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<tr>
<td>09:00-09:30</td>
<td>Opening Ceremony, Room F, 2&lt;sup&gt;nd&lt;/sup&gt; Floor</td>
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<td>09:30-10:00</td>
<td>Coffee Break, 2&lt;sup&gt;nd&lt;/sup&gt; Floor</td>
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<tr>
<td>10:00-12:00</td>
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<tr>
<td>10:00-10:40</td>
<td>A teleco’s view for better and better customer expectations in multi-band,</td>
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<td>multi-network, multi-device and multi-demand smart society</td>
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<tr>
<td>10:40-11:20</td>
<td>4G/Multiband Handheld Device Antennas and Their Antenna Systems</td>
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<tr>
<td>11:20-12:00</td>
<td>Rethinking the Wireless Channel for OTA testing and Network Optimization</td>
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<td></td>
<td>by including User Statistics: RIMP, Pure-LOS, Throughput and Detection Probability</td>
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<tr>
<td>12:00-13:30</td>
<td>Lunch</td>
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<tr>
<td>13:30-15:10</td>
<td>WP-1(A) Adv Ant for Radio-Astr. -1</td>
<td>WP-1(B) New Strategies of CEM-1</td>
<td>WP-1(C) UWB Antennas</td>
<td>WP-1(D) Compact Antennas</td>
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<tr>
<td>15:10-16:00</td>
<td>Poster Session: <strong>WP-C(Best Student Papers Contest)</strong> &amp; WP-P &amp; Coffee Break (Room E, 1&lt;sup&gt;st&lt;/sup&gt; Floor)</td>
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<tr>
<td>16:00-17:40</td>
<td>WP-2(A) Adv Ant for Radio-Astr. -2</td>
<td>WP-2(B) New Strategies of CEM-2</td>
<td>WP-2(C) Broadband Antennas</td>
<td>WP-2(D) Small Antennas</td>
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<tr>
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<td>TA-1(B) Computational EM</td>
<td>TA-1(C) WLAN Antennas</td>
<td>TA-1(D) Measurements</td>
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<tr>
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<td>12:10-13:30</td>
<td>Lunch</td>
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<tr>
<td>13:30-15:10</td>
<td>TP-1(A) Body-central Antennas</td>
<td>TP-1(B) SIW Antennas &amp; Devices</td>
<td>TP-1(C) Reflector &amp; Air-fed Array</td>
<td>TP-1(D) Mobile &amp; Indoor Propag.</td>
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<tr>
<td>15:10-16:00</td>
<td>Poster Session: TP-P &amp; Coffee Break (Room E, 1&lt;sup&gt;st&lt;/sup&gt; Floor)</td>
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<tr>
<td>16:00-17:40</td>
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<td>TP-2(B) Integrated MMW Antennas</td>
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<tr>
<td>10:30-12:10</td>
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<td>FA-2(B) MMW Antennas</td>
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<tr>
<td>13:30-15:10</td>
<td>FP-1(A) Antennas for RFID</td>
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<td>FP-1(D) A&amp;P in Meta-structures</td>
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2013 International Symposium on
Antennas and Propagation
(ISAP2013)

Final Technical Program

October 23-25, 2013
Jiangning Exhibition Center
Nanjing, China
2013 International Symposium on Antennas and Propagation

Sponsor & Organizer
Southeast University

Co-sponsor
University of Electronic Science and Technology of China

Technical Co-sponsors
CIE Antenna Society
IEICE Communications Society
IEEE Antennas and Propagation Society
European Association on Antennas and Propagation (EurAAP)
Science and Technology on Antenna and Microwave Laboratory
IEEE AP-MTT-EMC Joint Nanjing Chapter
The Jiangsu Institute of Electronics
Journal of Microwaves
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Message from the General Chairmen

The ISAP2013 will be held in Nanjing, China on October 23-25, 2013. On behalf of the conference committees, it is our pleasure to welcome all of you to attend the 2013 International Symposium on Antennas and Propagation (ISAP2013) in Nanjing, one of the most beautiful and ancient cities in China.

The 2013 International Symposium on Antennas and Propagation (ISAP2013) provides an international forum for exchanging information on, and updating progresses of, the most recent research and development in antennas, propagation, electromagnetic wave theory, and other related fields. It is also an important objective of this meeting to promote professional networking among conference participants.

Nanjing was awarded the title of Famous Historic and Culture City because she had been Capitals of China for ten times. Today, Nanjing is the Capital City of Jiangsu Province and one of the important wireless communication hubs in China. The ISAP2013 is sponsored and organized by Southeast University, co-sponsored by University of Electronic Sci. & Tech. of China, and technically co-sponsored by CIE Antenna Society, the IEICE Communications Society, IEEE Antennas and Propagation Society, the European Association on Antennas and Propagation (EurAAP), Laboratory of Science and Technology on Antenna and Microwave, IEEE AP/MTT/EMC Nanjing Joint Chapter, the Jiangsu Institute of Electronics, Journal of Microwaves, etc.

ISAP2013 totally received 420 submissions, and finally 359 papers are accepted after its rigorous peer reviews by TPC members based on their technical merits and interests to the antennas and propagation communities. Among a large number of students’ papers, 15 papers were selected by the TPC into the final-list for the best student paper contest.

Finally, please enjoy technical sessions of the conference, and also the Chinese culture in, and the beautiful modern city scenery of, the ancient Nanjing.

Prof. Wei Hong, Prof. Joshua Le-Wei Li, and Prof. Shuxi Gong
General Co-Chairs

October 23, 2013
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Chi Hou Chan (City University of Hong Kong)
Dau-Chyrh Chang (Oriental Institute of Technology)
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Yingjie Jay Guo (CISRO)
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Fan Yang (Tsinghua University)
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Julien Le Kernec (The University of Nottingham Ningbo)
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Kam Weng Tam (University of Macau)
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Zhijun Zhang (Tsinghua University)
Zhongxiang Shen (Nanyang Technological Univ. Singapore)
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Maomao Xia (Southeast University)
Zhihao Tang (Southeast University)

ISAP2013 Online Support

Guangqi Yang (Southeast University)
Kaihua Gu (Southeast University)
Conference Site and Office Location
2013 International Symposium on Antennas and Propagation (ISAP2013) will be held on October 23-25, 2013, at Jiangning Exhibition Center, Nanjing, China. The office and session locations are shown in the back cover of this program.

