

IEEE IMWS-Bio 2013

Final Program

**2013 IEEE MTT-S
International Microwave Workshop Series
on RF and Wireless Technologies for
Biomedical and
Healthcare Applications**

**December 09 – 11, 2013
Singapore**



Sunday, December 8, 2013			
13:30-18:00	Registration, Apollo Room, Level 1		
Monday, December 9, 2013			
Registration, Level 3			
07:30-15:00	Venus I, Level 3	Jupiter III, Level 3	
08:30-09:00	Opening Address		
09:00-10:20	(MK1) Keynote Speeches		
10:20-10:50		Tea Break	
10:50-12:10	(MK2) Keynote Speech and Distinguished Microwave Lecture		
12:10-13:20		Lunch (The Square @ Level 2)	
13:20-15:20	(MP1)		(MP2)
	Wireless power for on-/in-body devices (I)		RF/microwave methods and hardware for high-field MRI
15:20-15:40		Tea Break	
15:40-17:30	Industry Seminars		
18:00-21:00	Welcome Reception (Mercury @ Level 5)		
Tuesday, December 10, 2013			
Registration, Level 3			
08:00-15:00	(TK1) Keynote Speeches		
08:30-10:30		Tea Break	
10:30-10:50	(TA2)		(TA1)
10:50-12:10	RFIC technologies, devices, and sensors for biomedical applications (I)		Microwave imaging for biomedical applications (I)
12:10-13:20		Lunch (The Square @ Level 2)	
13:20-15:10	(TP2)		(TP1)
	Antennas and body channel modeling for off-/on-/in-body communications (I)		Wireless localization and remote patient monitoring (I)
15:10-15:40		Tea Break	
15:40-17:30			
18:00-21:30	TPoster (Jupiter II/III)		
Banquet and Awards Presentation (Mercury @ Level 5)			
Wednesday, December 11, 2013			
Registration, Level 3			
08:30-12:00			
08:30-10:30	(WA2)		(WA1)
	RFIC technologies, devices, and sensors for biomedical applications (II)		Therapeutic and diagnostic applications of RF/microwave technologies
10:30-10:50		Tea Break	
10:50-12:10	(WA4)		(WA3)
	Antennas and body channel modeling for off-/on-/in-body communications (II)		Wireless localization and remote patient monitoring (II)
12:10-13:20		Lunch (The Square @ Level 2)	
13:20-15:20	(WP2)		(WP1)
	RF and wireless techniques for implants and body-centric communications		Emerging theories/technologies in microwaves for biomedical applications
15:20-15:40		Tea Break	
15:40-17:00	(WP4)		(WP3)
	Wireless power for on-/in-body devices (II)		Microwave imaging for biomedical applications (II)

2013 IEEE MTT-S International Microwave Workshop
Series on RF and Wireless Technologies
for Biomedical and Healthcare Applications
(IEEE IMWS-Bio 2013)

Final Technical Program

December 09-11, 2013
Furama Riverfront Hotel
Singapore

Organizers



Technical Co-Sponsors



2013 IEEE MTT-S International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications

Organizers

National University of Singapore

Nanyang Technological University

Singapore University of Technology and Design

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Welcome Message from the General Chairs



On behalf of the organizing committee, and with great pleasure, we warmly welcome you to the 2013 IEEE MTT-S International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-Bio 2013) to be held at the Furama Riverfront Hotel, Singapore from

Monday, December 09 to Wednesday, December 11, 2013. The organizing committee has put together a comprehensive technical program to facilitate the exchange of information on the progress and advancements of RF and wireless technologies for biomedical and healthcare applications, along with a memorable and entertaining social program.

IEEE IMWS-Bio 2013 is co-organized by National University of Singapore, Nanyang Technological University and Singapore University of Technology and Design. This workshop is technically co-sponsored by IEEE, IEEE MTT Society, IEEE AP Society, IET, IEEE Singapore Section and IEEE MTT/AP Joint Singapore Chapter. The IEEE IMWS is an initiative promoted by the MTT-S Transnational Committee (now renamed Members & Geographic Committee), to complement the existing workshops of the MTT-S International Microwave Symposium. The purpose of this new platform is to boost and promote MTT-S technical and educational activities as well as MTT-S international exchanges and collaborations. The IEEE IMWS-Bio 2013 brings in a unique mix of high-quality keynote, invited and contributed papers. In particular, we urge you not to miss our keynote and invited talks, featuring innovative and enabling technologies on RF and wireless technologies for biomedical and healthcare applications, by world-class speakers from the industry and academia.

In addition to the comprehensive technical and scientific program and exciting social events, the IEEE IMWS-Bio 2013 also offers you ample opportunities to explore the most vibrant Singapore. You will be enthralled by the multitude of entertainment and leisure options available, not to mention the mouth-watering foods that you can sample in Singapore. We invite you to come and enjoy all these wonderful activities specially organized for you, see old friends and make new ones.

We look forward to welcoming you all in the Lion City!

Yongxin Guo (General Chair)
National University of Singapore, Singapore

Wee Ser (General Co-Chair)
Nanyang Technological University, Singapore

Welcome Message from the TPC Chairs



On behalf of the Technical Program Committee (TPC), we cordially welcome you to the IEEE MTT-S International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-Bio 2013) to be held in Singapore on December 09-11, 2013.

The IMWS-Bio 2013 received a total submission of 170 papers, including invited papers and regular papers from 22 countries. Each paper was reviewed by at least two expert reviewers and the final decisions were made at the TPC meeting held in Singapore in September 2013. Among all the submissions, all of the invited papers and 35 regular papers were accepted for oral presentations; 77 regular papers were accepted for poster presentations. The TPC is very pleased with the quality of the submissions and we trust that you will find many papers interesting and informative.

The technical sessions will be divided into oral and poster sessions. The oral sessions will be split into two parallel tracks spanning over three days. In addition to the regular sessions, we are honoured to have seven renowned experts as plenary speakers and one Distinguished Microwave Lecture from the IEEE Microwave Theory and Techniques Society (MTT-S). Another highlight is the best paper awards for two categories, i.e., the best regular paper and the best student paper. They were nominated by the TPC after considering reviewers' review reports and were further carefully evaluated by the Awards Committee.

The TPC has worked hard to generate a diverse and well-organized technical program, which covers nearly all topics on the RF and Wireless Technologies for Biomedical and Healthcare applications. On behalf of the TPC, we would like to express our sincere thanks to all authors for their contributions to the workshop. We would like to express our sincere appreciation to all TPC members, sub-committee chairs, reviewers, panelists, session chairs, and all who have been involved for their effort and dedication in finalizing this technical program. In particular, we would like to thank the IEEE MTT-S for their strong support to this workshop.

We are looking forward to seeing you in Singapore!

Xudong Chen (TPC Chair), National University of Singapore, Singapore
Minkyu Je (TPC Co-Chair), Institute of Microelectronics, Singapore
Dominique Schreurs (TPC Co-Chair), University of Leuven, Belgium
Ada Poon (TPC Co-Chair), Stanford University, USA

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Shiwen Yang

Xue-Xia Yang

Jijun Yao

Kamya Yekeh Yazdandoost

Yong-Kyu Yoon

Hao Yu

Lei Zhao

Yuanjin Zheng

Min Zhang

Conference Venue



Venue Address

Furama Riverfront Hotel Singapore
409 Havelock Road
Singapore 169633
Tel: (65) 6333 8898
Fax: (65) 6733 1588

How to get to the Furama Riverfront Hotel

- **By Cab**

Travel time: 20 mins approx., Charges: S\$26 approx.*

* Please note that fare rates may vary depending on taxi type, traffic condition, routes taken, as well as peak/electronic road pricing (ERP) surcharges.

- **By MRT (Mass Rapid Transit)/Bus**

(Method 1) Take MRT from Changi Airport (CG2) and alight 2 stops later at Tanah Merah (EW4). Board train towards Joo Koon, alight 9 stops later at City Hall (EW13). Walk to bus-stop @ North Bridge Road, opposite Peninsular Plaza (B04168) and take bus 51. Alight 6 stops later at Havelock Road, Miramar Hotel (B06151) and walk about 150 m to Furama Riverfront Hotel.

[Travel time: 1 hr approx.]

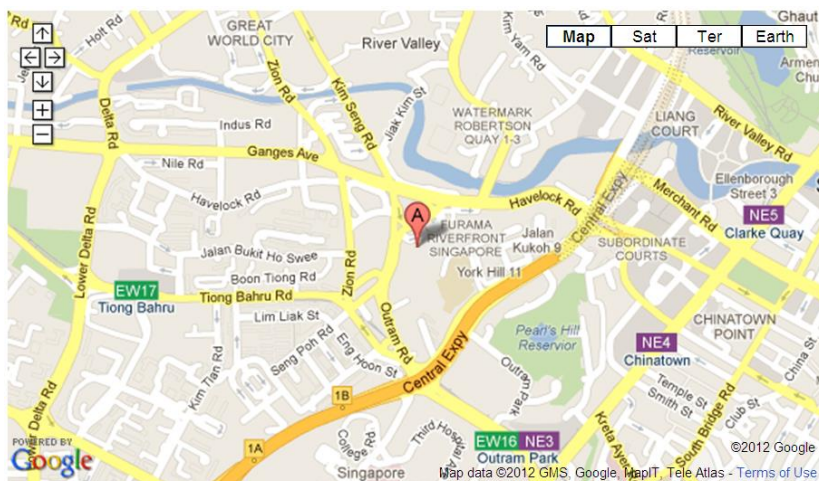
(Method 2) Take MRT from Changi Airport (CG2) and alight 2 stops later at Tanah Merah (EW4). Board train towards Joo Koon, alight 12 stops later at Outram Park (EW16). Walk about 150 m to bus-stop @ Outram Road, opposite Outram Park MRT station (B06011) and take bus 970. Alight 2 stops later at Zion Road, Blk 2B (B06071) and walk about 350 m to Furama Riverfront Hotel.

[Travel time: 1 hr approx.]

Nearest Bus Stop: Bus 1N, 2N, 3N, 4N, 5N, 6N, 51, 64, 123 and 186 (2 mins walk from bus stop B06151).

Nearest MRT station: Outram Park MRT (NE3/EW16).

Location Map



Useful Telephone Numbers

Police	999	Airport Flight Information	1800 542 4422
Fire/Ambulance	995	Directory Assistance	6777 7777
Non-Emergency Ambulance	1777	Singapore Tourism Board	1800 738 3778
Police Hotline	6225 0000	NTUC Comfort Taxi	6552 1111
Singapore General Hospital	6222 3322	Foreign Mission One Call Centre	1800 334 4800

Registration

Registration will be opened according to the following schedule:

December 08, 2013 (Sunday)	13:30–18:00, Apollo Room, Level 1
December 09, 2013 (Monday)	07:30–15:00, near Venus I, Level 3
December 10, 2013 (Tuesday)	08:00–15:00, near Venus I, Level 3
December 11, 2013 (Wednesday)	08:30–12:00, near Venus I, Level 3

The on-site registration fee is shown in the following table. If you have pre-registered, your name badge and Technical Program book will be ready for you to pick up during the above conference registration time. Please wear your name badge throughout the conference. Access will be prohibited to the exhibition, tea break, and technical sessions if a name badge is not present.

