinese Mandarin is commonly spoken in Xi'an.

VISA

Each person from abroad, who wants to enter the Chinese Customs, needs to hold a visa issued by Chinese Embassy or Consulate. It should be submitted to the Chinese Embassy in your country for you to apply for the visa. You can also apply for a visa type of common tourist, which is convenient to be issued without the requisition form and valid for 30 days.

CURRENCY AND CREDIT CARDS

China's currency is RMB with its monetary unit RMB Yuan. The exchange rate is about 1 RMB for 15 JPY.

TAX AND TIP

All the shopping is free of tax. Be sure to make big bargaining when buy merchandise from the Street Market. Tipping is by no means a traditional Chinese custom. Please help keep the good customs and do not tip a waiter/waitress or a taxi driver and other person who provides regular services.

OPENING HOURS

Bank and Post Office Opening hours: 9:00 a.m. to 5:00 p.m., from Monday to Sunday.
Government Office Opening hours: 8:00 a.m. to 5:00 p.m., from Monday to Friday.
Store Opening hours: 9:00 a.m. to 8:00 p.m., but the large shopping center serves till 10:00 p.m., from Monday to Sunday.

ELECTRICITY

In China, the standard outlets provide AC of 220 V/50 Hz.

TAXI

Usually, a taxi is available along the roadsides, while you wave for it. However, at main

streets it is only available at taxi stops or in front of a hotel.

INTERNET ACCESS

There is WLAN with internet access in the conference venue.

Keynote Speech 1

October 31 (Thursday), 09:00 – 09:45

The Updated SSPS-OMEGA Design Project and the Latest Development of China

Baoyan Duan
Research Institute on Mechatronics, Xidian University
Academician of Chinese Academy of Engineering
President of Xidian University from April 2002 to July 2012
Chairman of the Antenna Industry Alliance of China
Chairman of Electromechanical Engineering Society of China
E-mail: byduan@xidian.edu.cn

Abstract of the talk

Energy is the material base of mankind existence and society development. Facing with such critical problems as energy exhaustion, ecological destruction and environmental deterioration that threaten human existence, the proposal of space solar power station can effectively solve the energy problem of mankind in the future.

Space solar power station is an electric power system that collects and converts solar energy into electricity in space and then transmits it back to the ground through wireless energy transmission device, which can provide abundant and reliable clean energy for human beings.

Through contrastive analysis of several international SSPS schemes, in 2014, we proposed a concentrator scheme based on the spherical line focusing principle -OMEGA space solar power station scheme. The system, compared with the ALPHA program propesde by USA, can effectively lost 24 percent of system weight when generates electricity with the same power.

This is a report on some recent progress of the OMEGA. For the problem of maximizing the BCEs and yielding beam intensity distributions across the rectenna aperture, a kind of aperture amplitude distribution is presented to obtain flat beam patterns in the far field.

Aiming at SSPS, a large-scale and multi-system space project, we established the cooperative equations of the three subsystems for the orderly operation, function coordination and low cost of the system, which includes the condenser, the photoelectric conversion and transmission, and the transmitting antenna.

Then, we proposes the dynamic model of assembly process of SSPS. On this basis, a new technology based on mechanical meta-materials and permanent magnets is proposed for vibration reduction/isolation with medium and low frequency. Meanwhile, a locking and docking technology based on composite (SMPC+ mechanical components) is presented.

At the end of the report, the future development direction of SSPS is forecastred.

Biography of the speaker

Prof. Baoyan Duan, male, Chinese, born in March of 1955, received the B.S., M.S. and Ph.D. degrees of Mechanical Engineering from Xidian University, Xi'an, China, in 1981, 1984, and 1989 respectively. From 1991 to 1994, he studied as Postdoctoral Fellow at Liverpool University, U.K. He was a Visiting Scientist at Cornell University, Ithaca, NY, in 2000. He is currently a full Professor in the School of Electromechanical Engineering at Xidian University where he founded Research Institute on Mechatronics about electronic equipment design. His current research interests include electromechanical coupling theory and application (EMCTA), mechatronics and engineering structural optimization. He has published 6 books and authored or coauthored over 200 papers and 40 patents. He was invited to give more than 20 keynote speeches at int. conferences and symposia.

He is a Fellow of IET and Chinese Institute of Electronics (CIE), Members of Int. Association for Computational Mechanics (IACM) and Int. Society for Structural and Multidisciplinary Optimization (ISSMO). He is the chief editor of Electromechanical Engineering Journal in Chinese.

He has received, as the first contributor, the 2nd prize of national award for science and technology progress of China three times (2004, 2008 and 2013). In 2012, he was issued Hong Kang HLHL prize of science and technology progress. In 2016, CCTV (Chinese Central TeleVision station) produced and broadcasted a special video program titled with DUAN Baoyan: Minor discipline and Great Vision http://v.qq.com/x/page/i08412h2chd.html. In 2017, He was, owing to the contribution on FAST design and engineering, issued Golden Prize of Chinese Good Design and Outstanding contribution prize of Chinese Academy of Science. In 2018, He received Fellow Award of Asian Society for Structural and Multidisciplinary Optimization.

Keynote Speech 2

October 31 (Thursday), 13:30 – 14:15

Ambient Energy Harvesting for Wireless Internet of Things and Smart Environment

Ke Wu
Professor, FIEEE, FCAE and FRSC
2016 President of IEEE Microwave Theory and Techniques Society (MTT-S)
Faculty of Information Science and Engineering, Ningbo University
NSERC-Huawei Industrial Research Chair in Future Wireless Technologies
Poly-Grames Research Center, Department of Electrical Engineering Ecole Polytechnique
E-mail: ke.wu@ieee.org

Abstract of the talk

The dynamic evolution and chronological progress of device technologies, energy conversion and recycling techniques and related breakthroughs are reviewed with emphasis on low-density electromagnetic energy harvesting technologies for IoT systems and smart environments. Ambient radiofrequency (RF) energy sources are examined in connection with omnipresent wireless system deployment. The effective use and recycling of such an ambient energy are the most relevant and critical issue for the current and future practicability of wireless energy harvesting in support of emerging sensing hardware. In this talk, a set of performance criteria and development considerations required to meet the IoT needs for ambient energy harvesting is derived. A technological outlook of the performances that can be expected from different device technologies is assessed. Promising devices and emerging solutions in the development of ambient energy harvesters are also presented and discussed with focus on our proposed disruptive schemes, which include hybrid energy harvesting approaches, cooperative system design platforms.