Registration
The ISAP2013 registration begins on October 22, 2013. The registration desk is at Jiangning Exhibition Center on October 22 and October 23. 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.

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<tr>
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<th>On-site</th>
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<tr>
<td>Student/Retired Participants</td>
<td>2200 CNY (350 USD)</td>
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<td>CIE/EIICE/IEEE member</td>
<td>3100 CNY (500 USD)</td>
</tr>
<tr>
<td>Regular Participants</td>
<td>3400 CNY (550 USD)</td>
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Projection Facilities
Standard LCD projector (connected to a local PC) will be provided in each conference room. If you need an overhead projector, please contact the conference office.

Guidelines for Presentations

INFORMATION FOR ORAL PRESENTERS

Presenters are required to report at their session room and to their Session Chair at least 15 minutes prior to the beginning of their session. Presenters are suggested to try out their presentations if there is any concern about the format, presentation length, etc. It is mandatory that the presentations should be loaded to the computer supplied by conference committee before the beginning of each session. Any delays in the start of a presentation behind schedule due to the presenter's disregard of this guidance will result in less presentation time for that paper.

All presentations are limited to 20 minutes in their entirety. The strict limits are 15 minutes for the formal presentation and 5 minutes for questions and discussions. To accommodate attendees who move between sessions, it is important to carry out every presentation on schedule. The Session Chair will remind the presenter 15 minutes after the presentation starts.

The session room will be equipped with a computer and an LCD projector. This is the only permissible projection system. Presenters must use the session's computer for their presentation, i.e., their presentation must be loaded in advance on this computer. Other computers will not be permitted. Each computer is equipped with a CD-ROM drive and a USB port to read CDs and USB flash memory, respectively. If you have a special requirement to use an overhead projector, please contact with the conference office at least one hour prior to the start of their session.
The operating system for session computers is Microsoft Windows XP (or newer). The softwares available on each machine are Adobe Acrobat Reader (for PDF), MathType and Microsoft Office that includes Word, Excel, and PowerPoint. Therefore, all presentations must be compatible with these packages. There will be also assistance and advice available to presenters at registration desk.

Please remember that the responsibility of having your paper ready for presentation at the scheduled time is primarily in your hands. Due to the very large number of papers and a very tight schedule, we cannot tolerate delays due to presenters’ inadequate preparations.

INFORMATION FOR POSTER SESSION PRESENTATIONS

Presenters are required to put up their papers 15 minutes prior to the beginning of their session. Each poster presentation will last about 50 minutes. 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. Each sheet should be numbered. 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. Your poster abstract should appear in the top left-hand corner of the board. Lettering should be simple, bold, and easily legible from a distance of one meter.

Two poster boards are provided for each presentation, which is 1.8 meter high by 0.9 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 you arrive. Supplies will not be available at the conference site.
General Information

CONFERENCE VENUE

ISAP2013 will be held at Jiangning Exhibition Center, Nanjing, China
Address: No. 1528 Shuanglong, Jiangning District, Nanjing, China

TRANSPORTATION

Please refer to the website: http://www.emfield.org/ISAP2013/ for details.

ABOUT Nanjing

Nanjing is the capital of Jiangsu Province. It lies in the lower reaches of the Yangtse River, covering 6.5 thousand square kilometers, with a population of 5.1 million. Perennial temperature averages 17.8 °C (64 °F). Nanjing is one of the important hub of communications in China. The railway, highway and aviation are all convenient. Nanjing had been awarded the title of Famous Historic and Culture City.

Being one of China’s six ancient capitals and cultural centers, it was built 2400 years ago and was the capital of six dynasties-the Eastern Wu, the Eastern Jin, the Song, the Qi, the Liang, the Chen, the Southern Tang and the early Ming dynasties. Nanjing had the world’s longest city wall-extending 34 km. The Xiaoling Tomb was listed in the World Heritage.

The Mausoleum of Dr. Sun Yat-sen is situated on the southern slope of the Purple Mountain in the eastern suburb of Nanjing. The mausoleum, shaped like an alarm bell, is built at the foot of the mountain.

Plum Blossom Hill is one of the eight best places for enjoying the plum blossom in China.

Qinhuai River is the cradle of civilization around Nanjing. Dozens of Neolithic primitive sites have been unearthed along the river. It is famous for the wealth of ancient sites, gardens, painted boats, streets and folklore. Historically, the place teemed with nobles and men of letters. At its peak years during the Ming and Qing dynasties, Qinhuai was bustling with businessmen, whorehouses and racing lantern boats.

On the bank of Qinhuai River, there is the Confucius Temple, a famous tourist resort in Nanjing. It is also known as Fuzimiao in Chinese.

And also, there are numerous mountains, lakes and other views in Nanjing. Zhong Mountain and Xuanwu Lake are the national major place of interest. They are the most magnificent scenery in China.

More about Nanjing please visit the following websites: www.nju.gov.cn/english/

LANGUAGE
The official language for the Conference is English. However, in the public society, Chinese
mandarin is commonly spoken in Nanjing.

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 USD FOR 6.2 RMB. ONLY RMB cash is acceptable on the registration desk on the conference site. This is also the case in most large shopping centers and other hotels.

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 custom and do not tip a waiter/waitress or a taxi driver and other person who provides regular service.

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. - 5:00 p.m., from Monday to Friday. Store Opening hours: usually 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 are WLAN with internet access in the conference venue.