	On-site
IEEE Member	SGD950
Non-IEEE Member	SGD1080
IEEE Student Member	SGD650
Non-IEEE Student Member	SGD750

Kindly ensure that you receive the coupons for luncheons and conference banquet when you register at the conference desk. Each (Regular and Student) registration is entitled to three luncheon coupons and each Regular registration is entitled to one banquet coupon.

Additional banquet coupons are also available at SGD 120 per coupon. Electronic version of the proceedings is also available at SGD 50 per copy.

Please remember to collect the hardcopy of the receipt from the registration desk if necessary.

Session Information

Instructions for Presenters in Oral Sessions

Speakers are requested to be in their respective session rooms at least 10 minutes prior to the commencement of each session. The duration of the invited paper presentation is 25 minutes. This includes 20 minutes for the presentation itself and 5 minutes for questions from the audience. The duration of the regular paper presentation is 15 minutes, which includes 12 minutes for the presentation itself and 3 minutes for questions from the audience. We could appreciate it if all presenters can adhere strictly to this time limit.

Presentation slides must be prepared using Microsoft PowerPoint or Adobe Acrobat. Speakers should bring their files on a thumb-drive and upload their file at least 10 minutes before the commencement of each session as well as report to their respective Session Chairs. A standard LCD projector (connected to a local PC) will be provided in each conference room.

All papers must be presented in person at the conference in order to be included in the proceedings published in IEEE Xplore[®].

Instructions for Presenters in Poster Sessions

The venue for the poster sessions will be inside the Jupiter II/III Room. Poster stands will be provided with foam boards for you to mount the poster. The size of the poster should be A1 (841 mm x 594 mm). It is advisable that your poster be readable from 1.5 to 2 m away.

Please set up your poster at least 10 minutes before the start of the session. Speakers (presenting authors) are requested to stay at their posters during the poster session. After the session, posters must be removed by the speaker him/herself. All papers must be presented in person at the conference in order to be included in the proceedings published in IEEE Xplore[®].

Instructions for Oral Session Chairs

We provide a small bell in every session room. Please ring a reminder bell as follows: at 18 minutes for invited paper; at 10 minutes for regular paper. That is, 2 minutes after the ring reminder, the presentation should be finished, and then Q & A will start.

It is a good idea to warn your presenters at the start of the session that you will be ringing this bell. Please leave this bell in the room for the next chairperson.

Please remember the time frame. Keeping the program to time is very important and please be aware of the time periods (slots) speakers have been designated to present.

Instructions for Poster Session Chairs

As a Session Chair, we appreciate that you check if all authors are present at the session. In order for you to meet the Presenters in advance, be at the room of your session 10 minutes before the beginning of the session.

There will be student volunteers in the room to ensure that facilities are functioning properly, and to give you any assistance you may require during the session.

Social Program

Welcome Reception

Date: December 09, 2013 (Monday)

Time: 18:00–21:00 hrs

Venue: Mercury Ballroom, Level 5, Furama Riverfront Hotel

Cost: Free for all registered attendees, exhibitors and guests

Banquet and Awards Presentation

Date: December 10, 2013 (Tuesday)

Time: 18:00–21:30 hrs

Venue: Mercury Ballroom, Level 5, Furama Riverfront Hotel

Cost: One coupon included for each Regular Registration. Additional coupons are available at SGD 120 each from the registration desk.

Keynote Speech

MK1-1 (Monday, 09:00-09:40)

Frontiers of Implantable Neuro Technologies: from Nerve to Brain to Brain Machine Interface



Nitish V. Thakor

National University of Singapore, Singapore

Johns Hopkins University, USA

Abstract

Implantable technologies have had major impacts in many medical fields such as cardiology (pacemakers, defibrillators, stents), sensory prosthesis (cochlear implant, retinal prosthesis) and treatment of diseases or impairments (Parkinson's, diabetes). During the past decade revolutionary advances have entered the field of neuroscience/neurological disorders and their treatment (e.g. deep brain stimulators for Parkinson's and seizure) and therapeutic treatments of limbs (upper and lower limb prosthesis). The cutting edge is the development of neuroprosthesis: namely building various interfaces to nerves, spinal cord and brain to control impaired limbs or prosthesis. This talk will review medical problems and exciting research opportunities for engineers to develop cutting edge technological solutions: MEMS electrodes, ultra low power VLSI circuits, wireless power and data transfer and power harvesting. While these technologies are essential, critical success will only come through complete integration of technology with the nervous system, and testing in vivo from animal models to humans. Two examples from our own will be discussed: neural prosthesis for control of prosthetic limb and bidirectional neural interface for nerves. Talk will conclude with the current status and challenges in the field of Brain Machine Interface.

Nitish V. Thakor is a Professor of Biomedical Engineering, Electrical and Computer Engineering, and Neurology at Johns Hopkins and directs the Laboratory for Neuroengineering. He is also the Director the Singapore Institute for Neurotechnology (SINAPSE) at the National University of Singapore. Dr. Thakor's technical expertise is in the field of Neuroengineering, including neural diagnostic instrumentation, neural microsystems, neural signal processing, optical imaging of the nervous system, neural control of prosthesis and brain machine interface. He is currently the Editor in Chief (EIC) of Medical and Biological Engineering and Computing, and was the EIC of IEEE Transactions on Neural Systems and Rehabilitation Engineering from 2005-2011. Dr. Thakor is a recipient of a Research Career Development Award from the National Institutes of Health and a Presidential Young Investigator Award from the National Science Foundation, and is a Fellow of the American Institute of Medical and Biological Engineering, IEEE, Founding Fellow of the Biomedical Engineering Society, and Fellow of International Federation of Medical and Biological Engineering. He is a recipient of the award of Technical Excellence in Neuroengineering from IEEE Engineering in Medicine and Biology Society, Distinguished Alumnus Award from Indian Institute of Technology, Bombay, India, and a Centennial Medal from the University of Wisconsin School of Engineering.

Keynote Speech

MK1-2 (Monday, 09:40-10:20)

Bio-Telemetry Creating an Exciting Paradigm in Modern Healthcare System: Medical Monitoring and Diagnostics using Ingestible Capsules



**Yahya Rahmat-Samii,
University of California, Los Angeles, USA**

Abstract

About quarter of century ago, the research community was advertising the concept of “global connectivity with anyone, at any time, in any place and with any amount of data”. This is now a reality. The next big concept is “bio-telemetry connecting patients to their doctors and hospitals at anytime, any location and with any amount of monitoring and diagnostics data”. History has shown that it typically takes about quarter of century to bring any out-to-the-box idea into the mainstream. We are in the midst of this new paradigm to becoming a reality. Advances over the past decade has enabled the use of smart capsules (electronic digestible pills) in biomedical applications helping in the treatment and diagnosis of various diseases (GI tract diseases, etc.). One of the paramount components in effective implementation of these devices is the development of unique ingestible capsule antenna designs for smart pill systems suitable for medical monitoring and diagnostic applications. In this paper two classes of application are considered. First a novel conformal offset fed meandered dipole capsule antenna is discussed for medical diagnostic procedures. The antenna performance is evaluated by studying the impedance, radiation, polarization and return loss characteristics inside the human body model. A link budget is evaluated to ensure successful and robust wireless telemetry. Next an RFID bio-capsule tag is presented for medicine monitoring purposes. The tag is designed based on

concept of inductive feed loop coupled to conformal meandered dipole. The tag performance is evaluated inside the human body model in terms of impedance, radiation pattern and power reflection characteristics. The unique tag design matches to the chip impedance only when the tag is inside the human body. Future outlook for the medical monitoring and diagnostics within the paradigm of the bio-telemetry health care system will be highlighted.

Yahya Rahmat-Samii, Distinguished Professor of Electrical Engineering, and Northrop-Grumman Chair in electromagnetics, is a member of the National Academy of Engineering (NAE) and the former chairman of the Electrical Engineering Department at the University of California, Los Angeles (UCLA). Before joining UCLA, he was a Senior Research Scientist at Caltech/NASA's Jet Propulsion Laboratory (JPL). Dr. Rahmat-Samii was elected 1995 President of the IEEE Antennas and Propagation Society (AP-S) and currently serves as the chairman of the U.S. National Committee of URSI for the duration of 2009-2011. Rahmat-Samii's dedication to research and teaching has resulted in more than 800 technical journal articles and conference papers, more than 30 book chapters, four books titled, *Electromagnetic Optimization by Genetic Algorithms*, *Electromagnetic Band Gap Structures in Antenna Engineering*, and *Impedance Boundary Conditions in Electromagnetics and Implanted Antennas in Medical Wireless Communications*, and several patents. His pioneering research contributions cover a diverse area of electromagnetics and antennas with many applications in wireless, cell phone and satellite communications, planetary and remote sensing missions and bio-telemetry and medical devices. Rahmat-Samii has been appointed an IEEE Distinguished Lecturer for the second time, presenting lectures internationally. Dr. Rahmat-Samii was elected as a Fellow of IEEE in 1985 and a Fellow of IAE in 1986 and also served as the Vice President of AMTA. Dr. Rahmat-Samii has received numerous awards, including the 1992 and 1995 Wheeler Best Application Prize Paper Award for his papers published in the IEEE Antennas and Propagation Transactions, 1999 University of Illinois ECE Distinguished Alumni Award, IEEE Third Millennium Medal, and AMTA'2000 Distinguished Achievement Award. In 2001, Rahmat-Samii was the recipient of an Honorary Doctorate in Physics from the University of Santiago de Compostela, Spain. In 2001, he was elected as a Foreign Member of the Royal Flemish Academy of Belgium for Science and the Arts. In 2002, he received the Technical Excellence Award from JPL and in 2005 he was the recipient of the URSI Booker Gold Medal. He is the recipient of the 2007 Chen-To Tai Distinguished Educator Award of the IEEE Antennas and Propagation Society and in the same year elected as Edmond S. Gillespie Fellow of Antenna Measurement Techniques Association. In 2009, he received the IEEE Antennas

and Propagation society Distinguished Achievement Award. In 2010, he was the recipient of the Lockheed Martin Excellence in Teaching Award from The Henry Samueli School of Engineering and Applied Science, UCLA. Prof. Rahmat-Samii is the designer of the IEEE AP-S logo which is displayed on all IEEE AP-S publications.