Biography of the speaker

Dr. Ke Wu is Professor of Electrical Engineering at Polytechnique Montreal (University of Montreal). He holds the NSERC-Huawei Industrial Research Chair in Future Wireless Technologies (the first Huawei-endowed Chair in the world). He has been the Director of the Poly-Grames Research Center. He was the Canada Research Chair (2002-2016) in RF and millimeter-wave engineering and the Founding Director (2008-2014) of the Center for Radiofrequency Electronics Research of Quebec. Dr. Wu is also with the School of Information Science and Engineering, Ningbo University, on leave from his home institution, leading a special 5G and future wireless research program. He has authored/co-authored over 1300 referred papers, and a number of books/book chapters and more than 50 patents. Dr. Wu was the general chair of

the 2012 IEEE MTT-S International Microwave Symposium (the largest IEEE annual conference). He was the 2016 President of the IEEE Microwave Theory and Techniques Society (MTT-S). He also serves as the inaugural North-American representative in the General Assembly of the European Microwave Association (EuMA). He was the recipient of many awards and prizes including the inaugural IEEE MTT-S Outstanding Young Engineer Award, the 2004 Fessenden Medal of the IEEE Canada, the 2009 Thomas W. Eadie Medal from the Royal Society of Canada (The Academies of Arts, Humanities and Sciences of Canada), the Queen Elizabeth II Diamond Jubilee Medal, the 2013 Award of Merit of Federation of Chinese Canadian Professionals, the 2014 IEEE MTT-S Microwave Application Award, the 2014 Marie-Victorin Prize (Prix du Québec – the highest distinction of Québec in the Natural Sciences and Engineering), the 2015 Prixd' Excellence en Recherche et Innovation of Polytechnique Montréal, the 2015 IEEE Montreal Section Gold Medal of Achievement and the 2019 IEEE MTT-S Microwave Prize. He is a Fellow of the IEEE, a Fellow of the Canadian Academy of Engineering (CAE) and a Fellow of the Royal Society of Canada. He was an IEEE MTT-S Distinguished Microwave Lecturer from Jan. 2009 to Dec. 2011.

Keynote Speech 3

November 01 (Friday), 09:00 – 09:45

Recent Standardization of Microwave Power Transfer

Naoki Shinohara
Professor, Kyoto University
E-mail: shino@rish.kyoto-u.ac.jp

Abstract of the talk

A Microwave Power Transfer (MPT) system is started to commercialize in the world as battery-less IoT sensors, wireless charger for mobiles, and beam MPT to flying drone, etc. Recently in International Telecommunication Union (ITU), International Electrotechnical Commission (IEC) and each domestic ministry, there are hot discussion to make new standard of the MPT. In this talk, based on recent R&D results of the MPT, the recent discussion of the standardization of the MPT is shown.

Biography of the speaker

Prof. Naoki Shinohara received the B.E. degree in electronic engineering, the M.E. and Ph.D (Eng.) degrees in electrical engineering from Kyoto University, Japan, in 1991, 1993 and 1996, respectively. He was a research associate in Kyoto University from 1996. From 2010, he has been a professor in Kyoto University. He has been engaged in research on Solar Power Station/Satellite and Microwave Power Transmission system. He was IEEE MTT-S Distinguish Microwave Lecturer (2016-18), and is IEEE MTT-S Technical Committee 26 (Wireless Power Transfer and Conversion) chair, IEEE MTT-S Kansai Chapter TPC member, IEEE Wireless Power Transfer Conference founder and advisory committee member, URSI commission D vice chair, international journal of Wireless Power Transfer (Cambridge Press) executive editor, the first chair and technical committee member on IEICE Wireless Power Transfer, Japan Society of Electromagnetic Wave Energy Applications president, Space Solar Power Systems Society board member, Wireless Power Transfer Consortium for Practical Applications (WiPoT) chair, and Wireless Power Management Consortium (WPMc) chair. His books are “Wireless Power Transfer via Radiowaves” (ISTE Ltd. and John Wiley & Sons, Inc., “Recent Wireless Power Transfer Technologies Via Radio Waves (ed.)” (River Publishers), and “Wireless Power Transfer: Theory, Technology, and Applications (ed.)” (IET), and some Japanese text books of WPT.

Invited Talk 1

October 31 (Thursday), 09:45 – 10:10

Cut-off Parallel Plate Waveguide for Near-field Wireless Power Transfer

Qiang Chen
Graduate School of Engineering, Tohoku University
Aramaki Aza Aoba 6-6-05, Aoba-ku, Sendai, Japan
E-mail: chenq@ecei.tohoku.ac.jp

Abstract of the talk

A wireless power transfer (WPT) system using rectangular waveguide with cutoff parallel plate waveguide is proposed. The operating frequency is set to be lower than the cutoff frequency of the parallel plate waveguide (PPW) in order to make the WPT system leakage-free. A rectangular waveguide at the end of a parallel plate waveguide is provided and the operating frequency is set to be higher than the cutoff frequency of the rectangular waveguide in order to extend the coupling length. It is shown numerically that the strong coupling between transmitting antenna and receiving antenna is maintained over a long distance by selecting the operating frequency near to the cutoff frequency of rectangular waveguide with PPW.

Invited Talk 2

October 31 (Thursday), 10:25 – 10:50

Towards Automated Rectifier Synthesis: An Improved Rectification Model

Siping Gao, Yongxin Guo
Department of Electrical and Computer Engineering
National University of Singapore, Singapore 117576
E-mail: yongxin.guo@nus.edu.sg

Abstract of the talk

With the rapid development of 5G and internet of thing, the dense deployment of sensor nodes and heterogenous integration of sensor network become more and more popular. An easy access to power with the least dependence on power storage system (battery) is highly desirable. To address the power hunger of sensor nodes wireless power transfer (WPT) technology emerges. In a WPT system, a rectifier, capable of transforming AC power to its DC form plays an important role. However, people usually design a rectifier by resorting to global optimization methods simply because the rectification process is very complicated. Such a design method is prone to fall into local minima or end up with no solution, neither of which results in an optimal solution. In our work, an automated design methodology for rectifiers is proposed, where an improved rectification model is developed to guide the design. The proposed design methodology is capable of automatically determining all the design parameters with the least engagement of global optimization method. It is very useful to fresh engineers and can be directly integrated into existing EDA tools.

Invited Talk 3

October 31 (Thursday), 10:50 – 11:15

RF Input Impedance Formula on Single-Series Diode Rectifier Featuring Flow-Angle Equation

Shinji Abe
Toyohashi University of Technology
1-1 Hibarigaoka, Tempaku-cho, Toyohashi-shi, Aichi 441-8580 Japan
E-mail: abe@ee.tut.ac.jp

Abstract of the talk

Rectifiers have two functions; one is well-known RF-to-DC power conversion. This is often discussed in system design such as wireless power transfer. Another function is RF-to-DC impedance conversion. This is also important as much as the first one because how its impedance matches the RF power source to be used matters to the power conversion efficiency. However, input impedance characterization of a rectifier is rather complicated due to diode's nonlinear behavior. This lecture reveals theoretical RF input impedance of a single-series diode rectifier. The derived formula is verified with numerical circuit simulation.