ISAP2013 Online

Information on ISAP2013 has been posted on the World Wide Web at http://www.emfield.org/isap2013
Workshop

October 22 (TUE)  14:00-18:00

Room A, 2nd Floor

Latest Progress in Millimeter Wave Antennas
Chair:  Prof. Zhi Ning Chen
National University of Singapore

1. A Low-Cost Low-Profile Printed Millimeter-Wave Antenna Array
   Prof. Kwai-Man Luk
   City University of Hong Kong

2. Recent Advances in High-efficiency Millimeter-wave Band Planar Antennas
   Prof. Jiro Hirokawa
   Tokyo Institute of Technology

3. Helpful Techniques for the Design of General Near-Field Focused Phased Array Antennas:
   from Fundamentals toward Antenna Realization
   Prof. His-Tseng Chou
   Yuan Ze University

4. Substrate-integrated Millimeter-Wave Antennas
   Prof. Zhi Ning Chen
   National University of Singapore
A Low-Cost Low-Profile Printed Millimeter-Wave Antenna Array
(Invited)

Kwai Man Luk
State Key Laboratory of Millimeter Wave,
City University of Hong Kong, Kowloon, Hong Kong, P R China

SUMMARY

With the availability of low-cost millimeter-wave circuits and components, various wireless applications have been proposed, including the 60-GHz unlicensed short range data links [1], the 77-GHz automotive radar [2], and the 94-GHz imaging radar [3]. Due to high free-space propagation loss and strong atmospheric absorption, the distance of communications of these applications cannot be too large. To mitigate this problem, high-gain antennas are preferable for these applications.

Several high-gain antenna arrays were proposed recently [4]–[8] for 60-GHz applications such as the high definition multimedia interface, high definition video streaming, high-speed internet, wireless gigabit Ethernet, and so on. These antennas are complex in structure and ought to be made of multi-layer substrates which is high in production costs.

In this talk, a new unidirectional antenna element consisting of a directed planar electric dipole and a double-loop antenna is presented. Design of high gain antenna arrays based on this new antenna element is followed. The antenna arrays are constructed using a single-layer printed circuit board substrate and are designed to operate at 60-GHz band. They have a low profile of $0.05\lambda_0$ ($\lambda_0$ is the wavelength referring to 60GHz) and exhibit wide impedance bandwidths and high gains. The design procedure, antenna geometry and principle of operation for 4-element, 14-element and 50-element antenna arrays are discussed.

ACKNOWLEDGMENT

The authors would like to thank Mr. Mingjian Li for his contribution to this research work, which was supported by a grant from the Research Grants Council of the Hong Kong SAR, China. [Project No. CityU 9041677]

REFERENCES

Recent Advances in High-efficiency Millimeter-wave Band Planar Antennas
(Invited)

Jiro Hirokawa
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SUMMARY

This talk covers the recent advances in two types of millimeter-wave planar antennas in Tokyo Institute of Technology.

One is on a patch antenna placed on a thick resin layer on the opposite side of a CMOS RF circuit in a silicon chip and fed through a hole with coaxial-line structure in the 60GHz band [1]. The thick resin layer of 200μm thickness can enhance the radiation efficiency. The connection loss between the antenna and the RF circuit is expected to be small. We design and fabricate a patch antenna over a 5 mm square silicon chip. The simulated connection loss is 0.2 dB, and the radiation efficiency including the connection loss is 76.4%. The high antenna efficiency of 77% was measured by a reverberation chamber with ±3% error [2].

The other is on plate-laminated hollow-waveguide corporate-feed slot array antennas [3]. Etching of the laminated plates gives high precision of about 20μm. Diffusion bonding gives perfect electric contact. The broad band characteristic of about 20% has been achieved by controlling many parameters with fast analysis of the method of moments, which can cover almost communication systems in the millimeter-wave bands such as fixed wireless access system [4]. In the 120GHz band, A 32x32-element array shows 38 dBi gain with 70% antenna efficiency over 13 GHz bandwidth and a 64x64-element array shows 43 dBi gain with 60% antenna efficiency over 13 GHz bandwidth, respectively [5]. High gain more than 40dBi can be achieved with keeping high antenna efficiency and wide bandwidth.

ACKNOWLEDGMENTS

The author would like to express sincere thanks to Prof.Makoto Ando, Dr.Yasutake Hirachi, Dr.Takuichi Hirano, Dr.Miao Zhang of Tokyo Institute of Technology, Prof.Tadao Nagatsuma of Osaka University and Dr.Akihiko Hirata of NTT for continuing this work.

REFERENCES


Jiro Hirokawa was born in Tokyo, Japan, on May 8, 1965. He received the B.S., M.S. and D.E. degrees in electrical and electronic engineering from Tokyo Institute of Technology (Tokyo Tech), Tokyo, Japan in 1988, 1990 and 1994, respectively. He was a Research Associate from 1990 to 1996, and is currently an Associate Professor at Tokyo Tech. From 1994 to 1995, he was with the antenna group of Chalmers University of Technology, Gothenburg, Sweden, as a Postdoctoral Fellow. His research area has been in slotted waveguide array antennas and millimeter-wave antennas. He received an IEEE AP-S Tokyo Chapter Young Engineer Award in 1991, a Young Engineer Award from IEICE in 1996, a Tokyo Tech Award for Challenging Research in 2003, a Young Scientists' Prize from the Minister of Education, Cultures, Sports, Science and Technology in Japan in 2005, a Best Paper Award in 2007, a Best Letter Award in 2009 from IEICE Communications Society and Asia Pacific Microwave Conference prize in 2011 and 2012. He is a Fellow of IEEE and a Senior Member of IEICE.
Helpful Techniques for the Design of General Near-Field Focused Phased Array Antennas: from Fundamentals toward Antenna Realization (Invited)

Hsi-Tseng Chou
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SUMMARY

Due to the electromagnetic field’s nature in the millimeter wave band, the technologies are expected to be implemented in the short range applications such as car collision avoidance systems or the indoor communication systems. Its bottlenecks of high energy attenuations and multipath field cancellation within a few millimeters of propagation have obstructed it from the successful realization because a slight location shift may experience a complete null signal. The measure to overcome this communication deficiency would be the applications of phased array antennas implemented in terms of MIMO or smart antenna systems, which may help to create space, polarization or angular beam diversities.