Keynote Speech

MK2-1 (Monday, 10:50-11:30)

WBAN Circuits and Systems



Hoi-Jun Yoo

**Korea Advanced Institute of Science and
Technology, Republic of Korea**

Abstract

According to a paradigm shift in advent of u-healthcare era, a demand to control the number of portable and implantable personal healthcare devices in a single wireless network is strongly increased. Finally in February 2012, IEEE 802.15 WBAN task group established the standard for a short-range, low-power and highly reliable wireless communication around the human body.

In this talk, we will overview the WBAN standard with summarizing its three types of physical layers (PHYs) including narrowband (NB), ultra-wideband (UWB), and human body communication (HBC). Especially among three PHYs, HBC, which uses the human body as a communication channel, has remarkable advantages in energy efficiency over NB and UWB, because it has lower path loss without the body shadowing effect of RF communication, and it utilizes electrodes as a communication interface rather than a low impedance antenna. With these critical advantages, human-friendly HBC is expected to play an important role in medical and health-care applications.

In multiple studies with the clear understanding of the body channel with a T-shaped body channel model and theoretical channel analysis based on Maxwell equation, we present 6 HBC transceivers implemented in CMOS technology, including from the prototype system to the world's first WBAN transceiver satisfying all of the specifications listed in IEEE 802.15.6 standard. Through these implemented transceivers with a high perfection, we successfully demonstrate MP3 player for entertainment, and the smart-patch system for healthcare application examples.

These small revolutionary steps for human-friendly systems make a giant leap for the life pattern of mankind ultimately, expecting to strengthen the individual life healthier, happier and more comfortable.

Hoi-Jun Yoo received the B.S. in electronics from Seoul National University, Seoul, Korea, in 1983, and the M.S. and Ph.D. degrees in electrical engineering from the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea, in 1985 and 1988, respectively.

In 1998, he joined the faculty of the Department of Electrical Engineering at KAIST and now is a full Professor. From 2001 to 2005, he was the Director of the Korean System Integration and IP Authoring Research Center (SIPAC). From 2003 to 2005, he was the full-time Advisor to Minister of Korea Ministry of Information and Communication and National Project Manager for SoC and Computer. In 2007, he founded the System Design Innovation and Application Research Center (SDIA), KAIST. Since 2010, he has served the General Chair of the Korean Institute of Next Generation Computing Seoul, Korea. He is a coauthor of DRAM Design (Korea: Hongleung, 1996), High Performance DRAM (Korea: Sigma, 1999), Networks on Chips (Morgan Kaufmann, 2006), Low-Power NoC for High-Performance SoC Design (CRC Press, 2008), Circuits at the Nanoscale (CRC Press, 2009), Embedded Memories for Nano-Scale VLSIs (Springer, 2009), Mobile 3-D Graphics SoC from Algorithm to Chip (Wiley, 2010), and Bio-Medical CMOS ICs (Springer, 2011). His current interests are computer vision SoC, Body Area Networks, biomedical devices and circuits.

Dr. Yoo received the Electronic Industrial Association of Korea Award for his contribution to DRAM technology in 1994, Hynix Development Award in 1995, the Korea Semiconductor Industry Association Award in 2002, Best Research of KAIST Award in 2007, Scientist/Engineer of this month Award from Ministry of Education, Science and Technology of Korea in 2010, Best Scholarship Awards of KAIST in 2011, and Order of Service Merit from Ministry of Public Administration and Security of Korea in 2011 and has been a corecipient of the ASP-DAC Design Award in 2001; Outstanding Design Awards of the 2005, 2006, 2007, 2010, and 2011 A-SSCC; and the Student Design Context Award of 2007, 2008, 2010, and 2011 DAC/ISSCC. He has served as a member of the executive committee of ISSCC, Symposium on VLSI, and A-SSCC and the TPC chair of the A-SSCC 2008 and ISWC 2010, IEEE Distinguished Lecturer (2010–2011), and Far East Chair of ISSCC (2010–2011).

Distinguished Microwave Lecture

MK2-2 (Monday, 11:30-12:10)

Implantable Wireless Medical Devices and Systems



J. C. Chiao,

University of Texas at Arlington, USA

Abstract

Radio frequency identification (RFID) has been utilized to increase efficiency and care quality in hospitals for patient information management, drug and equipment inventory, scheduling and staffing. To further improve healthcare, enable new diagnosis and treatment while aiming to reduce costs, major technical challenges still exist. Limited sampling and acquisition of physiological parameters during the interaction period for caregivers and patients provide incomplete information about the patients. Better care with higher diagnosis accuracy can be provided if more and time-lapsed data can be obtained without causing patients discomfort or limiting their mobility. Meanwhile, patient data documentation has become too cumbersome. The lack of portability and timely accessibility of the physiological information prevent real-time management by caregivers and/or patients themselves. Wireless technologies bring promising solutions to the aforementioned issues. Low-cost portable wireless electronics have made significant impacts to our societies. Furthermore, recent advances in micro- and nano-technologies provide unique interfacing functionalities to human tissues, and advantages such as miniaturization and low power consumption enabling novel applications in medicine and biological studies. Interfaces between biological objects and electronics allow quantitative measurement and documentation of physiological and biochemical parameters, and even behaviors. The interfaces also provide direct control or modification of cells, tissues, or organs by the electrical circuits making it possible to manage chronic diseases with a closed loop between biological objects and computers. With wireless communication, implantable devices and systems make the interfacing possible for freely behaving animals or patients without constraints, discomfort or limits in mobility. This increases the study or diagnosis accuracy in realistic environments

as well as permits remote synthesis of physiological functions and delivery of therapeutic treatment. Furthermore, wireless communication enables networks for ubiquitous access to physiological information at various system levels either within one's body or within a group of patients for better deterministic and statistical understanding of issues in complex systems. The lecture focuses on the development of wireless micro devices and systems for clinical and biological applications. The systems are based on technology platforms such as wireless energy transfer for batteryless implants, miniature electrochemical sensors, nanoparticle modified surfaces, microelectromechanical system devices and microwave communication. In this talk, several implantable wireless diagnosis and therapeutic treatment systems will be discussed. An integrated wireless body network for chronic pain management has been demonstrated with wireless closed-loop integration of neurorecorders to recognize pain signals and neurostimulators to inhibit pain. Batteryless endoluminal sensing telemetry architecture has been demonstrated for an esophagus implant for remote diagnosis of gastroesophageal reflux disease (GERD), an endoscopically-implantable wireless gastro-stimulator for gastroparesis management, and a wireless bladder volume monitoring implant for urinary incontinence management. These applications enable new medicines to improve human welfare and assist better living.

J. C. Chiao received his Ph.D. degree at California Institute of Technology in 1995, and served as a Research Scientist at Bell Communication Research, Assistant Professor at University of Hawaii, and Product Line Manager and Senior Technology Advisor at Chorum Technologies from 1996 to 2002. He joined UTA as an Associate Professor in 2002. He is now a Jenkins Garrett Professor of Electrical Engineering and Joint Biomedical Engineering Program at University of Texas - Arlington; and an Adjunct Associate Professor in the Internal Medicine Department at UT-Southwestern, Medical Center. Dr. Chiao is a senior member of IEEE. He has published numerous peer-reviewed papers, edited several proceedings and books, and chaired several international conferences. He obtained five awarded and six pending patents. He received the 2011 O'Donnell Award in Engineering presented by The Academy of Medicine, Engineering and Science of Texas (TAMEST). He also received the 2011 Dallas Fort Worth Metroplex Technology Business Council Tech Titan Technology Innovator Award, and 2011 Lockheed Martin Aeronautics Company Excellence in Engineering Teaching Award. His webpage is at <http://www.uta.edu/faculty/jcchiao/>.

Keynote Speech

TK1-1 (Tuesday, 08:30-09:10)

Integrated BioMEMS



Dennis L. Polla

**Intelligence Advanced Research Projects Activity,
USA**

Abstract

The Trusted Integrated Chips (TIC) program at the Intelligence Advanced Research Projects Activity (IARPA) is exploring new ways to integrate sensing, power, communications, actuators, and photonics with advanced CMOS electronics fabricated at sub-130nm nodes. When processed in a vertical structure, such integration is often referred to as 3D heterogeneous stacking and is likely to enable tremendous opportunities for the semiconductor industry's More-than-Moore roadmap strategy.

A heterogeneous stacking of electronics and MEMS related approaches are important for biosensors where small systems size can potentially lead to benefits in localized sensing, onsite information processing, and wireless readout.

This paper will describe the opportunities and challenges of integrated BioMEMS for sensing in medicine and other life sciences applications.

Dennis Polla is currently the Deputy Director of the Safe and Secure Operations Office at for the Office of the Director of National Intelligence - IARPA and serves as the Program Manager for IARPA's Trusted Integrated Chips Program (TIC) and Bio Intelligence Chips (BIC) Program. His technology responsibilities are in nanotechnology and microelectronics cybersecurity.

Prior to joining IARPA, Dr. Polla spent eight years in government service as a Program Manager at DARPA's Microsystems Technology Office and held a variety of faculty and administrative positions at the University of Minnesota, including serving as the Director of the Biomedical Engineering Institute and

holder of the Earl E. Bakken Chair in Biomedical Engineering. He is a graduate of the Massachusetts Institute of Technology with B.S. degrees in electrical engineering and physics, a M.S. degree in electrical engineering, and an electrical engineering E.E. degree. He received a Ph.D. degree in electrical engineering and a M.B.A. from the University of California, Berkeley. Dr. Polla is a recipient of a Presidential Young Investigator Award under President Reagan. In 1994, he received the W.M. Keck Outstanding Engineering Educator Award while serving as a Professor at the University of Minnesota.

Keynote Speech

TK1-2 (Tuesday, 09:10-09:50)

Advances and Challenges in Bioelectromagnetics for Implantable Devices: Current and Future Applications



Gianluca Lazzi
University of Utah, USA

Abstract

Over the past decade, we have witnessed significant changes in the area of bioelectromagnetics, primarily spearheaded by new opportunities that implantable devices, and medical applications in general, have offered. In this talk we will discuss recent advances in bioelectromagnetics with particular emphasis on the application to the development of an artificial retina to restore partial vision to the blind and neurostimulators in general. We will discuss the relevance of bioelectromagnetic research to the modeling of neural stimulation, the development of implantable antennas and telemetry systems, novel neurostimulators, flexible electronics for implants, and the electromagnetic safety assessment of implantable devices. Future opportunities and research efforts will also be discussed.