Invited Talk 4

October 31 (Thursday), 11:15 – 11:40

Wireless Power Harvesting and Transfer -Progress and Challenge-

Zhizhang Chen
Professor, FIEEE, FCAE and FEIC
Fuzhou University / Dalhousie University
E-mail: zz.chen@ieee.org

Abstract of the talk

Electromagnetics forms the foundation of modern electrical and electronic systems that see the technologies we enjoy and take for granted today. It has been used to transfer information and power in daily lives. In the wireless domain, however, it had not been considered and employed much for power transfer until 2008 when a MIT research team lead by Prof. Marin Soljacic successfully demonstrated the mid-range wireless power. Since then, many efforts and much progress have been made to improve power transfer efficiency, reduce system size and include more functionality; the goal is to cut the last wires in electrical and electronic devices and systems if all possible. In this talk, we will first present the principles of the wireless power harvesting and transfer and then focus on mid-range wireless power transfer and its applications and commercialization. We will present the challenges, progresses, and future directions in the areas.

Invited Talk 5

October 31 (Thursday), 14:15 – 14:40

Boundary of the Near and Far Field Region of Large-Scale Array Antenna

Qiaowei Yuan
National Institute of Technology, Sendai College
4-16-1, Ayashi Chuo Aoba-ku, Sendai, Miyagi, 989-3128, Japan
E-mail: qwyuan@sendai-nct.ac.jp

Abstract of the talk

In this paper, the boundary of the near and far field region of large-scale array antenna will be calculated by using maximum MISO system efficiency and compared with the Fraunhofer distance. The rule of the amplitudes of the far-field components falling off as 1/r is utilized to define the near field and far field region. It will be observed that the proposed approach perhaps can be applied to arbitrary antenna to define the near field region and far field region.

Invited Talk 6

October 31 (Thursday), 14:55 – 15:20

Polarization Agile Active Integrated Antenna and Its Application to Wireless Power Transfer

Ichihiko Toyoda
Saga University
1 Honjo-machi, Honjo, Saga-shi, Saga, 840-8502 Japan
E-mail: toyoda@cc.saga-u.ac.jp,

Abstract of the talk

This invited talk introduces the concept of the active integrated antennas (AIA) developed at Saga University. The AIAs integrate oscillation and polarization switching functions in a simple structure. Even though the AIAs are developed for spatial modulation wireless communication systems, they are also suitable to achieve simple wireless power transfer (WPT) systems as the AIA radiates RF power by just applying a DC voltage to the antenna. A 12-patch array antenna integrating a 4- port Gunn oscillator and two PSK modulators is demonstrated as an example to highlight the advantages of the proposed concept. A new concept of selective WPT systems utilizing the proposed AIA is also discussed.

Invited Talk 7

October 31 (Thursday), 15:20 – 15:45

Retro-reflective Beamforming for Wireless Power Transmission from Satellite to Earth

Xin Wang
College of Electronic and Information Engineering, Nanjing University of Aeronautics and Astronautics
Nanjing, Jiangsu, China
E-mail: wang90@nuaa.edu.cn

Abstract of the talk

Wireless power transmission for Space Solar Power Satellites (SSPS) calls for extremely high accuracy in steering the microwave power beam from the satellite to earth, which can be achieved by employing retro-reflective beamforming technique. In this paper, we present a numerical analysis of the performance of retro-reflective beamforming scheme in the context of SSPS. Effects of some non-ideal factors on the forming and steering of microwave power beam are simulated. A preliminary experimental system emulating microwave power transmission of the SSPS application is constructed to demonstrate the performance of retro-reflective beamforming technique.

Invited Talk 8

October 31 (Thursday), 15:45 – 16:10

A Study on Near Field of Printed Antennas for Wireless Power Transfer

Takafumi Fujimoto
Graduate School of Engineering, Nagasaki University
1-14 Bunkyo, Nagasaki,852-8521 Japan
E-mail: takafumi@nagasaki-u.ac.jp

Abstract of the talk

In this paper, the near field of the printed monopole antenna with a reflector and the microstrip antenna are discussed. In order to investigate the near field, the magnitude of the transmitting coefficient (|S21|) is simulated in the case that the transmitting and receiving antennas are located facing each other. Although the gain of the printed monopole antenna with a reflector is greater than the gain of the microstrip antenna, |S21| of the printed monopole antenna with a reflector is similar to that of the microstrip antenna in the near field. It is clarified that |S21| of the printed monopole antenna can be improved by installing the reflector with side wall.

Invited Talk 9

November 01 (Friday), 09:45 – 10:10

A Microwave High Power Rectifier Using GaAs pHENT Schottky Diode

Fei Cheng and Kama Huang

Key Laboratory of Wireless Power Transmission Ministry of Education, College of Electronics and Information Engineering, Sichuan University
Chengdu, 610065 China

E-mail: kmhuang@scu.edu.cn

Abstract of the talk

In this paper, a microwave high power rectifier using GaAs pHENT Schottky diode is proposed. Series single diode topology is employed in the rectifier design. In order to improve the rectifier power handling ability, 64 fingers are adopted in the designed Schottky diode. The fabricated rectifier working at 5.8 GHz has a maximum RF-to-dc conversion efficiency of 59.59% at an input power level of 26.43 dBm and a 587 Ω load. Moreover, taking advantage of the high power GaAs diode, the measured rectifier power handling ability is more than 37 dBm.

Invited Talk 10

November 01 (Friday), 10:25 – 10:50

A Novel Transmission Line Technique to Realize Broadband Rectenna for WEH and WPT Applications

Yi Huang

Department of Electrical Engineering and Electronics, University of Liverpool
Liverpool, UK
E-mail: Yi.Huang@liverpool.ac.uk

Abstract of the talk

A novel technique to realize broadband rectennas by eliminating lumped elements and complex circuits for impedance matching is introduced. A Smith chart-based optimization makes use of the properties of short and open stubs for implementing broadband rectifier. A simple design procedure is initiated by controlling the impedance at the center frequency in the required band, followed by two steps to make a wideband impedance matching. For validation, a broadband rectifier is designed operating over 1.28-2.55 GHz (FBW = 66%) with conversion efficiency of more than 50% for a 5 dBm input power which is the highest so far under such a condition. Thus, this low complexity design procedure is suitable for realizing broadband rectennas for WEH (wireless energy harvesting) and WPT (wireless power transfer) applications

Invited Talk 11

November 01 (Friday), 10:50 – 11:15

Underwater WPT and Cavity Resonance Enabled WPT Focusing on Capacitive Coupling

Masaya Tamura
Toyohashi University of Technology
1-1 Hibarigaoka, Tempaku-cho, Toyohashi, Aichi, 441-8580 Japan
E-mail: tamura@ee.tut.ac.jp

Abstract of the talk

This paper introduces two topics focusing on Capacitive Coupling: Underwater WPT and Cavity Resonance enabled WPT. In the former case, the pivotal elements that improve the coupling coefficient of the coupler under water are discussed. Then, measured Q-factors of fresh water and seawater are incorporated and a coupler suitable for each environment is designed. In the latter case, the key is to handle the electric field distribution in the cavity and the method of utilizing the reflection probes inserted to the cavity is proposed. The principle is explained by theoretical calculation and experiment. Finally, the improvement in the power transfer efficiency is demonstrated.