To effectively realize the antenna design, our research team has attempted to build up the required technologies especially for the applications of short range communications. A scenario of near-field focused antenna radiation is thus defined, which provides a most global scope of antenna characteristics. In particular, we have built up the fundamentals in terms of ray theories which provide the advantages of easy and physical appealing wave interpretation. Afterward, a sequence of numerical techniques realized as the design tools have also been developed, which are used to design the antenna from a different aspect. In this study, a do main transformation technique has been developed to investigate the antenna design scenario from the point of view in an alternative domain. Based on an application scenario, a phased array antenna has been realized to demonstrate the utilization of these numerical techniques. The advantages of these techniques are that they may be used to effectively reduce the multipath interferences outcome from the wave propagation indoor. Also with a proper implementation, the propagation effects can be incorporated in the design stage of antennas.

The talk will first discuss the fundamental wave phenomena in terms of ray optics, some of them have not been explored in the conventional array theories. Afterward, I will step-by-step present the developed techniques which will be very helpful to realize an extremely large array of antennas from the incubation of an application scenario toward a realistic antenna design.

Prof. Hsi-Tseng Chou received his B.S. degree in electrical engineering from National Taiwan University in 1988, and his M.S. and Ph. D. degrees in electrical engineering from Ohio State University (OSU) in 1993 and 1996, respectively. He is a professor in Yuan Ze University, Taiwan since 1998. He is also currently an adjunct CTO for Wha-Yu Industrial Corp in the antenna development.

Dr. Chou joined ElectroScience Laboratory (ESL) in OSU as a graduate research associate during 1991-1996 and as a post-doctoral researcher during 1996-1998. After joining YZU in 1998, he had also simultaneously been technical consultants to several industries including Wistron NeWeb, Zinwell, Jonsa and Skstech. His research interests include wireless communication network, antenna design, antenna measurement, electromagnetic scattering, asymptotic high frequency techniques such as Uniform Geometrical Theory of Diffraction (UTD), novel Gaussian Beam techniques, and UTD type solution for periodic structures.

Prof. Chou has received many national awards to recognize his distinguished contributions in the technological developments. Some important ones includes a young scientist research award from Academia Sinica of Taiwan, a distinguished contribution Award in promoting inter- academic and industrial cooperation from Ministry of Education, distinguished engineering professor award from the Chinese Institute of Engineers, distinguished electrical engineering professor award from the Chinese Institute of Electrical Engineering, and University’s Industrial Economics Contribution Award and National Award for Industrial Innovation—Key Technology Elite Award both from Ministry of Economics. Prof. Chou was elected in 2004 as one of the nation’s ten outstanding young persons by Junior Chamber International, in 2005 a National Young Person Medal from China Youth Corps of Taiwan, and as one of the top 10 rising stars in Taiwan by Central News Agency of Taiwan. He has served as the chair of IEEE AP-S Taipei Chapter and received the best chapter award in 2012. He also received outstanding branch counselor awards from IEEE including IEEE headquarter, R-10 and Taipei Section, respectively.

Prof. Chou has published more than 350 journal and conference papers. He is an IEEE Fellow and IET Fellow, and an elected member of URSI International Radio Science US commission B.
Substrate-integrated Millimeter-Wave Antennas (Invited)

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Institute for Infocomm Research
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SUMMARY

Recently millimeter wave (mmW) technology has become a hot topic in high speed wireless communications, high resolution imaging system and vehicular radar systems. In such mmW-band systems, due to high operating frequency antenna design has many unique challenging issues, such as high losses and integration into other circuits. The changes push us to rethink about the issues related to design, materials and fabrication process in mmW antenna engineering.

The materials used in design of mmW antennas should be acceptable in terms of loss typically at an order of loss tangent of 0.001. The fabrication should reach the tolerance typically of at least 0.1-0.01 mm but at a acceptable cost. Besides the materials and fabrication process, the design also affects the key issues like loss and cost. Using substrate-integration technology, the antennas will be fabricated onto any circuit boards such as printed circuit board, low-temperature co-fired ceramic (LTCC), and semiconductor substrate to reduce cost, size, transmission loss and enhance integration into circuits.

This talk will brief the design challenges in mmW antenna design and substrate-integration technology first. After that, recently developed substrate-integrated high gain antenna arrays for 60 and 140 GHz applications are exemplified with the introduction of the latest built measurement system up to 325 GHz. Last, the comments on the development of substrate-integration technology in antenna design at mmW and submmW bands are provided.

ACKNOWLEDGMENTS

The author would like to thank his team for their excellent work in this field in the past years, who are Drs Xianming Qing, Siew Bee Yeap, Junfeng Xu, Mei Sun, Yue Li, and Yan Zhang, Ke Gong, Wei Hong, and Zhenhe Feng.

REFERENCES


Zhi Ning Chen received his B.Eng, M.Eng, and PhD degrees all in Electrical Engineering from the Institute of Communications Engineering (ICE), China and his second PhD degree from University of Tsukuba, Japan, respectively. During 1988-1995, he worked at ICE as a faculty and PDF at Southeast University, China. During 1995-1997, Professor Chen joined the City University of Hong Kong as a Researcher. In 1997, he was awarded the JSPS Fellowship to work at University of Tsukuba, Japan. In 2004, he worked at IBM T. J. Watson Research Center, USA as an Academic Visitor. During 1999-2012, he worked with the Institute for Infocomm Research as a scientist and Head of RF & Optical Department. In 2012, he joined National University of Singapore as a Professor with a joint appointment of Advisor at IFR.

Professor Chen has been the founding General Chairs of International Workshop on Antenna Technology (IWAT), International Symposium on InfoComm & Media Technology in Bio-Medical & Healthcare Applications (IS 3T-in-3A), International Microwave Forum (IMWF) as well as Asia-Pacific Conference on Antennas and Propagation (APCAP).

Professor Chen’s current research interest includes engineering electromagnetics, antennas for microwaves, mmW, submmW, and THz systems. He has published 380 technical papers, authored/edited the four books, and is holding 30 granted and filed patents. He is the recipients of several international best paper awards.

Professor Chen is a Fellow of the IEEE for the contribution to small and broadband antennas for wireless applications. He is serving IEEE Trans Antennas and Propagation as an Associate Editor and served IEEE Antennas and Propagation Society as a Distinguished Lecturer.
Reflect array Technology: From Fundamentals to Recent Advances

Chair:  Prof. Fan Yang
Tsinghua University

1. Non Conventional Re-Radiating Elements for Broad-Band Reflectarrays
   Paola Pirinoli
   Politecnico di Torino, Italy.