Gianluca Lazzi is a USTAR Professor and Department Chair of the Department of Electrical and Computer Engineering, The University of Utah. Prior to his appointment at the University of Utah, he was a Professor from 2006 to 2009, an Associate Professor from 2003 to 2006, and an Assistant Professor from 1999 to 2003 with the Department of Electrical and Computer Engineering, North Carolina State University (NCSU), Raleigh. He has been a Visiting Researcher with the Italian National Board for New Technologies, Energy, and Environment (ENEA) in 1994, a Visiting Researcher with the University of Rome “La Sapienza” from 1994 to 1995, and a Research Associate and Research Assistant Professor with the University of Utah from 1995 to 1998 and 1998 to 1999, respectively. He has authored or coauthored over 170 international journal papers

or conference presentations on implantable devices, medical applications of electromagnetics, antenna design, FDTD modeling, dosimetry, and bioelectromagnetics.

Dr. Lazzi was the Chair of Commission K (Electromagnetics in Biology and Medicine) from 2006 to 2008 and a Member-at-Large of the U.S. National Committee of the International Union of Radio Science (URSI) from 2009 to 2011. In 2009, he was the Technical Program Committee Chair of the IEEE Antennas and Propagation International Symposium and URSI meeting in Charleston, SC. He was an Associate Editor for IEEE Antennas and Wireless Propagation Letters from 2001 to 2007 and served as a Guest Editor for the Special Issue on Biological Effects and Medical Applications of RF/Microwaves of the IEEE Transactions on Microwave Theory and Techniques in 2004. He is currently a member of the Editorial Board of the Proceedings of the IEEE, the Chair of the IEEE Sensors Council Technical Achievement Award Committee, and the Chair of the Publications Committee of the IEEE Antennas and Propagation Society. Since January 2008, he has been the Editor-in-Chief of the IEEE Antennas and Wireless Propagation Letters. A Fellow of the IEEE for "contributions to bioelectromagnetics and implantable devices," he was the recipient of the 1996 Curtis Carl Johnson Memorial Award for the best student paper presented at the 18th Annual Technical Meeting of the Bioelectromagnetics Society (BEMS), a 1996 URSI Young Scientist Award, a 2001 Whitaker Foundation Biomedical Engineering Grant for Young Investigators, a 2001 National Science Foundation (NSF) CAREER Award, a 2003 NCSU Outstanding Teacher Award, the 2003 NCSU Alumni Outstanding Teacher Award, the 2003 ALCOA Foundation Engineering Research Award, the 2006 H. A. Wheeler Award from the IEEE Antennas and Propagation Society for the best application paper published in the IEEE Transactions on Antennas and Propagation in 2005, a 2008 Best Paper Award at the IEEE GLOBECOM conference, the 2009 ALCOA Foundation Distinguished Engineering Research Award, a 2009 R&D 100 Award, and the 2009 Editor's Choice Award from R&D Magazine for the Artificial Retina Project. He is currently the principal investigator of a interdisciplinary and multi-institution, NIH supported, research effort on "Multiscale Modeling for Neural Excitation." He has been working for nearly 15 years on several research aspects toward the development of an artificial retina to restore partial vision to the blind; in this project, he has been a co-investigator of a DOE sponsored center, which involved 3 universities, 5 national laboratories, and one company .

Keynote Speech

TK1-3 (Tuesday, 09:50-10:30)

In Silico Effectiveness and Safety Evaluations of Active Implantable Neuro-Stimulating Devices: Still A Dream or Soon Reality



Niels Kuster

**Foundation for Research on Information Technologies in Society (IT'IS),
Swiss Federal Institute of Technology (ETH),
Switzerland**

Abstract

The experimental standards to demonstrate compliance with EM safety limits of wireless devices (e.g. IEEE 1528, IEC 62209) were developed based on numerical evaluations of EMF absorption in various human anatomies of varying ages, sexes, heights, and body-mass indexes. The guidelines to demonstrate the MR safety of active medical devices such as pacemakers, spinal neuro-stimulators, and deep brain stimulators (DBS) were the first procedure based on combined experimental and in silico evaluations to be accepted by the FDA. At present, industries have taken one more step and are considering the application of new real-time safety monitoring concepts based on in silico data for their latest scanning systems. In line with these developments, the IT'IS Foundation and the FDA are currently developing together a functionalized high-resolution head model that can simulate EM-neuron interactions in complex anatomical geometries. The anatomical head model is derived from high-resolution MR images of a human volunteer including diffusion tensor imaging data to guide neuron model placement and to derive information about tissue anisotropy. The model is functionalized with embedded dynamic neuron models and coupled with dedicated EM simulation solvers. The main objective of developing this functionalized head model is to investigate its potential for in silico evaluations to demonstrate the effectiveness and safety of active neuro-stimulating devices such as DBS. In addition to DBS, neuroprosthetic implants are other examples of

medical devices exploiting EM-neuron interaction mechanisms inside the highly complex and inaccessible head tissues to compensate for lost sensory or other functionalities (e.g., blindness, deafness, loss of sense of balance, and paralysis). In this keynote lecture, we will present the concept behind the utilization of in silico evaluations in the regulatory process of past applications as well as its strengths and weaknesses. We will also discuss what requirements in silico models and solvers need to meet before they can be applied to reduce or replace clinical trials, and discuss when the dream of in silico effectiveness and safety evaluations of active implantable neuro-stimulating device is likely to become a reality.

Niels Kuster received the M.S. and Ph.D. degrees in electrical engineering from the Swiss Federal Institute of Technology, ETH Zürich (ETHZ), Zürich, Switzerland.

From 1993 to 1999, he was an Assistant Professor with the Department of Electrical Engineering, ETHZ. In 2001, he became a Professor with the Department of Information Technology and Electrical Engineering, ETHZ. Since 1999, he has been the Founding Director of the Foundation for Research on Information Technologies in Society (IT²S), Zürich, Switzerland. In 2010, he initiated the sister institute IT²S USA, a nonprofit research unit incorporated in the State of Maryland, of which he is currently the President. During his career, he has been an Invited Professor with the Electromagnetics Laboratory of Motorola Inc., Fort Lauderdale, FL, and, in 1998, with the Metropolitan University, Tokyo, Japan. He also founded several spin-off companies: Schmid & Partner Engineering AG, MaxWave AG, NFT Holding AG, and Zurich MedTech AG and advises other companies as a board member.

He has authored or coauthored over 700 publications (books, journals, and proceedings) on measurement techniques, computational electromagnetics, computational life sciences, dosimetry and exposure assessments, and bioexperiments. His primary research interests are in EM technologies, in silico tissue models and personalized medicine. Dr. Kuster is a member of several standardization bodies and serves as a consultant on the safety of mobile communications for government agencies around the globe. He is a Fellow of the IEEE Society, a delegate of the Swiss Academy of Science, and an associate editor of IEEE Transactions on Electromagnetic Compatibility. He served as the President of the Bioelectromagnetics Society from 2008-2009 and as a member of various editorial boards. In 2012, he received the prestigious d'Arsonval Award, the highest scientific honor of the Bioelectromagnetics Society.

Keynote Speech

TK2-1 (Tuesday, 18:10-18:50)

Biomedical Sensors for Imaging and Neurological Monitoring



John L. Volakis

The Ohio State University, USA

Abstract

Wireless devices are an inseparable part of our daily lives in terms of communications and information exchange. But wireless sensors provides for an even greater application impact of wireless technologies. In fact, there is an estimate of 10,000 sensors per person among industrialized nations. In this presentation we will focus on wireless sensors and devices for medical sensing and imaging. Textile imaging and diagnostic sensors for deep body imaging and electronic brain-machine interface will be presented. The concept of a wrap-around textile belt as part of clothing can serve to identify tissue abnormalities by measuring deep tissue permittivity without being affected from variations among human bodies. Such variations are deemphasized by using multiple probes across the textile's surface. Measurements using this multiprobe sensor will be provided to validate its performance. An electronic brain-machine interface system will be also presented using bio-compatible passive sensors. The letter is based on (a) a novel implantable miniaturized neurosensors relying on back-scattering, (2) miniature textile antennas, and (3) RF circuits on flexible polymer substrate. This sensor has the unique property of only minor heating, thus, minimizing injury and trauma to the brain. The fully wireless interconnectivity also eliminates a need for wires through the cranium to preserve natural lifestyle and comfort. The acquired neurosignals are collected via self-powered wearable body area network for continuous real-time monitoring and subsequent physiological interpretation. These sensing concepts have a very wide range of potential applications in health, overcoming the challenges in safety and long-term reliability presented by

conventional neurosensor technology. Thus, they could transform healthcare for people suffering from severe chronic neurological disorders.

John L. Volakis was born in Chios, Greece in 1956 and immigrated to the U.S.A. in 1973. He is currently the Chope Chair Professor at The Ohio State University, Electrical and Computer Engineering Dept. He also serves as the Director of the ElectroScience Laboratory with \$10M in external research funding. He was on the faculty of the University of Michigan-Ann Arbor from 1984 to 2003. Over the years, he carried out research in antennas, wireless communications and propagation, computational methods, electromagnetic compatibility and interference, design optimization, RF materials, multi-physics engineering, bioelectromagnetics, and medical sensing. His publications include 8 books (among them: Approximate Boundary Conditions in Electromagnetics, 1995; Finite Element Methods for Electromagnetics, 1998; the classic 4th ed. Antenna Engineering Handbook, 2007; Small Antennas, 2010; and Integral Equation Methods for Electromagnetics, 2011), over 325 journal papers, nearly 600 conference papers and 23 book chapters. He has graduated/mentored over 70 doctoral students/post-docs with 20 of them receiving best paper awards at conferences. His service to Professional Societies include: 2004 President of the IEEE Antennas and Propagation Society, twice the general Chair of the IEEE Antennas and Propagation Symposium, IEEE APS Distinguished Lecturer, IEEE APS Fellows Committee Chair, IEEE-wide Fellows committee member & Associate Editor of several journals. He is listed by ISI among the top 250 most referenced authors (2004), and is a Fellow of IEEE and ACES. Among his awards are: The Univ. of Michigan College of Engineering Research Excellence award (1993), Scott award from The Ohio State Univ. College of Engineering for Outstanding Academic Achievement (2011), IEEE Tai Teaching Excellence award (2011) and the IEEE Henning Mentoring award (2013).

Technical Program

08:30-12:10 Monday, December 9

08:30-09:00 **Opening Address**

Session: MK1 Keynote

Room: Venus I

Chair: Wee Ser, Nanyang Technological University, Singapore.