Invited Talk 12

November 01 (Friday), 11:15 – 11:40

Rectifier Design with High Efficiency/Wide Dynamic Range for WPT from Chip to Circuit Level Design

Xiuyin Zhang
School of Electronic and Information Engineering, South China University of Technology
Guangzhou, 510641 China
E-mail: zhangxiuyin@scut.edu.cn

Abstract of the talk

Rectifier is the key component of a Wireless Power Transmission system. The optimal power conversion efficiency of a conventional rectifier can only be found at certain input power level. When input power shifts from optimal point, the efficiency drop rapidly. To overcome this, resistance/impedance compression network (RCN/ICN) is introduced in this report. When connected RCN/ICN to the rectifier, the resistance/impedance variation of a rectifier is significantly reduced. The matching performance of the rectifier with RCN/ICN is improved within wide input power range, resulting in efficiency enhancement. Other methods for extending input power dynamic range like power recycling technique are introduced, and a basic view of enhancing the efficiency when designing a rectifier chip is provided.

Invited Talk 13

November 01 (Friday), 15:15 – 15:40

Near-ideal GaN Schottky Barrier Diode for High-power and High-efficiency Wireless Power Transfer Application

Hong Zhou
Xidian University
Shannxi, China
E-mail: hongzhou@xidian.edu.cn

Abstract of the talk

In this work, we present a high performance lateral GaN SBD designed for microwave rectifier, which is the main component of Microwave Wireless Power Transfer. By introducing LPCVD passivation, recessed-anode etch, and low work function metal processes, near ideal GaN diode is achieved, with which a 5.8GHz microwave rectifier is constructed and evaluated.

Invited Talk 14

November 01 (Friday), 15:40– 16:05

Compact and High Efficiency Wireless Power Transfer System through Biological Tissues for Implant Sensors and Biomedical Implants

Ramesh K. Pokharel
Faculty of Information Science and Electrical Engineering, Kyushu University
Fukuoka, 819-0395 Japan
E-mail: pokharel@ed.kyushu-u.jp

Abstract of the talk

In this work, wireless power transfer (WPT) system using coupled defected ground structure (DGS) resonators is proposed as an alternative for the conventional WPT system using coupled printed inductor resonators. The WPT using coupled DGS resonators possesses two advantages over the conventional WPT system. The efficiency of the DGS-based system is higher than that of the inductor-based system. Besides the DGS function as inductive loop, it acts as the system ground plane. In return, the remaining components such as the rectifier can be implemented using the same space. Hence, the overall system has compact size than that of the conventional one.

Invited Talk 15

November 01 (Friday), 16:05 – 16:30

Recent Advances of Microwave Rectennas for the SSPS

Changjun Liu
School of Electronics and Information Engineering, Sichuan University
Chengdu, 610065 China
E-mail: cjliu@scu.edu.cn

Abstract of the talk

Microwave wireless power transmission is a key technique of the space solar power station (SSPS). It has enormous potential applications in stratospheric airships, unmanned aerial vehicles, wireless sensors, and so on. The rectifying antenna (rectenna) is an important component of a microwave power transmission system. A rectenna coverts collected microwave power into DC power. Some novel rectennas in recent years are presented in this paper, including their principles, and measurement results. They have some advantages, such as providing special functions, achieving high efficiency through non-uniform distribution, or thin and light, miniaturization. The design method of a rectenna is briefly discussed as well.

Invited Talk 16

November 01 (Friday), 16:45 – 17:10

Complex Impedance Matching Filtering Antenna for Rectenna in MPT

Yazhou Dong
CAST-National Key Laboratory of Science and Technology on Space Microwave
Xi'an, 710100 China
E-mail: yazhoudong@gmail.com

Abstract of the talk

In traditional rectenna design, the matching network and filter occupy lots of space, introduce additional losses, and reduce efficiency. Applying the concept of the filtering antenna to rectenna design can eliminate the filter and also simplify the rectenna structure. Since the input impedance of the rectifying diode is always a complex value, it is highly desirable to make the antenna be conjugated matched to it. This talk presents a novel filtering antenna with complex impedance suitable for rectenna applications. The developed antenna has the advantages of broadband operation, harmonics suppression, compact size, and low cost.

Invited Talk 17

November 01 (Friday), 17:10 – 17:35

Laser Wireless Power Transmission Technology for UAVs

Dele Shi

CAST-Shandong Institute of Space Electronic Technology

E-mail: songzhenjiang513@163.com

Abstract of the talk

Laser wireless Power transmission(LWPT) technology was one of the effective ways to attain long-distance wireless power transmission used for unmanned aerial vehicles(UAVs), and its principle and sub-system were introduced in this presentation. The research of LWPT for UAVs in recent years was analyzed and the key technologies were discussed. A LWPT prototype for UAVs was developed in our team, and a UAV flight trial was carried out to verify the performance of this LWPT prototype. When the UAV?s velocity was 4-7km/h, a long-distance transfer of around 200m and received power of 40W for this prototype were obtained.

Invited Talk 18

November 01 (Friday), 17:35 – 18:00

High Power Microwave Energy Transmission

Huaiqing Zhang

State Key Laboratory of Power Transmission Equipment& System Security and New Technology, Chongqing University

Chongqing, 400044 China

E-mail: zhanghuaiqing@cqu.edu.cn

Abstract of the talk

High-power long-distance microwave wireless energy transmission is one of the key technologies of space solar power station (SSPS). The related research involves the following, the wireless energy transmission and energy control mechanism, the interaction mechanism of high-power microwave and atmosphere, and the high-power microwave electromagnetic biological effects and safety protection. The Bishan ground experimental base for SSPS will be built and the high-power microwave energy transmission experiments will be carried out. The related progress will be reported in this talk.

Invited Talk 19

November 02 (Saturday), 09:00 – 09:25

Simulated Limitations on Rectification Efficiency of 5.8 GHz Band Bridge Rectifiers

Naoki Sakai
Electrical and Electronic Engineering Department, Kanazawa Institute of Technology
7-1 Ohgigaoka, Nonoichi, Ishikawa, 921-8501 Japan
E-mail: naoki.sakai@neptune.kanazawa-it.ac.jp

Abstract of the talk

This paper presents limitations on rectification efficiency of 5.8 GHz band bridge rectifiers. In simulations, lossless circuit components are assumed to clarify efficiency limitations that are defined with diode performances: breakdown voltage V_{br} and RC product R_s*C_{j0}. The simulation results indicate improvements of maximum rectification efficiencies with higher V_{br} or lower R_s*C_{j0}.