2. Tunable Reflectarray Antennas: ADynamic Approach for Wireless Communications
   Muhammad Yusof Ismail
   Universiti Tun Hussein Onn Malaysia, Malaysia.

3. Integration Design of High Efficiency Reflectarray for Millimeter Wave Wireless Communications
   Yan Zhang and Wei Hong
   Southeast University, China.

4. Reflectarray Antenna: Theory, Designs, and Applications
   Fan Yang
   Tsinghua University, China.
Non conventional re-radiating elements for broad-band Reflectarrays (Invited)

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Politecnico di Torino
c. Duca degli Abruzzi 24, 10129 Torino, Italy

SUMMARY

Printed reflectarrays (RAs) are nowadays a well established technology, with interesting electrical and mechanical features, virtually suitable for a wide range of applications. Nevertheless, printed reflectarrays also suffer for some drawbacks, that limit their use especially in those applications where requirements such as large bandwidth, multi-band operability and possibility of beam steering have to be satisfied.

For what concerns the bandwidth, it is essentially limited by two different reasons: the intrinsically poor bandwidth of printed radiating elements, usually no larger than the 3-6%, and the frequency dependence of the phase delay of the incident field. In particular this second aspect is quite critical and becomes dominant in large RAs [1], [2], since it requires that the RA elements should be able to compensate different phase delays at different operating frequencies. The most commonly solutions adopted for solving this problem generally result in quite complex, multi-layer re-radiating structures [3]-[5]). Recently, alternative solutions have been proposed, in which the RA elements are single-layer printed patches of non conventional shape [6]-[16], that present more degrees of freedom and therefore are potentially able to compensate also the frequency variation of the phase, allowing the bandwidth enhancement.

In this context, a possible solution is that of using a RA unit cell consisting in two or more radiating elements, resonating at different frequencies: in such a way, the range of variation of the phase for the unit cell reflection coefficient increases and therefore the enhancement of the RA bandwidth is obtained. The most suitable for this purpose are square, circular or elliptical rings [8], [9] that could be easily combined together obtaining a compact unit cell and present the further advantage of having a reduced resonant size with respect to other more conventionally shaped patches. The results reported in [9] show that among the different analyzed configurations, the most promising ones seemed to be those consisting in two concentric square rings, or in a combination of an outer circular ring and an inner square one. Using these two possible type of unit cells, reduced size RAs have been designed, manufactured and tested. While the results reported in [12] show that the two concentric square rings provide a bandwidth of about the 11%, the use of the combination of the circular and square rings allows the design of a medium-size off-set RA with a measured bandwidth of the 19%, as appears from Fig. 1, in which the variation of the measured gain with the frequency has been plotted.

A further enhancement of the bandwidth could be reached, still in the multi-resonant unit cells context, varying two or more geometrical parameters independently, in order to compensate both the reflection coefficient spatial phase delay and its frequency variation, and a proper RA design procedure [14]-[16]. In [15], two concentric square rings have been still used as re-radiating elements, but varying the size of the outermost ring and the ratio between the sides of the two rings independently: in this way it was possible to design a 19λ×19λ off-set reflectarray with a gain variation lower than 1 dB within the entire considered frequency range ([10.75-12.75] GHz); similar results have been obtained using modified Malta cross re-radiating elements [14], that have been used for the design of an off-set RA with double polarization, bandwidth greater than 19% and efficiency of the 62%.

ACKNOWLEDGMENT

The results presented here are the outcomes of the work carried out in the past years by the antenna research group of the Politecnico di Torino, and particularly by Prof. Orefice, Ing Dassano and the author, by Prof. Zich and Dr. Mussetta, from Politecnico di Milano and by Prof. Freni from University of Florence.
REFERENCES


Paola Pirinoli received the M.S. (Laurea) and Ph.D. (Dottorato di Ricerca) degrees in electronic engineering, from the Politecnico di Torino, Italy, in 1989 and 1993, respectively. In October 1994, she joined the Politecnico di Torino as an Assistant Professor (Ricercatore) in the current Department of Electronics and Telecommunications, where she presently is Associate Professor. From November 1996 to February 1997 she was a Visiting Research Fellow at University of Nice - Sophia Antipolis (F).

Her main research activities include the development of analytically based numerical techniques, essentially devoted to the fast analysis of printed structures on planar or curved substrates, the modeling of non conventional substrates, the design and analysis of antennas for wireless communications, the design of printed reflectarrays with enhanced properties. She is the co-holder of a patent on a new, non conventional printed element for single layer broad band reflectarrays.

Dr. Pirinoli received a URSI Young Scientist Award, the “Barzilai” prize for the best paper at the National Italian Conference of Electromagnetics in 1998, and was the recipient of the prize for the best oral paper on antennas at the Millennium Conference on Antennas and Propagation in 2000.
Tunable Reflectarray Antennas: A Dynamic Approach for Wireless Communications
(Invited)

M. Y. Ismail
Wireless and Radio Science Centre (WARAS)
Universiti Tun Hussein Onn Malaysia
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Abstract of the talk

For wireless communications, the antenna beam shape must be designed to satisfy the system level requirements. For example, radar acquisition systems often require the generation of multiple reconfigurable beams which must be steered rapidly within the scan volume. Mechanical systems rely on gimbals and gear arrangements of conventional parabolic reflectors to physically rotate the antenna. However, the systems are slow, gravity sensitive, and susceptible to mechanical failure. A better option is to employ electronic scanning because of faster beam steering and since no moving parts are required, this is a more robust method for obtaining the required coverage. Low profile waveguide and printed phased array antennas are well understood, however, the devices are less well developed because of the low switching, cost, weight, and power consumption simultaneously. For example, ferrite phase shifters are generally large and require high voltages, whereas semiconductor devices are expensive, and at very high frequencies, these are noisy, difficult to impedance match and have narrow bandwidth and very low efficiency. Therefore, for applications at higher frequencies, mechanical scanning is the only option available to obtain beam shaping. In recent years, there has been interest in developing tunable microwave components using nonlinear dielectrics, mainly ferroelectrics and anisotropic materials. These can be integrated into single substrates thus combining the key benefits of full integration, low weight and cost with continuous phase control. In this talk, important highlights on an alternative novel solution of creating a new integrated phase control strategy of reconfigurable reflectarray antennas by exploiting the anisotropic property of nonlinear dielectrics and strategic slot element configurations for reconfigurable antenna pattern shaping is presented. Since the dielectric constant and hence the phase properties of many of these materials are controlled by a small bias voltage, a further benefit of electronic adjustment can be made for age and environmental compensations. Furthermore, a mathematical model has been developed to establish a technique for a progressive phase distribution across the periodic structure of reflectarray antennas. Moreover, the RCS of the reflectarray can be dynamically controlled to reduce the RCS signature of the antenna.
**Biography of the Speaker**