MK1-1 Frontiers of Implantable Neuro Technologies: from Nerve to Brain to Brain Machine Interface (keynote)

09:00-09:40 Nitish V. Thakor^{1,2}, ¹National University of Singapore, Singapore, ²Johns Hopkins University, USA

MK1-2 Bio-Telemetry Creating an Exciting Paradigm in Modern Healthcare System: Medical Monitoring and Diagnostics using Ingestible Capsules (keynote)

09:40-10:20 Yahya Rahmat-Samii, UCLA, USA

Session: MK2 Keynote/DML

Room: Venus I

Chair: Minkyu Je, Institute of Microelectronics, A*STAR, Singapore

MK2-1 WBAN Circuits and Systems (keynote)

10:50-11:30 Hoi-Jun Yoo, KAIST, Republic of Korea

MK2-2 Implantable Wireless Medical Devices and Systems (IEEE MTT-S DML)

11:30-12:10 J.C. Chiao, University of Texas at Arlington, USA

13:20-15:15 Monday, December 9

Session: MP1

Wireless power for on-/in-body devices (I)

Room: Venus I

- Chairs:** Chul Soon Park, KAIST, Korea
Chin-Lung Yang, National Cheng Kung University, Taiwan
- MP1-1** **An Improved Wireless Power Transfer System with Adaptive Technique for Implantable Biomedical Devices (invited)**
13:20-13:45 K. Na, H. Jang, S. K. Oruganti, F. Bien, Ulsan National Institute of Science and Technology, Ulsan, Republic of Korea
- MP1-2** **Design of an Integrated Resonant Structure for Wireless Power Transfer and Data Telemetry**
13:45-14:00 A. Khripkov¹, W. Hong², K. Pavlov¹, ¹Samsung Electronics, Moscow, Russian Federation, ²Samsung Electronics, Suwon, Republic of Korea
- MP1-3** **Improvement of Power Output for Efficient Wireless Power Transfer by Using a Stacked Coil Array**
14:00-14:15 D. Liang, S. Pu, H. T. Hui, National University of Singapore, Singapore
- MP1-4** **CMOS Rectifier for Wireless Power Transmission Using Multiplier Configuration**
14:15-14:30 N. Jeong, Y. Bae, C. Cho, Korea Aerospace University, Goyang, Republic of Korea
- MP1-5** **Electric Near-Field Coupling for Wireless Power Transfer in Biomedical Applications**
14:30-14:45 R. Jegadeesan^{1,2}, Y. Guo¹, M. Je², ¹National University of Singapore, Singapore, ²Institute of Microelectronics, Agency for Science Technology and Research A*STAR, Singapore, Singapore
- MP1-6** **Efficient Low-Frequency Integral Equation Solver for Wireless Power Transfer Modeling**
14:45-15:00 Y. Li, S. Sun, The University of Hong Kong, Hong Kong, Hong Kong
- MP1-7** **Energy and Thermal Distribution under the Skin during Ultrasound Power Transfer**
15:00-15:15 H. Song ¹, M. Cho¹, Y. Lee¹, I. Oh¹, J. Jung², H. Choi², C. Park¹, ¹KAIST, Daejeon, Republic of Korea, ²DGIST, Daegu, Republic of Korea

13:20-15:20 Monday, December 9

Session: MP2

RF/microwave methods and hardware for high-field MRI

Room: Jupiter III

Chairs: Mikhail Kozlov, Max Planck Institute for Human Cognitive and Brain Sciences, Germany
Shaoying Huang, Singapore University of Technology and Design, Singapore

MP2-1 RF Technology for Human MRI at 10.5T (invited)

13:20-13:45 J. T. Vaughan, L. DelaBarre, J. Tian, S. Sohn, D. Shrivastava, G. Adriany, K. Ugurbil, University of Minnesota, Minneapolis, United States

MP2-2 Simulation-driven design and optimization of RF coil arrays for MRI (invited)

13:45-14:10 M. Kozlov, R. Turner, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

MP2-3 Multi-Channel Transmit/Receive RF Coil Arrays for MRI at Ultrahigh Fields: Design, Validation and Clinical Application (invited)

14:10-14:35 T. Niendorf, Berlin Ultrahigh Field Facility (B.U.F.F.), Berlin, Germany

MP2-4 Theory and Simulation of an Orthogonal-Coil Directional Beam Antenna for Biomedical Applications

14:35-14:50 G. M. Noetscher¹, S. N. Makarov¹, J. Yanamadala¹, A. Pascual-Leone², ¹Worcester Polytechnic Institute, Worcester, United States, ²Beth Israel Deaconess Medical Center, Boston, United States

MP2-5 Electrical properties retrieval using one-dimension finite element method

14:50-15:05 L. F. Hou¹, S. Y. Huang², J. H. Wu¹, S. H. Foong², ¹Xi'an Jiaotong University, Xi'an, China, ²Singapore University of Technology and Design, Singapore, Singapore

MP2-6 Manipulation the near field with wire metamaterials

15:05-15:20 A. P. Slobozhanyuk¹, I. V. Melchakova¹, A. V. Kozachenko¹, C. R. Simovski^{2,1}, P. A. Belov^{1,1}, ¹National Research University of Information Technologies, Mechanics and Optics, St. Petersburg, Russian Federation, ²Aalto University, Helsinki, Finland

15:40-17:30 Monday, December 9

Session: MPoster

Room: Jupiter II/III

Chairs: Sha Luo, National University of Singapore, Singapore
Teck Beng Lim, Nanyang Polytechnic, Singapore

MPoster-1 A highly sensitive glucose biosensor based on a microstrip ring resonator

U. Schwerthoeffer, R. Weigel, D. Kissinger, University of Erlangen-Nuremberg,, Erlangen, Germany

MPoster-2 Supervision and Control of Medical Sterilization Processes Utilizing the Multipole Resonance Probe

C. Schulz¹, T. Styrnoll², P. Awakowicz², I. Rolfes¹, ¹Ruhr-University Bochum, Bochum, Germany, ²Ruhr-University Bochum, Bochum, Germany

MPoster-3 A Millimeter-Wave based Measuring Method for the Differentiation of Atherosclerotic Plaques

C. Baer¹, G. Notzon¹, C. Dahl², C. Schulz², B. Will², I. Rolfes², T. Musch¹, ¹Institute of Electronic Circuit, Bochum, Germany, ²Institute of Microwave Systems, Bochum, Germany

MPoster-4 CMUT Ultrasonic Power Link Front-end for Wireless Power Transfer Deep in Body

S. Banerji^{1,2}, W. L. Goh², J. H. Cheong¹, M. Je¹, ¹Institute of Microelectronics, A*STAR (Agency for Science, Technology and Research), Singapore, Singapore, ²Nanyang Technological University, Singapore.

MPoster-5 Analysis of Inductive Coupling Coils for Extending Distances of Efficient Wireless Power Transmission

C. Yang, C. Yang, National Cheng Kung University, Tainan , Taiwan

MPoster-6 A hybrid sodium/proton double-resonant transceiver array for 9.4T MRI

X. Yan^{1,2}, L. Shi¹, L. Wei², Y. Zhuo¹, X. J. Zhou³, R. Xue¹, ¹Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, ²Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China, ³University of Illinois, Chicago, United States

MPoster-7 In-home Monitoring Sensor Using Stepped-FM UWB-IR

R. Nakamura, A. Kajiware, The University of Kitakyushu, Kitakyushu, Japan

MPoster-8 Miniaturized Slot PIFA Antenna for Triple-band Implantable Biomedical Applications

F. Gozasht, A. Sanagavarapu Mohan, University of Technology Sydney, Sydney, Australia

MPoster-9 Wirelessly Powered and Controlled, Implantable, Multi-channel, Multi-wavelength Optogenetic Stimulator

R. Mandal¹, S. Nag², N. V. Thakor², ¹Indian Institute of Technology, Kharagpur, Kharagpur, India, ²National University of Singapore, Singapore, Singapore

MPoster-10 Detection and Localization of Brain Strokes in Realistic 3-D Human Head Phantom

A. T. Mobashsher, P. T. Nguyen, A. Abbosh, The University of Queensland, St Lucia, Australia

MPoster-11 Preliminary Experimental Investigations on Near Field Breast Cancer Thermotherapy

M. Li¹, D. Yin¹, L. Wang¹, J. L. Li^{2,3}, ¹University of Electronic Science & Technology of China, Chengdu, China, ²Monash University, Sunway, Malaysia, ³Monash University, Clayton, Australia

MPoster-12 Stepped-FM UWB Sensor System for Health-care Support

N. Shimomura, R. Nakamura, A. Kajiura, The University of Kitakyushu, Kitakyushu, Japan

MPoster-13 Design of a Low-Power and High-Linear UWB CMOS Mixer

M. Mahmoudi Meimand^{1,2}, A. Hakimi^{2,1}, ¹Graduate University of Advance Technology, Kerman, Iran, ²Shahid Bahonar University of Kerman, Kerman, Iran

MPoster-14 A 900MHz fractional-N synthesizer with quadrature signals for Low Power transceiver in 0.13um CMOS

D. Yan, B. Zhao, A. Bansal, R. M. K, Y. Akira, M. Je, Institute of Microelectronics, Singapore, Singapore

MPoster-15 Implementation of a Dual Band Body Sensor Node

K. M. Thotahewa, J. Redouté, M. R. Yuce, Monash University, Clayton, Australia

MPoster-16 Efficient Simulation of Graphene Antennas for Biomedical Applications

I. Ahmed, E. Khoo, D. Li, E. Li, Institute of High Performance Computing, Singapore, Singapore

MPoster-17 A 5.15-5.825 GHz high-gain and low-noise CMOS down-conversion mixer with low-power for WLAN 802.11a