Invited Talk 20

November 02 (Saturday), 09:25 – 09:50

Illustration of Energy Flows in IPT Systems with Multiple Transmitters and/or Multiple Receivers

Quang-Thang Duong
Nara Institute of Science and Technology
8916-5 Takayama, Ikoma, Nara, 630-0192 Japan
E-mail: thang@is.naist.jp

Abstract of the talk

Poynting vector analysis visualizes the directional energy flflux in electromagnetic fifields. This tool has been used in previous works to reveal how the energy flflux distributes in typical inductive power transfer (IPT) system with one transmitter and one receiver. In this work, we employ this analysis technique to illustrate the energy flflows in more complicated IPT systems, which consist of multiple transmitters and/or multiple receivers. Three simple topologies: 1-to-2, 2-to-1 and 2-to-2 will be investigated.

Invited Talk 21

November 02 (Saturday), 09:50 – 10:15

Metasurfaces for Harvesting Electromagnetic Energy

Xuexia Yang

Shanghai University, Shanghai, 200444 China

E-mail: yang.xx@shu.edu.cn

Abstract of the talk

Electromagnetic (EM) waves fill our ambient environment with the rapid development of various wireless communication technologies. Harvesting the ambient EM energy and power the low-power-consumption electronic devices is an attractive topic. The environmental EM waves are diverse in incident angles, polarizations and operation bands so the EM harvesting efficiency of rectenna (receiving antenna integrated with rectifying circuit) is very limited. The development of metamaterial brings opportunities and challenges for harvesting EM energy. In this paper, multi- and broad-band metasurfaces with features of polarization-insensitive and wide incident angle range are investigated. The multi- and broad-band characteristics are achieved by exciting different current path lengths on a metasurface cell. With the newly suggested geometrical structures of the cells with the rotational symmetry, the polarization-insensitive and wide incident angle features could be obtained. Furthermore, the simplified metasurface cells with only one via for harvesting EM energy would be proposed for practical applications. The design, demonstration and discussion of these metasurfaces are presented. Finally, the next research points about metasurfaces for harvesting EM energy would be suggested.

Invited Talk 22

November 02 (Saturday), 10:30 – 10:55

Wavefront Regulation for Microwave Power Transmission

Long Xiao

Science and Technology on Electromagnetic Compatibility Laboratory, China Ship Development and Design Center, Wuhan, China

E-mail: xiaolong@tsinghua.org.cn

Abstract of the talk

The beam transmission efficiency (BTE), which defined as microwave power transfer efficiency between the transmitting and receiving antenna, plays a key role in the overall transmission efficiency of the microwave power transmission (MPT) system. And BTE is directly dominated by wavefront of transmitting and receiving antenna. Two strategies of wavefront regulation are reviewed. For the application of near field MPT system, the bull'eye structure antenna is proposed to realize focusing beam for high BTE. For the application of far field MPT system, far field diffraction-free beam is proposed and analyzed.

Invited Talk 23

November 02 (Saturday), 10:55 – 11:20

Efficiency Enhancement Technology of Electromagnetic Power Transmission in Space

Xianqi Lin
School of Electronic Science and Engineering, University of Electronic Science and Technology
China2006 Xiyuan Avenue, Chengdu, Sichuan, China
E-mail: xqlin@uestc.edu.cn

Abstract of the talk

The efficiency is one of the core parameters in electromagnetic power transmission. This report analyzed and compared multiple ways to improve the transmission efficiency. Based on the experience in research, the advantages and shortcomings of point-focusing transmission, non-diffraction transmission, and tracking focusing transmission are discussed. Finally, the development tendency and some suggestions of electromagnetic power wireless transmission in the future are presented.

Invited Talk 24

November 02 (Saturday), 11:20 – 11:45

Wireless Power Interface for Launch Vehicles: Technical Challenges and Applications

Kai Xie
Xidian University
Shannxi, China
E-mail: kaixie@mail.xidian.edu.cn

Abstract of the talk

The launch vehicle relied on ground power until the moment before it was launched. The action of disconnecting power cable is achieved through a mechanical structure named ‘drop-off separating’ connector, which is a high-risk step in the launch procedure. This presentation will discuss the alternative solutions by using wireless power technology. The technical challenges such as achieving high power, high efficiency transmission, and adapting to vibration coupling environment, will be discussed in detail. The innovative solutions and application attempts will also be demonstrated. This Technology will make the separation of launch vehicles flexible, safe and more reliable.

2019-10-31 AM

Keynote Speech and Invited Talk Session 1

Session Chair: Ke Wu

09:00 - 09:45 The Updated SSPS-OMEGA Design Project and the Latest Development of China (keynote)
Baoyan Duan
(Xidian University)

09:45 - 10:10 Cut-off Parallel Plate Waveguide for Near-field Wireless Power Transfer (invited)
Qiang Chen
(Tohoku University)

2019-10-31 AM

Invited Talk Session 2

Session Chair: Takafumi Fujimoto

10:25 – 10:50 Towards Automated Rectifier Synthesis: An Improved Rectification Model (invited)
Yongxin Guo
(National University of Singapore)

10:50 – 11:15 RF Input Impedance Formula on Single-Series Diode Rectifier Featuring Flow-Angle Equation (invited)
Shinji Abe
(Toyohashi University of Technology)

11:15–11:40 Wireless Power Harvesting and Transfer -Progress and Challenge- (invited)
Zhizhang Chen
(Fuzhou University / Dalhousie University)

2019-10-31 PM

Keynote Speech and Invited Talk Session 3

Session Chair: Zhizhang Chen

13:30 – 14:15 Ambient Energy Harvesting for Wireless Internet of Things and Smart Environment (keynote)
Ke Wu
(University of Montreal)

14:15 – 14:40 Boundary of the Near and Far field (invited)
Qiaowei Yuan
(National Institute of Technology, Sendai College)

2019-10-31 PM

Invited Talk Session 4

Session Chair: Qiang Chen

14:55 – 15:20 Polarization Agile Active Integrated Antenna and Its Application to Wireless Power Transfer (invited)
Ichihiko Toyoda
(Saga University)

15:20 – 15:45 Retro-reflective Beamforming for Wireless Power Transmission from Satellite to Earth (invited)
Xin Wang
(Nanjing University of Aeronautics and Astronautics)

15:45 – 16:10 A Study on Near Field of Printed Antennas for Wireless Power Transfer (invited)
Takafumi Fujimoto
(Nagasaki University)

2019-10-31 PM 16:30 – 18:00

Poster Session 1 (Best Student Contest 1)

Session Chair: Huiqing Zhai

P.1 Calculations on Radar Cross Section of Human Body for Its Detection System in Wireless Power Transfer
Masahiro Suzuki, Kazuyuki Saito
(Chiba University)

P.2 Design of an UWB Biconical Antenna for Substations from 17 to 3600 MHz
Ying Wen, Taolin Liu, Shilin Zhou, Hu Yang, Yan He, Yi Liu
(National University of Defense Technology)