**Name:** Muhammad Yusof Ismail, Ph.D.

**Affiliation:** Wireless and Radio Science Centre (WARAS), Universiti Tun Hussein Onn Malaysia

Dr. Muhammad Yusof Ismail received his Bachelor of Electrical and Electronics Engineering (Hons.) from Universiti Kebangsaan Malaysia in 2002. He worked as a communication engineer and as an academician in an engineering firm and Universiti Tenaga Nasional in Kuala Lumpur respectively before he furthered his doctoral program in the field of Satellite Communications. He completed his Doctor of Philosophy in Communications Engineering in 2007 from Queen's University of Belfast, United Kingdom. Dr Muhammad Yusof, who is currently a Senior Lecturer at Department of Communications Engineering, Universiti Tun Hussein Onn Malaysia (UTHM), Johor had been appointed as Deputy Dean (Research) in 2010 at the Office of Research, Innovation, Commercialization and Consultancy, UTHM. Dr. Muhammad Yusof currently heads Wireless and Radio Science Centre (WARAS) which is one of active research centres in UTHM. His research interests include design of active and passive planar antennas, microwave absorbers and frequency selective surfaces. Dr. Muhammad Yusof who is also an editor of International Journal of Integrated Engineering has published more than 70 articles including a manuscript book in high impact factor journals and indexed conferences. Based on several completed projects, he has successfully filed four patents on reflectarray antennas and microwave absorbers. He had been invited to give talks and keynote sessions at various national and international conferences in which he also received numerous research awards for best papers and best innovative research products at national and international levels. His name was also mentioned in the magazine "Marquis Who is Who in the World" edition 2011 issue of USA. Based on his research performance, he was awarded “Best Fundamental Research Grant Scheme Project Award” and was successful in securing a grant from Prototype Research Grant Scheme (PRGS) by the Ministry of Higher Education of Malaysia in 2011 and 2012 respectively.
Integration Design of High Efficiency Reflectarray for Millimeter Wave Wireless Communications (Invited)

Yan Zhang and Wei Hong
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SUMMARY

High gain, high efficiency antenna design is a challenge for millimeter-wave (mmW) long range wireless communication [1]. As is well known, the conductor loss and radiation loss are increased evidently with the operating frequency goes up. Thus, the conventional antenna array, comprising of many low-gain elements, usually suffer from severe loss due to its essentially complicated feeding network [2]. The reflectarray [3-6], inspired by conventional parabolic reflector antenna, is more preferred as an effective solution for implementing high gain antennas in mmW bands because of its air feed scheme.

In general, reflectarray is composed of a planar reflector and a primary source [3], i.e., horns or open waveguides. However, these used primary sources always have bulk sizes, and a transition between the antenna and planar circuits is necessary. Again, the transition will introduce additional insertion loss to the entire system, and cause an integration issue. To alleviate these problems, an integrated approach of the reflectarray and a planar primary source is proposed [6], and the used feed source is a substrate integrated waveguide antenna array [7], which ensures that the proposed reflectarray possesses the capability of directly integration with mmW planar circuits.

This talk will introduce the concept of reflectarray with integrated planar feed first. Then, the analysis of loss for the proposed antenna will be elaborated. Next, design considerations will be provided according to the loss factors for achieving high efficiency. Prototype in mmW bands will be presented for verification, and finally a conclusion will be drawn.

ACKNOWLEDGMENTS

The authors would like to thank their team for the contribution in this field in the past years, who are Miss Mei Jiang, Mr. Abd Elhandy, Mr. Shunhua Yu, Dr. Raj. Mittra, Dr. Haiming Wang, and Dr. Jixin Chen.

REFERENCES


Yan ZHANG (S’09-M’12) received the B. Eng. degree in Information Engineering, and Ph.D. degree in Electrical Engineering from Southeast University (SEU), Nanjing, China, in 2006 and 2011, respectively.

During Jan. 2009 to July 2009, he was with the Institute for Infocomm Research (I2R), Agency for Science, Technology, and Research (A*STAR), Singapore, as a research engineer. From Nov. 2009 to Dec. 2010, he was with the Electromagnetic Communication Laboratory of the Pennsylvania State University as a visiting scholar. Since Dec. 2011, he has been a lecture with the State Key Laboratory of Millimeter Waves, SEU.

His research interests include millimeter wave and terahertz antennas, planar transmission line techniques and filters, RF and antenna design for satellite communication.

He has published over a dozens of peer-viewed papers, and is holding 14 granted and filed patents. He is the recipient of best student paper award of the international conference on microwave and millimeter wave technology (2008). He serves as a reviewer for several journals, including IEEE Trans Antennas and Propagation, PIER, etc. He was a TPC member of 2013 IEEE MTT-S International Wireless Symposium.

This work was supported in part by NSF of Jiangsu province under Grant SBK201241785 and in part by National 973 project 2010CB327400.
Reflectarray Antenna: Theory, Designs, and Applications  
(Invited)

Prof. Fan Yang  
Microwave and Antenna Institute  
Electronic Engineering Department, Tsinghua University  
Beijing, China

Abstract:

As a new generation of high gain antenna, reflectarray antenna attracts growing interests in the last decade. Compared to conventional parabolic reflectors or phased arrays, the reflectarray antenna has a number of advantages, such as conformal geometry, low cost, light weight, high efficiency, easy integration with RF circuitry, and wide beam scanning capability. As a consequence, they have great potential in a wide range of applications, including radar, remote sensing, wireless communications, spatial power combining, and THz images and sensors. This talk will present an overview on our recent developments on reflectarray antennas, including the analysis and synthesis methods of reflectarrays, wideband and multi-band reflectarray designs, multi-beam and beam scanning reflectarrays. The presentation will also discuss several challenging topics in this area, with the hope to inspire and promote reflectarray research for future applications.