Y. H. Dai, C. F. Jou, National Chiao Tung University, Hsinchu, Taiwan

MPoster-18 A 0.5V 16nW 8.08-ENOB SAR ADC for Ultra-Low Power Sensor Applications

Y. Yang^{1,2}, X. Liu², J. Zhou², J. Cheong², M. Je², W. Goh¹, ¹Nanyang Technological University, Singapore,

- Singapore, ²Institute of Microelectronics, Singapore, Singapore
- MPoster-19 RFDAC for Medical Body Area Network 802.15.6 Applications**
F. F. Wong, R. M. Kumarasamy, M. Je, A-STAR, 11 Science Park Road, Science Park II, Singapore
- MPoster-20 Characterizations of Silicon Nanowires (SiNWs) Embedded NEMS Sensors and for Potential Bio-medical Applications**
S. Zhang^{1,2}, L. Lou², T. Wang¹, W. Tsang², D. Kwong², C. Lee¹, ¹National University of Singapore, Singapore, Singapore, ²Institute of Microelectronics, Singapore, Singapore
- MPoster-21 Implantable Stimulator for Biomedical Applications**
L. Yao¹, J. Zhao², P. Li¹, X. Liu^{1,2}, P. Y. Xu², M. Je¹, ¹Institute of Microelectronics, Singapore, Singapore, ²National University of Singapore, Singapore, Singapore
- MPoster-22 A Novel Rectifier Circuit Operating at Dual-Frequencies of 1.8 and 2.4 GHz**
L. Shen, X. X. Yang, School of Electrical and Computer Engineering, Shanghai, China
- MPoster-23 Study of Wireless Power Transfer Link with Metallic Plates**
J. Ma¹, S. Sun¹, C. Liu², ¹The University of Hong Kong, Hong Kong, Hong Kong, ²Sichuan University, Chengdu, China
- MPoster-24 Inverse Scattering Problem of a Two- Dimensional Dielectric Cylinder in Slab Medium**
C. Huang^{3,3}, C. Sun^{2,3}, C. Li^{3,3}, C. Chiu^{3,3}, L. Tuen^{3,3}, S. Lee^{3,3}, ¹National Taiwan University of Science and Technology, Taipei City, Taiwan, ²Taipei College of Maritime Technology, New Taipei City, Taiwan, ³Tamkang University, New Taipei City, Taiwan
- MPoster-25 Acoustic Transducers for Medical Imaging**
J. Zhao¹, H. Ye¹, K. Huang¹, Z. Chen¹, B. Li^{1,2}, C. Qiu¹, ¹National University of Singapore, Singapore, Singapore, ²Tongji University, Shanghai, China
- MPoster-26 Ultra Wideband Antenna for Portable Brain Stroke Diagnostic System**
A. T. Mobashsher, B. J. Mohammed, S. Mustafa, A. Abbosh, The University of Queensland, St Lucia, Australia
- MPoster-27 Single-Fed Dual-Band Dual-Polarized U-Slot Patch Antenna**
S. Liu, S. Qi, W. Wu, D. Fang, Nanjing University of Science and Technology, Nanjing, China
- MPoster-28 Numerical Analysis of the Communication Channel Path Loss at the THz Band inside the Fat Tissue**
K. Yang, A. Pellegrini, A. Brizzi, A. Alomainy, Y. Hao, Queen

Mary University of London, London, United Kingdom

MPoster-29 Why Headache Using GSM Cellular Phones?

Y. Lu, Y. Huang, Nanyang Technological University, Singapore, Singapore

MPoster-30 Magnetically mediated thermoacoustic imaging and technical considerations on its coil design

X. Feng, F. Gao, Y. Zheng, Nanyang Technological University, Singapore, Singapore

MPoster-31 Effects of Dielectric Values of Human Eye Models on Specific Absorption Rate Following RF Exposure

L. Zhao, D. Liu, G. Chen, Q. Ye, Jiangsu Normal University, Xuzhou, China

MPoster-32 An Overview of Cancer Treatment by Terahertz Radiation

M. Wang^{1,3}, G. Yang^{1,2}, W. Li^{1,2}, Q. Wu^{1,2}, ¹Harbin Institute of Technology, Harbin, China, ²Southeast China University, Nanjing, China, ³The Fourth Affiliated Hospital of Harbin Medical University, Harbin, China

MPoster-33 Continuous Wave Simulations on the Propagation of Electromagnetic Fields Through the Human Head

J. M. Elloian¹, G. M. Noetscher¹, S. N. Makarov¹, A. Pascual-Leone², ¹Worcester Polytechnic Institute, Worcester, United States, ²Beth Israel Deaconess Medical Center, Boston, United States

MPoster-34 An Investigation of Microwave Thermal Ablation for Bone Drilling

A. Sanpanich¹, K. Petsarb¹, W. Sroykham¹, C. Apaiwong¹, S. Thanangkul¹, Y. Kajornpredanon¹, P. Phasukkit², ¹Mahidol university, Nakhonpathom, Thailand, ²King mongkut's institute of technology ladkrabang, Bangkok, Thailand

MPoster-35 Evaluation of Wireless Charging and Telemetry Design Concepts for Subcutaneous Implantable Devices at Sub to Low GHz Range

X. Chen, Swiss Federal Institute of Technology, Lausanne, Switzerland

MPoster-36 Appropriate Two Probable Value Technique For Reducing Spur in DDS

T. H. Liu¹, Y. C. Guo¹, G. Y. Zhang¹, Z. L. Liu¹, ¹Zhongbo Information Technology Research Institute, Nanjing, China, ²Nanjing Research Institute of Electronics Technology, Nanjing, China

MPoster-37 Optimization of geometry for a dual-row MRI array at 400 MHz

M. Kozlov, R. Turner, Max Planck Institute for Human Cognitive

and Brain Sciences, Leipzig, Germany

MPoster-38

Non-contact Detection of Doppler Bio-signals Based on Gradient Decent and Extended DACM Algorithms

Q. Lv¹, T. Hu³, Q. Shan², J. Huangfu¹, L. Ran¹, ¹Zhejiang University, Hangzhou, China, ²Zhejiang University City College, Hangzhou, China, ³Science and Technology on Space Microwave Laboratory, Xi'an, China

MPoster-39

Design of High-Efficiency Inductive Power Transfer Coils for Biomedical Implants

X. Zhang, R. Xue, K. Cheng, J. Cheong, C. Ho, L. Yao, C. He, M. Je, Institute of Microelectronics, Singapore, Singapore, Singapore

08:30-10:30 Tuesday, December 10

Session: TK1 Keynote

Room: Venus I

Chair: Dominique Schreurs, University of Leuven, Belgium

TK1-1 Integrated BioMEMS (Keynote)

08:30-09:10 Dennis L. Polla, IARPA, USA

TK1-2 Advances and Challenges in Bioelectromagnetics for Implantable Devices: Current and Future Applications (Keynote)

09:10-09:50 Gianluca Lazzi, University of Utah, USA

TK1-3 In Silico Effectiveness and Safety Evaluations of Active Implantable Neuro-Stimulating Devices: Still A Dream or Soon Reality (Keynote)

09:50-10:30 Niels Kuster, Swiss Federal Institute of Technology (ETH) Zurich

18:10-18:50 Tuesday, December 10

Session: TK2 Keynote

Room: Mercury

Chair: Kwai Man Luk, City University of Hong Kong, China

TK2-1 Biomedical Sensors for Imaging and Neurological Monitoring (Keynote)

18:10-18:50 John Volakis, The Ohio State University, USA

10:50-12:05 Tuesday, December 10

Session: TA1

Microwave imaging for biomedical applications (I)

Room: Jupiter III

- Chairs:** Qinghuo Liu, Duke University, USA
Zhongxiang Shen, Nanyang Technological University, Singapore
- TA1-1** **Thermoacoustic Imaging and Spectroscopy for Breast Cancer Detection Applications (invited)**
10:50-11:15 X. Wang¹, T. Qin¹, D. R. Bauer², R. S. Witte², H. Xin¹, ¹University of Arizona, Tucson, United States, ²University of Arizona, Tucson, United States
- TA1-2** **Microwave Systems for Head Imaging: Challenges and Recent Developments (invited)**
11:15-11:40 A. Abbosh, The University of Queensland, Brisbane, Australia
- TA1-3** **Progress and Challenges in Microwave Imaging and Microwave Induced Thermoacoustic Tomography (invited)**
11:40-12:05 Q. H. Liu¹, Z. Zhao², X. Zhu^{1,2}, Z. Yu¹, W. Zhang¹, ¹Duke University, Durham, United States, ²University of Electronic Science and Technology of China, Chengdu, China

10:50-12:10 Tuesday, December 10

Session: TA2

RFIC technologies, devices, and sensors for biomedical applications

(I)

Room: Venus I

- Chairs:** Thomas Ußmüller, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Yuanjin Zheng, Nanyang Technological University, Singapore
- TA2-1 GaN on Si MMICs for Wireless Charged Smart Cloth Applications (invited)**
10:50-11:15 H. Chiu, H. Kao, K. Chin, F. Huang, Chang Gung University, Taoyuan, Taiwan
- TA2-2 A 100 Mb/s 0.36 mW Injection Locked Clock and Data Recovery Circuit for WBAN Transceivers**
11:15-11:30 V. V. Kulkarni, J. Lee, X. Liu, M. Je, Institute of Microelectronics, Singapore, Singapore
- TA2-3 Remote Powered Medical Implants (invited)**
11:30-11:55 T. Ussmueller, D. Brenk, J. Essel, J. Heidrich, G. Fischer, R. Weigel, University of Erlangen-Nuremberg, Erlangen, Germany
- TA2-4 An ultra low-power capacitor-less LDO with high PSR**
11:55-12:10 C. J. Leo, K. Raja, M. Je, Institute of Microelectronics, Singapore, Singapore

13:20-15:10 Tuesday, December 10

Session: TP1

Wireless localization and remote patient monitoring (I)

Room: Jupiter III

Chairs: Jenshan Lin, University of Florida, USA
Tong Tian, Shanghai Institute of Microsystem and Information
Technology, China

TP1-1 Radar-based health monitoring (invited)

13:20-13:45 D. Schreurs¹, M. Mercuri¹, P. Soh^{1,2},
¹KU Leuven, Leuven, Belgium, ²Universiti Malaysia Perlis, Perlis,
Malaysia

**TP1-2 Non-contact Detection of Doppler Bio-signals Based on
Gradient Decent and Extended DACM Algorithms**

13:45-14:00 Q. Lv¹, T. Hu³, Q. Shan², J. Huangfu¹, L. Ran¹, ¹Zhejiang
University, Hangzhou, China, ²Zhejiang University City College,
Hangzhou, China, ³Science and Technology on Space
Microwave Laboratory, Xi'an, China

**TP1-3 Wireless Intelligent Sensor System for Fetal Heart Rate
Tracing through Body Sound Monitoring on a Pregnant
Woman (invited)**

14:00-14:25 Z. Wang, H. Jiang, Tsinghua University, Beijing, China

**TP1-4 Noncontact Heart Rate Measurement using a 24 GHz
Doppler Radar**

14:25-14:40 W. Ser¹, J. Yu¹, X. Guo², J. Zhang¹, M. E. Ong³, ¹Nanyang
Technological University, Singapore, Singapore, ²Digital
Television, Shanghai, China, ³Singapore General Hospital,
Singapore, Singapore

**TP1-5 Noise and Sensitivity Analysis of Harmonic Radar System
for Vital Sign Detection**

14:40-14:55 L. Chioukh¹, H. Boutayeb¹, D. Deslandes², K.
Wu¹, ¹Polytechnique de montréal, Centre de Recherche Poly-
Grames, Montreal, Canada, ²UQAM, Université de québec à
montréal, Montreal, Canada

**TP1-6 A Coplanar Ultra Wide Band Antenna on a Plaster Substrate
for Health Monitoring Applications**

14:55-15:10 D. L. Paul, Y. Xu, J. P. McGeehan, University of Bristol, Bristol,
United Kingdom

13:20-15:10 Tuesday, December 10

Session: TP2

Antennas and body channel modeling for off-/on-/in-body communications (I)