P.3 Numerical Estimation of Indoor Propagation Characteristics Considering Human-Body Shadowing for Beam-type Wireless Power Transfer
Akika Yoshie, Keita Sakakibara, Takashi Hikage
(Hokkaido University)

P.4 Hamiltonian Approach to Electrode Shape Exploration of Strong Capacitive Couplers for Wireless Power Transfer
Tsukasa Yoshida, Shinji Abe, Takashi Ohira
(Toyohashi University of Technology)

P.5 Finite Element Modeling and Simulation for Ultrasonic Wireless Power Transfer System
Maopeng Wu, Xiyou Chen
(Dalian University of Technology)

P.6 Analysis of Power Transmission Efficiency of Capsule Endoscope Antenna
Kyohei Yoshida, Masaharu Takahashi
(Chiba University)

P.7 Power Control Scheme of Parallel Connected Class E Inverters Using Phase Adjustment of Each Gate Signal
Keisuke Miyaji, Satoshi Koyama, Minoru Mizutani, Shinji Abe, Takashi Ohira
(Toyohashi University of Technology)

P.8 The Simulation of Laser Wireless Power Transmission System
Wang Hao
(China University of Mining and Technology)

P.9 Analysis of the Maximum Transmission Power of Loosely Coupled Coils Under Non-sinusoidal Excitation
Yue Xu, Kai Xie, Shaowei Liu, Bicheng Wu, Fan zhu
(Xidian University)

P.10 Wireless Power Transmission to Small Sensors on the Human Arm
Hina Watanabe, Masaharu Takahashi
(Chiba University)

P.11 Minimum Size Design of Capacitive Coupler for Wireless Power Transfer to Achieve Specified Power Efficiency
Hikaru Kitaoka, Shinji Abe, Satoshi Tsukamoto, Takashi Ohira
(Toyohashi University of Technology)

P.12 A Novel Design of Miniature Antipodal Vivaldi Antenna by Loading Resistance and Serrated Edge
Jiansen Wen
(National University of Defense Technology)

P.13 High Gain and UWB Printed Quasi Log-Periodic Dipole Antenna with Power Exponential Function Profile
Zhijuan Wang, Taolin Liu
(National University of Defense Technology)

P.14 A Wideband Triple-layer Transmitarray Antenna
Yongliang Zhang, Xiuzhu Lv, Keyv Yan, Zhihua Han
(Inner Mongolia University)

P.15 Advanced Direct Synthesis Approach for High Selective In-line Topology Diplexers with Maximum Adjacent Frequency Variant Couplings
Yongliang Zhang, Wenxian Zhang, Jun Wen
(Inner Mongolia University)

P.16 Flexible Quasi-T matched Dipole Array for Wearable Electronic Devices
Ping Lu, Kama Huang
(Sichuan University)

P.17 Research and Design of Planar Array Antenna and Annular Metallic Grating Antenna Based on Energy Transmission
Ning Li, Jinling Zhang (School of electronic engineering), *Jinsheng Yang* (Twelfth Research Institute), *Zhanqi Zheng* (Department of Algorithm Design), *Xiongzhi Zhu* (School of electronic engineering)

P.18 A Dual-band and Broadband Back-to-back Microstrip Antenna for Wide-Angle RF Energy Harvesting and Wireless Power Transfer
Pei Zhang, Hao Yi, Xuanming Zhang, Long Li
(Xidian University)

P.19 Cardiac Pacemaker-based Broadband Implantable Antenna for Wireless Power Transfer and Medical Communication
Mengfan Wang, Pei Zhang, Xuefang Zhang, Xuanming Zhang, Long Li
(Xidian University)

P.20 Near-field Focusing-based Reflectarray Antenna for Wireless Power Transfer
Xinwang Cui, Pei Zhang, Mengfan Wang, Xuanming Zhang, Long Li
(Xidian University)

P.21 Design of 5.8 GHz Rectenna Array for RF Energy Harvesting
JiaNing Chen, Long Li, XuanMing Zhang
(Xidian University)

P.22 Aperture Illumination Integrated Designs for Microwave Wireless Power Transmission for SSPS
Shuo Zhang, Liwei Song, Shunxi Lou
(Xidian University)

P.23 A Research on Maximizing of Output AC and DC Power in an Electric Resonant Coupling-type Wireless Power Transfer System by a Complex Load
Yoshiki Maekawa, Tsunayuki Yamamoto, Hiroshi Kubo
(Yamaguchi University)

P.24 A Wireless Power Transfer System with Frequency Conversion Characteristic
Jie Yang, Yan Shi
(Xidian University)

2019-11-01 AM

Keynote Speech and Invited Talk Session 5

Session Chair: Yongxin Guo

09:00 - 09:45 Recent Standardization of Microwave Power Transfer (keynote)
Naoki Shinohara
(Kyoto University)

09:45 - 10:10 A Microwave High Power Rectifier Using GaAs pHENT Schottky Diode (invited)
Fei Cheng, Kama Huang
(Sichuan University)

2019-11-01 AM

Invited Talk Session 6

Session Chair: Qiaowei Yuan

10:25 – 10:50 A Novel Transmission Line Technique to Realize Broadband Rectenna for WEH and WPT Applications (invited)
Yi Huang
(University of Liverpool)

10:50 – 11:15 Underwater WPT and Cavity Resonance Enabled WPT Focusing on Capacitive Coupling (invited)
Masaya Tamura
(Toyohashi University of Technology)

11:15 – 11:40 Rectifier Design with High Efficiency/Wide Dynamic Range for WPT-- From Chip to Circuit Level Design (invited)
Xiuyin Zhang
(South China University of Technology)

2019-11-01 PM 13:30 – 15:00

Poster Session 2 (Best Student Contest 2)

Session Chair: Akio Wakejima

P.1 An Experimental Investigation of Equivalent Circuit for Large Scale WPT System with Multiple Receivers
Kohei Kawabata, Takeshi Higashino, Minoru Okada
(Nara Institute of Science and Technology)

P.2 A Study on Constant Voltage Design for Single-Frequency Two-Stream Contactless Power Transfer with Cross-Coupling
Shudai Kawai, Quang-Thang Duong, Okada Minoru, Takeshi Higashino
(Nara Institute of Science and Technology)

P.3 Basic Research on Searching Method of Coil Parameters Suppressing Magnetic Field Absorption in Wireless Power Transfer Via Magnetic Resonance Coupling Using Phased Array Power Transmission Coils
Yuji Tanaka (Hosei University), *Yoshinori Tsuruda* (DAIHEN Corporation), *Sousuke Nakamura* (Hosei University)

P.4 Bipolar Marx Generator Based on Double Transformers
Zhaokang Wu, Xiyou Chen, XianMin Mu
(Dalian University of Technology)

P.5 Diode Modeling for the Design of Rectifiers with Microwave Input
Takashi Hirakawa (Kyoto University), *Zhang Hao* (National University of Singapore), *Naoki Shinohara* (Kyoto University), *Yong Xin Guo* (National University of Singapore)