Bio:

Fan Yang received the B.S. and M.S. degrees from Tsinghua University, and the Ph.D. degree from University of California, Los Angeles (UCLA). Currently, he is a Professor at Tsinghua University, and serves as the Director of the Microwave and Antenna Institute. Dr. Yang’s research interests include antenna theory, designs, and measurements, novel electromagnetic materials, structures and their applications, computational electromagnetics and optimization techniques, and applied electromagnetic systems. He has published three books, five book chapters, and over 200 journal articles and conference papers. Dr. Yang is a Senior Member of IEEE and a Full Member of URSI/USNC. He serves as an Associate Editor for IEEE Trans. Antennas Propagation and Associate Editor-in-Chief for Applied Computational Electromagnetics Society Journal.
Keynote Speech

October 23 (WED)   Room F, 2nd Floor

10:00-10:40
A teleco's view for better and better customer expectations in multi-band, multi-network, multi-device and multi-demand smart society
Dr. Shinichi Nomoto
KDDI R&D Laboratories Inc.

10:40-11:20
4G/Multiband Handheld Device Antennas and Their Antenna Systems
Kin-Lu Wong, Professor
National Sun Yat-sen University

11:20-12:00
Rethinking the Wireless Channel for OTA testing and Network Optimization by Including User Statistics: RIMP, Pure-LOS, Throughput and Detection Probability
Per-Simon Kildal, Professor
Chalmers University of Technology
A teleco's view for better and better customer expectations in multi-band, multi-network, multi-device and multi-demand smart society

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Abstract:
Since people use smart phones in daily life, the mobile traffic over the network is changing. The rich content such as video streaming with high quality becomes popular and popular, resulting in huge traffic. The 4G (LTE) system with high capacity, launched in 2012 and now under rapid deployment, may not be sufficient to cope with the explosion. KDDI, the second-largest telco in Japan, is accelerating R&D activities towards LTE-Advanced, including Multi-User MIMO, Small Cell Enhancement, and Small-sized Active Antenna for Multi-band Basestations. Also, KDDI has a broader view under the name of “3M strategy” which comprises "Multi- Network", "Multi-Device" and "Multi-Use." We believe that further network enhancement from “Dumb Pipe” to “Smart Pipe” is the key for user-centric smarter life. Related R&D activities backed by Big Data will be introduced.

Biography
Shinichi NOMOTO received B.E., M.E., and Ph.D degrees, all in electrical engineering, from Waseda University, Tokyo, Japan, in 1980, 1982, and 1993, respectively. He joined Kokusai Denshin Denwa Co., Ltd. (now KDDI Corp.), in 1982. Since 1983, he has been engaged in research and development of radio transmission systems. As a professional assignee at Inmarsat HQ's from 1992 to 1995, he has contributed to the "Inmarsat-P (ICO)" project, which includes development of a global personal communications system using a number of non-geostationary satellites.

He is a Vice President, Managing Director, of KDDI R&D Laboratories, Inc., an R&D fellow of KDDI, a fellow of IEICE, a senior member of IEEE, and a Chairman of the Standardization Council in the Telecommunication Technology Committee (TTC). He has also been a visiting professor of Waseda University, Tokyo University of Agriculture and Technology, University of Electro-Communications, Tokyo Institute of Technology, Keio University, and Doshisha University. He received the Shinohara Memorial Young Researchers' Award from IEICE in 1988, the Piero Fanti International Prize from INTELSAT/Telespazio in 1988, and the Radio Distinguished Award from RCR (now ARIB) in 1991. In 2004, two of his published papers received the Best Paper Awards from IEICE, one of which was the recipient of the 10th Inose Award (the very best paper of the year) too. In 2010, he received the Prize for Science and Technology (Development Category) in the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology. He also received the 58th Maejima Hisoka Prize from Tsushinbunka Association in 2013.
4G/Multiband Handheld Device Antennas and Their Antenna Systems

Kin-Lu Wong
Department of Electrical Engineering
National Sun Yat-sen University, Kaohsiung, Taiwan
http://antenna.ee.nsus.edu.tw

Abstract
Promising 4G/multiband antennas for handheld devices will be presented. Some low-profile, small-size and wideband techniques for LTE/WWAN antennas will be addressed. The ground antenna design concept and promising ground antenna structure will be introduced, which is especially suitable for slim, flexible handheld devices. The promising antenna systems using the same for achieving wideband high-isolation antenna systems for MIMO, diversity or dual WWAN operation will be discussed.

Future trends for the handheld device antennas including the reconfigurable and tunable antennas that can be adaptive to environmental changes or tunable to cover different bands or switched to have multi-beams or suitable for antenna systems will also be discussed.

Biography
Prof. Kin-Lu Wong is Sun Yat-sen Chair Professor of National Sun Yat-sen University, Kaohsiung, Taiwan. He has published more than 500 refereed journal papers and 250 conference articles. He holds over 200 patents and is the author of three books including Compact and Broadband Microstrip Antennas (Wiley, 2002) and Planar Antennas for Wireless Communications (Wiley, 2003). Dr. Wong’s published works have been cited over 14,000 times in Google Scholar.