Room: Venus I

Chairs: Erping Li, Institute of High Performance Computing, Singapore
Yuan Gao, Institute of Microelectronics, Singapore

TP2-1 BAN Over-The-Air Testing Using an Arm-Swinging Dynamic Phantom (invited)

13:20-13:45 K. Ogawa, K. Li, K. Honda, Toyama University, Toyama, Japan

TP2-2 Antennas For Medical Implant Applications Operating In The MICS Band

13:45-14:00 T. Basmer, N. Todtenberg, F. Popiela, M. Birkholz, IHP, Frankfurt (Oder), Germany

TP2-3 Body-centric Wireless Communications for Healthcare Applications (invited)

14:00-14:25 Y. Hao, Queen Mary University of London, London, United Kingdom

TP2-4 Latex based Near-Endfire Wearable Antenna backed by AMC Surface

14:25-14:40 K. Agarwal¹, Y. Guo^{1,2}, B. Salam³, L. Albert³, ¹National University of Singapore, Singapore, Singapore, ²National University of Singapore (Suzhou) Research Institute, Suzhou, China, ³Singapore Institute of Manufacturing Technology, A*STAR, Singapore, Singapore

TP2-5 Electromagnetic Modelling and Measurement of Antennas for Wireless Brain-Machine Interface Systems

14:40-14:55 T. Björninen¹, E. Moradi¹, L. Sydänheimo¹, J. M. Carmena², J. M. Rabaey³, L. Ukkonen¹, ¹Tampere University of Technology, Tampere, Finland, ²University of California at Berkeley, Berkeley, United States, ³University of California at Berkeley, Berkeley, United States

TP2-6 Matching Network to Improve the Transmission Level of Capacitive Intra-Body Communication (IBC) Channels

14:55-15:10 L. Wu^{2,1}, J. Sakai^{3,1}, H. Sun¹, Y. Guo¹, ¹National University of Singapore, Singapore, Singapore, ²Shanghai Jiao Tong University, Shanghai, China, ³NEC Corporation, Kawasaki, Japan

15:40-17:30 Tuesday, December 10

Session: TPoster

Room: Jupiter II/III

- Chairs:** Karim Muhammad Faeyz, Institute for Infocomm Research, Singapore
Krishna Agarwal, National University of Singapore, Singapore
- TPoster-1** **A Recent Concise Ultra Wide Band Metamaterial Antenna for Wireless and Microwave Implementations**
M. AlibakhshiKenari, ShahidBahonar University of Kerman, Iran, Fereydonkenar, Iran
- TPoster-2** **An Inductive Biomedical Communication Processing Chain**
C. A. Gong¹, K. K. Yao², C. Wang², K. Wang², M. Shiue², C. C. Lu³, Y. Luo³, ¹Chang Gung University, Kwei-Shan, Taiwan, ²National Central University, Jhongli, Taiwan, ³Industrial Technology Research Institute, Chutung, Taiwan
- TPoster-3** **Millimeter-Wave Four-way SIW Power Combiner**
K. Song, F. Chen, F. Zhang, Q. Chen, Y. Fan, EHF Key Laboratory of Science, School of Electronic Engineering, Chengdu, China
- TPoster-4** **Embedded Cylindrical Magneto-Hydro-dynamic Antenna**
R. S. Yaduvanshi, AIACTR, Delhi, India
- TPoster-5** **Feasibility Study on Ambient RF Energy Harvesting for Wireless Sensor Network**
T. Lim, N. Lee, B. Poh, School of Engineering, Singapore, Singapore
- TPoster-6** **A Millimeter Tapered Slot Antenna Fed by SIW with Broadband and High Gain**
X. Yang, Y. Wang, G. Tan, Shanghai University, Shanghai , China
- TPoster-7** **Dual band low profile antenna for body centric communications with a split ring resonator**
Z. Liu¹, Y. Guo², ¹Southeast University, Nanjing, China, ²National University of Singapore, Singapore, Singapore
- TPoster-8** **Wearable Finger Ring Type Antenna Made of Fabric Cloth for BAN Use at UHF and ISM Bands**
H. Horie, H. Iwasaki, Shibaura Institute of Technology, Saitama, Japan

- TPoster-9 Path-Loss Modeling for On-body UWB and Off-body WiMax Combined-Channel**
Q. Xu, A. Gao, H. Peng, J. Zou, Shanghai Jiao Tong University, Shanghai, China
- TPoster-10 A compacted dual linearly polarization wideband feed for parabolic reflector antenna**
W. Ye¹, S. He^{2,1}, W. Che¹, Y. Juan¹, ¹Nanjing University of Science and Technology, Nanjing, China, ²Anhui University of Technology, Ma An Shan, China
- TPoster-11 Propagation Characteristics of MHz-Band RF Signals for Near-Field Coupling Communication**
N. Watanabe, T. Nakamura, M. Nozawa, M. Ishida, H. Shimasaki, Y. Kado, University, Kyoto, Japan
- TPoster-12 Adaptive Powerline Interference removal from Cardiac Signals using Leaky based Normalized Higher Order filtering techniques**
G. T. Smt³, S. I. Smt³, M. M. Dr³, V. D. Dr³, ¹GITAM University , Visakhapatnam , India, ²GITAM University, Visakhapatnam, India, ³Andhra University , Visakhapatnam, India
- TPoster-13 Doppler Bio-signal detection Based Time-Domain Hand Gesture Recognition**
C. Zheng¹, T. Hu³, S. Qiao², J. Huangfu¹, L. Ran¹, ¹Zhejiang University, Hangzhou, China, ²Zhejiang University City College, Hangzhou, China, ³Science and Technology on Space Microwave Laboratory, Xi'an, China
- TPoster-14 Design of the directional horn-shaped planar antenna used for wireless mouse online test**
Y. Wang, X. Liu, H. Guo, X. Yang, Soochow University, Suzhou, China
- TPoster-15 Simple Octa-band Monopole Antenna with Rectangular-loop-loaded Meandered Line for LTE/WWAN Smartphone Applications**
W. Xiao, R. Huang, W. Lin, Y. Ban, University of Electronic Science and Technology, Chengdu, China
- TPoster-16 Pattern-reconfigurable antenna for on-body communication**
M. Li, S. Xiao, B. Wang, University of Electronic Science and Technology, Chengdu, China
- TPoster-17 UWB Circularly Polarized Planar Antenna on Flexible Substrate**
K. Fujita¹, D. Kanemoto², K. Yoshitomi¹, K. Yoshida¹, H. Kanaya¹, ¹Kyushu University, Fukuoka, Japan, ²Yamanashi University, Yamanashi, Japan
- TPoster-18 Chipless RFID Tag Based on Space Angle Information**

L. Yan, W. Zhang, R. Ma, X. Chen, Shanxi University, Taiyuan, China

- Tposter-19 Electrically Small RF Coil Arrays for Medical & Wireless Power Applications**
C. Mak¹, W. Lau¹, C. Rowell², ¹Hong Kong Applied Science and Technology Research Institute Company Limited, Shatin, Hong Kong, ²China Mobile Research Institute, Beijing, China
- TPoster-20 Cross Slot Antenna with Very Low Back Radiation for Various Wireless Communications at 5.8GHz ISM Band**
H. Lai, K. Mak, K. Luk, City University of Hong Kong, Kowloon, Hong Kong
- TPoster-21 Antenna Polarization Mismatch in BAN Communications**
K. Yekeh Yazdandoost, R. Miura, National Institute of Information and Communications Technology, Yokosuka, Japan
- TPoster-22 Novel Miniaturized Bandpass Filter with Wide Stopband Using Spiral Resonator**
L. Gao, X. Zhang, South China University of Technology, Guangzhou, China
- TPoster-23 Dual-Band Frequency Selective Structure With Large Frequency Band Ratio**
B. Li, Z. Shen, Nanyang Technological University, Singapore, Singapore
- TPoster-24 A Miniaturized Implantable Loop Antenna at MICS and ISM Bands for Biomedical Applications**
W. Lei, Y. Guo, National University of Singapore, Singapore, Singapore
- TPoster-25 RF-Activated Surface Standing Acoustic Wave For On-Chip Controllably Aligning of Bio-microparticles**
J. Guo¹, Y. Chen^{1,2}, Y. Kang², ¹Institute of Microelectronics A*STAR, Singapore, Singapore, ²Nanyang Technological University, Singapore, Singapore
- TPoster-26 FR4 PCB Grid Array Antenna for Millimeter-Wave 5G Mobile Communications**
Z. Chen, Y. Zhang, School of Electrical and Electronic Engineering, Singapore, Singapore
- TPoster-27 A W Band High Order Frequency Mixer Based on Avalanche Diode**
M. H. Zhao¹, K. Li¹, Y. Fan¹, Z. B. Zhu², ¹University of Electronic Science and Technology of China, Cheng Du, China, ²China Academy of Space Technology, Xi An, China
- TPoster-28 Development of a 94GHz Passive Millimeter Wave Imaging System for Target Detection in Haze and Smoke**

B. Luo, L. Ong, K. Muhammad Faeyz, Institute for Infocomm Research, Singapore, Singapore

TPoster-29 Low-profile Capacitive Fed Air-supported Microstrip Antenna at UHF Band for Biomedical Application

H. Wang¹, J. Zhou¹, Y. Huang², J. Wang², ¹Nanjing University of Sci. & Tech., Nanjing, China, ²Suzhou Bohai Microsystem CO., LTD., Suzhou, China

TPoster-30 A Wideband Antenna by 3D-TSV based Composite Right/Left Handed Transmission Line for Sub-THz Biomedical Imaging

P. Li¹, Y. Shang¹, M. Yu², H. Yu¹, ¹Nanyang Technological University, Singapore, Singapore, ²Institute of Microelectronics, Singapore, Singapore

TPoster-31 Design of a Triple Band Antenna for Wireless Body Area Network

M. N. Shakib, University of Malaya, Kuala Lumpur, Malaysia

TPoster-32 Linearized Asymmetrical GaN Doherty Power Amplifier with 100 MHz instantaneous bandwidth at 3.5GHz

J. Xia^{1,2}, M. Yang¹, X. Zhu¹, ¹Southeast University, Nanjing, China, ²Jiangsu University, Zhenjiang, China

TPoster-33 A Broad Beam-width Microstrip Cross Antenna Design for Wide Scan Angle Phased Array

Z. Wang¹, D. Dan¹, S. Xiao¹, M. Tang², ¹The Institute of Applied Physics, Chengdu, China, ²The College of Communication Engineering, Chongqing, China

TPoster-34 A Compact Dual-Band Meander-line Antenna for Biomedical Application

W. Yang, K. Ma, K. Yeo, W. Lim, Nanyang Technological University, Singapore, Singapore

TPoster-35 Analysis and Design of A 250-MHz Gm-C Filter with Discrete Tuning Scheme in 0.18- μ m CMOS for UWB Receiver