P.6 Characteristic Evaluation of Resonance Compensation Technology Using Low Loss Capacity Control Function in Wireless Power Transfer Via Magnetic Resonance
Takahiro Miyaura (Hosei University), *Yoshinori Tsuruda* (Daihen Corporation), *Sousuke Nakamura* (Hosei University)

P.7 Design and Use of Low Input Impedance DC-DC Converter in WPT
Junwei Xue

P.8 A 5.8GHz Magnetron Phased Array System
Bo Yang, Tomohiko Mitani, Naoki Shinohara
(Kyoto University)

P.9 Reflector Array Antenna in MWPT
Fanji Jin, LiWei Song, Na Li
(Xidian University)

P.10 EV Model Running Experiment by Electric Field Coupling WPT Applying the Rail of the Abandoned Line to the Feeder Line
Kazusa Ohno, Tamami Maruyama, Yuji Koita
(National Institute of Technology, Hakodate college)

P.11 Design and Analysis of EV Running Using WPT on Microwave Guide with Slot for Snow Melting
Yuji Koita, Kazusa Ohno, Tamami Maruyama
(National Institute of Technology, Hakodate college)

P.12 Study on the Practical Use of Microwave Power Transfer to Mini-drones Using Flat-topped Beams at 5.74 GHz
Nobuyuki Takabayashi, Naoki Shinohara, Tomohiko Mitani (Kyoto University), *Minoru Furukawa* (Space Power Technologies Inc.)

P.13 Comparative Study on Converter Position for Lunar Rover Wireless Power Transfer System with PV MPPT Control
Bingcheng Ji, Katsuhiro Hata (University of Tokyo), *Takehiro Imura* (Tokyo University of Science), *Yoichi Hori* (University of Tokyo), *Sayuri Honda, Shuhei Shimada, Osamu Kawasaki* (Japan Aerospace Exploration Agency)

P.14 Serial Compensation for Two-receiver Inductive Power Transfer Systems with Load-independent Output Voltages
Quoc-Trinh Vo, Quang-Thang Duong, Minoru Okada
(Nara Institute of Science and Technology)

P.15 Pareto Optimization of Power and Efficiency for Lunar Rover Wireless Power Transfer System with Multi-layer Insulation
Mingyang Chen, Bingcheng Ji, Katsuhiro Hata (University of Tokyo), *Takehiro Imura* (Tokyo University of Science), *Hiroshi Fujimoto, Yoichi Hori* (University of Tokyo), *Sayuri Honda, Shuhei Shimada, Osamu Kawasaki* (Japan Aerospace Exploration Agency)

P.16 Direct Induced Current Control for Inductive Coupling Wireless Charging System
Shaowei Liu, Kai Xie, Yue Xu, Bicheng Wu, Fan Zhu
(Xidian University)

P.17 Study on the Wireless Power Transfer in Multi-reflection Environment Based on Time Reversal
Jiaxu Li, Sen Yang, Kedi Zhang, Huiqing Zhai
(Xidian University)

P.18 High Efficiency Wireless Distribution Unit Based on ICPT
Liang Ma, Zhigang Liu, Xiaofeng Zhang, Liying Zhu
(BISEE)

P.19 Position-free Wireless Charging for Horizontally Placed Stylus Pen
Hua Shen, Yan Shi
(Xidian University)

P.20 Protecting Effect Against Unauthorized Receiver in IPT System with Receiver-Side Compensation Circuit
Shogo Isogai, Quang-Thang Duong, Okada Minoru
(Nara Institute of Science and Technology)

P.21 Design of Multiple Antiparallel Rectangular Coils for Range Stable Wireless Power Transfer
Danyu Yang, Menghan Sun, Huapeng Zhao (University of Electronic Science and Technology), *Jiafeng Zhou* (University of Liverpool)

P.22 Electric Field Energy Harvesting on Electrical Cables and Its Applications in Voltage Measurement
Chen Xu, Yuan Zhuang, Ye Wang, Le Fang, Yi Huang, Jiafeng Zhou
(University of Liverpool)

P.23 Microwave Rectifying Based on Schottky Diodes with Enhanced Dynamic Ranges
Changjun Liu, Pengde Wu, Zhongqi He
(Sichuan University)

P.24 Derivation and Comparison of Efficiency and Power in Non-resonant and Resonant Circuit of Capacitive Power Transfer
Shunya Kuroda
(Tokyo University of Science)

P.25 Wireless Power Transfer System for Spacecraft Docking
Haijin Li, Zhigang Liu, Liying Zhu, Liang Ma, Xiaofeng Zhang
(Beijing Institute of Spacecraft System Engineering)

2019-11-01 PM

Invited Talk Session 7

Session Chair: Yi Huang

15:15 – 15:40	Near-ideal GaN Schottky Barrier Diode for High-power and High-efficiency Wireless Power Transfer Application (invited) *Hong Zhou* (Xidian University)
15:40 – 16:05	Compact and High Efficiency Wireless Power Transfer System through Biological Tissues for Implant Sensors and Biomedical Implants *Ramesh K. Pokharel* (Kyushu University)
16:05 – 16:30	Recent Advances of Microwave Rectennas for the SSPS (invited) *Changjun Liu* (Sichuan University)

2019-11-01 PM

Invited Talk Session 8

Session Chair: Naoki Shinohara

16:45 – 17:10	Complex Impedance Matching Filtering Antenna for Rectenna in MPT (invited) *Yazhou Dong* (CAST-Xi'an Institute of Space Radio Technology)
17:10 – 17:35	Laser Wireless Power Transmission Technology for UAVs (invited) *Dele Shi* (CAST-Shandong Institute of Space Electronic Technology)
17:35 – 18:00	High Power Microwave Energy Transmission (invited) *Huaiqing Zhang* (Chongqing University)

2019-11-02 AM

Invited Talk Session 9

Session Chair: Xianqi Lin

09:00 - 09:25	Simulated Limitations on Rectification Efficiency of 5.8 GHz Band Bridge Rectifiers (invited) *Naoki Sakai* (Kanazawa Institute of Technology)
09:25 - 09:50	Illustration of Energy Flows in IPT Systems with Multiple Transmitters and/or Multiple Receivers (invited) *Quang-Thang Duong* (Nara Institute of Science and Technology)
09:50 – 10:15	Metasurfaces for Harvesting Electromagnetic Energy (invited) *Xuexia Yang* (Shanghai University)

2019-11-02 AM

Invited Talk Session 10

Session Chair: Naoki Sakai

10:30 – 10:55	Wavefront Regulation for Microwave Power Transmission (invited) *Long Xiao* (Science and Technology on Electromagnetic Compatibility Laboratory, China Ship Development and Design Center)
10:55 – 11:20	Efficiency Enhancement Technology of Electromagnetic Power Transmission in Space (invited) *Xianqi Lin* (University of Electronic Science and Technology of China)
11:20 – 11:45	Wireless Power Interface for Launch Vehicles: Technical Challenges and Applications (invited) *Kai Xie* (Xidian University)

Qian Xuesen Space Technology Laboratory

Qian Xuesen Space Technology Laboratory, founded in December 2011, is an innovative "special zone" of China Aerospace Science and Technology Group Co., Ltd. dedicated to developing into an internationally influential first-class space science and space technology laboratory.