Dr. Wong is an IEEE Fellow and received many awards including NSC (National Science Council) Outstanding Distinguished Researcher in 2013, top 50 NSC scientific achievements in past 50 years (1959~2009) in Taiwan, and the Academic Award from Ministry of Education of Taiwan, in 2012. He was selected as top 100 honor of Taiwan by Global Views Monthly in August 2010 for his contribution in mobile antenna researches. Dr. Wong received the 2008 APMC Best Paper Award (APMC Prize), and is an IEEE AP-S Awards Committee member (2011~2013). Dr. Wong was General Chair of 2012 APMC and will also serve as General Chair of 2014 ISAP at Kaohsiung, Taiwan.
Rethinking the Wireless Channel for OTA testing and Network Optimization by Including User Statistics: RIMP, Pure-LOS, Throughput and Detection Probability

Per-Simon Kildal, Professor
Chalmers University of Technology

Abstract
The reverberation chamber has through the last thirteen years been used to emulate a rich isotropic multipath (RIMP) environment, and it has successfully been demonstrated that it can be used to test performance of multiport antennas and complete wireless terminals with MIMO and OFDM. The measured throughputs of practical LTE devices have been shown to be in excellent agreement with basic theoretical algorithms.
Now is the time to use this concept and complete the picture so that also real-life environments can be covered. This is done by introducing the pure-LOS as another limiting environment, and by introducing the statistics of the user. The latter plays a major role in pure-LOS that thereby becomes a random-LOS. The two limit-environments are linked together with a real-life hypothesis, and work has started to test this by simulations.
It will be shown that the major characterizing quantity becomes the detection probability of the single or multiple bit streams (for diversity and multiplexing cases, respectively) over an ensemble of users. This detection probability becomes equal to throughput in a multipath environment, readily seen through a simple threshold receiver model representing an ideal digital receiver.
The new approach represents a way to start optimizing the wireless networks by taking the statistics of the user into account.

Biography
Professor Per-Simon Kildal, Distinguished Lecturer of IEEE Antennas and Propagation Society 2011-2013
Per-Simon Kildal is professor in antennas at Chalmers University of Technology in Gothenburg, Sweden since 1989. He is teaching antennas and heading a group doing research on antenna systems. Until now, 19 persons have received a Ph.D. from him.
Kildal received two doctoral degrees from the Norwegian Institute of Technology in Trondheim. He is a Fellow of IEEE since 1995, and in 2011 he was awarded the prestigious Distinguished Achievements Award from the IEEE Antennas and Propagation Society. Kildal has authored more than 120 articles in scientific journals; concerning antenna theory, analysis, design and measurements, two of which was awarded best paper awards by IEEE (1985 R.W.P. King Award and 1991 Schelkunoff Prize Paper Award).
Kildal’s research is innovative and industrially oriented, and has resulted in several patents and related spinoff companies. He has done the electrical design of the 40m x 120 m cylindrical reflector antenna and line feed of the EISCAT scientific organization, and the dual-reflector Gregorian feed of the 300 m Ø radio telescope in Arecibo. He is the inventor
behind technologies such as dipole with beam forming ring, the hat antenna, and the eleven feed. Kildal’s hat-fed reflectors have till now been manufactured in more than 930 000 copies for use in radio links.

Kildal was the first to introduce the reverberation chamber as an accurate measurement instrument for Over-The-Air (OTA) characterization of small antennas and wireless terminals for use in multipath environments with fading, commercialized in Bluetest AB. Kildal is also the originator of the concept of soft and hard surfaces from 1988, today being regarded as the first metamaterials concept. This concept is the basis of his newest and most fundamental invention, the gap waveguide technology.

Kildal organizes and lectures in courses within the European School of Antenna (ESoA, www.antennasvce.org). His textbook Foundations of Antennas - A Unified Approach (Lund, Sweden: Studentlitteratur, 2000) was well received, and is now in the process of being revised.
Session List

October 23 (WED) ~ October 25 (FRI)
### ORAL Session: WP-1(A)
**Adv Ant for Radio-Astr. -1**  
Session Chair: Jian Yang, Bo Peng

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<th>Time</th>
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Session Chair: Le-Wei Li, Qiang Chen

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Computational EM
Session Chair: André Barka, Yaming Bo

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*Lu Huang, Bi-yi Wu, Xin-qing Sheng* (China)

08:20 - 08:40  Finite Macro-Element Method for Two-Dimensional Eigen-Value Problems
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P.35 Design of Millimeter Wave Waveguide-Fed Omnidirectional Slotted Array Antenna
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**A &P for Mobile Comm.**

Session Chair: J. W. Modelski, Eko T Rahardjo

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<td>Tunable Antenna Impedance Matching for 4G Mobile Communications</td>
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### ORAL Session: FA-2(A)
**A &P for MIMO Comm.**

Session Chair: Richard W Ziolkowski, Jiaying Zhang

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MMW & THz Antennas
Session Chair: Xiaodong Chen, Makoto Ando

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Wenyan Ji, Haitao Wang, Zejian Lu, Yuan Yao, Junsheng Yu, Xiaodong Chen (China)

08:20 - 08:40 Millimeter Wave Power Divider Based on Frequency Selective Surface (Invited Paper)
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08:40 - 09:00 Equivalent Radius of Dipole-patch Nanoantenna with Parasitic Nanoparticle at THz band

09:00 - 09:20 Design and Implementation of A Filtenna with Wide Beamwidth for Q-Band Millimeter-Wave Short Range Wireless Communications
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09:20 - 09:40 Design of Terahertz Ultra-wide Band Coupling Circuit Based on Superconducting Hot Electron Bolometer Mixer
Chun Li, Lei Qin, Miao Li, Ling Jiang (China)

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MMW Antennas
Session Chair: Takeshi Manabe, Yan Zhang

10:30 - 10:50 Design of a Linear Array of Transverse Slots without Cross-polarization to any Directions on a Hollow Rectangular Waveguide
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10:50 - 11:10 Design of Package Cover for 60GHz Small Antenna and Effects of Device Box on Radiation Performance
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11:10 - 11:30 A Novel 60 GHz Short Range Gigabit Wireless Access System using a Large Array Antenna
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11:30 - 11:50 60 GHz On-Chip Loop Antenna Integrated in a 0.18 μm CMOS Technology
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11:50 - 12:10 Microstrip Comb-Line Antenna with Inversely Tapered Mode Transition and Slotted Stubs on Liquid Crystal Polymer Substrates
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14:50 - 15:10 The Analysis of Sea Clutter Statistics Characteristics Based On the Observed Sea Clutter of Ku-Band Radar
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#### Slot Antennas
Session Chair: Tsenchieh Chiu, Peng Chen

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