Qian Xuesen Laboratory inherits and develops Qian Xuesen's spirit, adheres to the innovative ideas of "task is longitude, and subject is latitude," "first questioning whether it is new, then questioning whether it is flexible," and "independent research is primary, and organizational research is supplementary." It establishes the business orientation of "creative center, research center and incubation center," and establishes the trinity of "strategic research, systematic research and applied basic research" to its innovative business development system. At present, the innovative business development system has become the first national innovation workstation of the Central Military Commission, the space technology innovation center of national defense science and technology industry, and the space system development research center of the group company, which are three open, convergent and collaborative innovation platforms.

Qian Xuesen Laboratory is committed to creating a good cultural atmosphere by exploring new mechanisms of innovative management, attracting high-level research talent at home and abroad, and generating numerous internationally influential achievements in the field of space science and technology. At present, Qian Xuesen Laboratory has implemented a management mode with PI system and synergistic system as its core, whilst implementing the tenure-track-like appointment assessment system with peer evaluation as its respective core. At present, it has formed an innovative interdisciplinary team led by Duan Baoyan, Zheng Ping, Zou Zhigang, Wang Weihua, Yang Mengfei and other academicians. At the same time, it has hired experts including academician Ye Yongtao and Ph.D Maria A. Baruccibo to participate in research work related to space science.

Qian Xuesen Laboratory, through building an open cooperation platform, is committed to developing into a window and link for cooperation between China's aerospace and domestic and foreign scientific research institutions; creating new opportunities for future space systems and missions. At present, the laboratory has established cooperative relationships with the American Planetary Science Institute, the Russian Academy of Ziolkowski Astronautical Sciences and other overseas institutions as well as Zhejiang University, Xi'an University of Electronic Science and Technology, Shenzhen University and other domestic scientific research institutions, and held a series of international and domestic academic conferences to promote research cooperation through academic exchanges and cooperation. At present, Qian Xuesen Laboratory is working with domestic and foreign scientific research institutions to carry out strategic demonstration, mission definition, application

basis, key technologies and load instruments to areas including the innovation workstation of the Central Military Commission, the innovation center of the Bureau of Science and Technology, major national projects in the future, and space science missions.

In the new era and new stage, Qian Xuesen Laboratory sincerely invites all people at home and abroad to join hands in the exploration of space technology upholding the original aspirations of opening-up, and collectively create a "space dream" to constantly push forward humanity’s future in the space industry!

China Promotion Committee for Space Solar Power Station (SSPS)

Committee objectives: The committee aims to actively coordinate the effective strength in China, promotes the development of the on Chinese space solar power satellite, including the innovation of theoretical method innovation, the breakthrough of key technologies, the transformation of scientific and technological achievements and growth in related industries. Furthermore, the committee strives to the planning and authorization of major, national projects, and facilitates the positive international cooperation and exchanges.

Committee structure: The committee is mainly comprised of experts from research institutions, universities, enterprises (companies) and other related fields. The advisory board of the committee is built with academicians in relevant fields. The committee gives full play to each member's advantages, benefits the adequate personnel exchanges and technical cooperation. The committee will hold technical seminars or high-end forums on the major issues periodically. There is a chairman and a vice chairman in the committee. The subgroup under the committee is formed with a general group, a space spotlight system group, a space photoelectric conversion and power management group, a microwave wireless energy transmission and sending/receiving antenna group, an in-orbit assembly, control and deployable structure group, an environmental safety group and a secretary group.

Chairman: Duan Baoyan, Academician, Xidian University

Vice chairman: Li Ming, Vice-president, China Acadamy of Space Technology

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盛路是国内领先的天线、射频产品研发、制造、销售于一体的高新技术企业，成立于1998年12月，公司总部占地150亩，厂房面积67000平方米，员工近千人，注册资金7.6亿元，总资产53.97亿。

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盛路上市后经过资产重组，在通信（广东盛路通信科技股份有限公司、佛山市盛夫通信股份有限公司）、汽车电子（深圳市合正汽车电子有限公司）、军工（南京恒电电子有限公司、深圳市朗赛微波通信有限公司、成都创新达微波有限公司）、产品检测（广东星磁检测技术研究有限公司）等领域拓展，发展多元化的集团公司。

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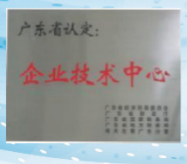
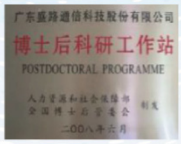
公司专业研发生产天线、射频无源器件等2000多个品种。被评定为广东省工程技术研究开发中心、广东省企业技术中心、广东省天线与射频技术企业重点实验室、国家级高新技术企业的盛路，拥有雄厚的研发生产能力和先进的国家级实验室，包括大型微波暗室，天线远场测试系统和环境实验室。





GD Midea Small Domestic Appliances Division

Midea Small Domestic Appliances is one of the core product divisions of Midea Group. The product portfolio includes small cooking appliances, beverage & food preparation appliances, fans, heaters, etc. We are the world's No.1 producer in terms of small domestic appliances, cooking fans and air coolers (Euromonitor,2018).

莱天通信
LT Technologies

Shanghai Laitian Technology Co., Ltd. is located in Shanghai's comprehensive national science center Zhangjiang Science City. It is guided by technological innovation and focuses on phased array systems, 5G NR OTA, millimeter wave, EMC, communication links and other electromagnetic field testing and verification technologies. The Company provides the most valuable electromagnetic field test verification solutions and technical services.

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Phased array system test
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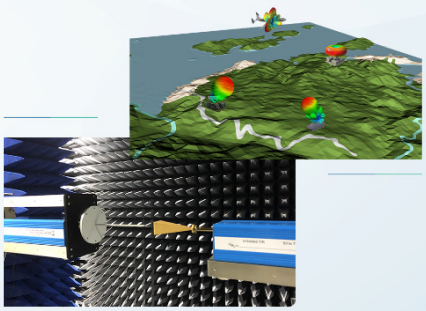

Shanghai
Rm.16100 NO.498 Guoshoujing Rd. Shanghai China,201203
Tel: 021-50800572
Fax: 021-50800573
E-mail: support@lai-tian.com

Chengdu
Rm. 1303 No.68, Zhiquan Section Dongdajie St. Jinjiang District Chengdu China,610065
Tel: 028-62122768

Beijing
Rm. 516 No.4 Building No.26 Chengtong St. Shijingshan District Beijing China,100040
Tel: 010-68863381

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