K. Raja, A. Arasu, B. Zhao, M. Je, Institute of Microelectronics, Singapore, Singapore

TPoster-36 LTCC Reconfigurable Bandpass Filters Using Vertically Short-Ended SIR

H. Tang, Y. Ge, G. Zhang, J. Chen, J. Shi, Z. Bao, J. Zhou, Nantong University, Nantong, China

TPoster-37 Design of UWB Bandpass Filter with Dual Notched Bands Based on E-shaped Resonator

J. Zhao¹, J. Wang¹, J. Li², ¹Nanjing University of Science and Technology, Nanjing, China, ²University of Electronic Science and Technology of China, Chengdu, China

TPoster-38 Fast Fill-in of Impedance Matrix in the Accurate Subentire Domain Basis Function Method for Large Planar Periodic

Structures

P. Du¹, S. Xiao², ¹Hefei University of Technology, Hefei, China, ²University of Electronic Science and Technology of China, Chengdu, China

TPoster-39 Wideband Bandpass Filter Based on Composite Right/Left Hand Unit-Cells

B. S. Virdee¹, K. U. Ahmed², ¹London Metropolitan University, London, United Kingdom, ²Pera Technologies, Melton Mowbray, United Kingdom

TPoster-40 Stub-Loaded Printed Antenna with a Ground Plane and Electromagnetically Coupled Feed for 2.45GHz Body Area Networks

S. Abbas¹, Y. Ranga², K. P. Esselle¹, ¹Macquarie University, Sydney, Australia, ²CSIRO, Epping, Australia

08:30-10:25 Wednesday, December 11

Session: WA1

Therapeutic and diagnostic applications of RF/microwave technologies

Room: Jupiter III

- Chairs:** Yong-Kyu Yoon, University of Florida, USA
Joshua Le-Wei Li, University of Electronic Science and Technology of China, China; and Monash University, Malaysia/Australia
- WA1-1 A New Wave in Electrosurgery – Therapeutic Applications of Microwave/RF Energy and Novel Antenna Structures (invited)**
08:30-08:55 C. P. Hancock, Bangor University, Bangor, United Kingdom
- WA1-2 Microwave based diagnostics and treatment in practice (invited)**
08:55-09:20 M. Persson^{1,4}, A. Fhager^{1,4}, H. Dobsicek Tréfná^{1,4}, P. Takook^{1,4}, Y. Yu¹, T. McKelvey¹, J. Karlsson³, X. Zeng¹, H. Zirath⁵, M. Elam^{5,4}, ¹Chalmers University of Technology, Göteborg, Sweden, ²Göteborg University, Göteborg, Sweden, ³Sahlgrenska University Hospital, Göteborg, Sweden, ⁴MedTech West, Göteborg, Sweden, ⁵Chalmers University of Technology, Göteborg, United States
- WA1-3 Millimeter Wave Imaging Using SAR Modeling**
09:20-09:35 H. Hu¹, M. F. Karim², L. Ong², B. Luo², T. Chiam², Y. Guo³, X. Zhu¹, ¹Nanjing University of Science and Technology, Nanjing, China, ²Institute for Infocomm Research, Singapore, ³National University of Singapore, Singapore
- WA1-4 Microwave Near-Field Effects and Characterizations for Non-invasive Breast Cancer Treatment (invited)**
09:35-10:00 M. Li¹, D. Yin¹, L. Wang¹, J. L. Li^{2,3}, ¹University of Electronic Science & Technology of China, Chengdu, China, ²Monash University, Sunway, Malaysia, ³Monash University, Clayton, Australia
- WA1-5 Neural Signal Regeneration and Motor Function Rebuilding of Paralyzed Limbs Based on Principles of Communication Incorporated with Microwave Transmission System (invited)**
10:00-10:25 Z. Wang¹, X. Lu², Y. Xia³, Z. Huang¹, Y. Zhou², S. Zong¹, W. Li¹, X. Zhao¹, J. Xu¹, J. Yang², S. Wang², H. Wang¹, X. Bao², B. Wang³, M. Ma³, ¹Institute of RF- & OE-ICs, Southeast University, Nanjing, China, ²State Key Lab of Bioelectronics, Southeast University, Nanjing, China, ³Rehabilitation Center of Zhongda Hospital, Southeast University, Nanjing, China

08:30-10:30 Wednesday, December 11

Session: WA2

RFIC technologies, devices, and sensors for biomedical applications

(II)

Room: Venus I

Chairs: Hao Yu, Nanyang Technological University, Singapore
Xiuying Zhang, South China University of Technology, China

WA2-1 A Fully-Integrated Low-Power High-Coexistence 2.4-GHz ZigBee Transceiver for Biomedical Applications (invited)

08:30-08:55 J. Gil¹, J. Kim², C. Kim², C. Park², J. Park², H. Park², H. Lee², S. Lee², Y. Jang², M. Koo², Y. Kwon², I. Song², ¹TLi, Seongnam-si, Republic of Korea, ²RadioPulse, Gangdong-gu, Republic of Korea

WA2-2 Wireless sensor capsule for bioreactor

08:55-09:10 N. Todtenberg¹, J. Klatt¹, S. Schmitz-Hertzberg², F. Jorde², K. Schmalz¹, ¹IHP, Frankfurt (Oder), Germany, ²Fraunhofer IBMT, Potsdam-Golm, Germany

WA2-3 A Fully Integrated 3 – 5 GHz UWB RF Transceiver for WBAN Applications (invited)

09:10-09:35 J. Ha¹, S. Jung², M. Park¹, K. Lee², Y. Eo^{1,2}, ¹Kwangwoon University, Seoul, Republic of Korea, ²Silicon R&D Inc., Seoul, Republic of Korea

WA2-4 Digital system design for wireless bionic neural link

09:35-09:50 P. Li, L. Yao, M. Je, Institute of Microelectronics, A*STAR, Singapore, Singapore

WA2-5 Fully-Additive Printed RFID on a Plastic Film (invited)

09:50-10:15 J. S. Chang, T. Ge, T. Lin, Nanyang Technological University, Singapore, Singapore

WA2-6 An LSK Demodulator for Sub-Scalp EEG Recording

10:15-10:30 Z. Chen, J. Xu, P. Sun, Z. Yang, National University of Singapore, Singapore, Singapore

10:50-12:10 Wednesday, December 11

Session: WA3

Wireless localization and remote patient monitoring (II)

Room: Jupiter III

Chairs: Lixin Ran, Zhejiang University, China
Kaixue Ma, Nanyang Technological University, Singapore

WA3-1 Noncontact Measurement of Cardiopulmonary Movements: A Review of System Architectures and the Path to Micro-Radars (invited)

10:50-11:15 J. Lin, University of Florida, Gainesville, United States

WA3-2 A Miniature Device for Long-term Monitoring for Nasopharynx Cancer

11:15-11:30 W. Liu¹, H. Ren¹, C. Lim^{2,3}, ¹Faculty of Engineering, National University of Singapore, Singapore, Singapore, ²National University Hospital, Singapore, Singapore, ³Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore

WA3-3 A non-invasive lung monitoring sensor with integrated body-area network

11:30-11:45 S. Salman¹, Z. Wang¹, A. Kiourti¹, E. Topsakal², J. L. Volakis¹, ¹The Ohio State University, Columbus, United States, ²Mississippi State University, Starkville, United States

WA3-4 Electromagnetic radiation test and effect in ICU of hospitals (invited)

11:45-12:10 S. F. Li, Beijing University of Posts and Telecommunications, Beijing, China

10:50-12:10 Wednesday, December 11

Session: WA4

**Antennas and body channel modeling for off-/on-/in-body
communications (II)**

Room: Venus I

- Chairs:** Yang Hao, Queen Mary, University of London, United Kingdom
Hongli Peng, Shanghai Jiaotong University, China
- WA4-1** **Physical Human Phantoms for Evaluation of Implantable Antennas (invited)**
10:50-11:15 K. Ito, H. Lin, Chiba University, Chiba, Japan
- WA4-2** **Balun's Effect on the Measurement of Transmission Characteristics for Intrabody Communication Channel**
11:15-11:30 J. Sakai^{1,2}, L. Wu^{2,3}, H. Sun², Y. Guo², ¹NEC Corporation, Kawasaki, Japan, ²National University of Singapore, Singapore, Singapore, ³Shanghai Jiao Tong University, Shanghai, China
- WA4-3** **Making a Telemetry System Implantable: Challenges and Opportunities in Antenna Design (invited)**
11:30-11:55 S. Islam¹, K. Esselle¹, D. Bull², P. Pilowsky³, ¹Macquarie University, Sydney, Australia, ²BCS Innovations, Sydney, Australia, ³Macquarie University, Sydney, Australia
- WA4-4** **A Helical Folded Dipole Antenna for Medical Implant Communication Applications**
11:55-12:10 B. Basari, D. C. Sirait, F. Y. Zulkifli, E. T. Rahardjo, Universitas Indonesia, Depok, Indonesia

13:20-15:25 Wednesday, December 11

Session: WP1

Emerging theories/technologies in microwaves for biomedical applications

Room: Jupiter III

- Chairs:** James Hwang, Lehigh University, Bethlehem, United States
Yilong Lu, Nanyang Technological University, Singapore
- WP1-1** **BME and MWT R&D Activities at USTC (invited)**
13:20-13:45 F. Lin, Uni of Sci& Tech of China (USTC), Hefei, China
- WP1-2** **Fibrous and Flexible Supercapacitors with a hierarchical nanostructure comprised of carbon spheres and graphene (invited)**
13:45-14:10 X. Zhang, Y. Zheng, K. Zhang, Soochow University , Suzhou, China
- WP1-3** **Tunable Metamaterials and Optofluidic Transmission Optics (invited)**
14:10-14:35 A.-Q. Liu, Nanyang Technological University, Singapore
- WP1-4** **Microwave and THz Surface Plasmons on Ultrathin Corrugated Metal Structures (invited)**
14:35-15:00 T. Cui¹, X. Shen^{1,2}, ¹Southeast University, Nanjing, China, ²Southeast University, Nanjing, China
- WP1-5** **Fast, Compact and Label-Free Electrical Detection of Live and Dead Single Cells (invited)**
15:00-15:25 Y. Ning, C. R. Multari, X. Luo, C. Merla, C. Palego, X. Cheng, J. C. Hwang, Lehigh University, Bethlehem, United States

13:20-15:20 Wednesday, December 11

Session: WP2

**RF and wireless techniques for implants and body-centric
communications**

Room: Venus I

- Chairs:** Kuang-Wei Cheng, National Cheng Kung University, Taiwan
Terence See, Institute for Infocomm Research, Singapore
- WP2-1 Commercial Development of RF Medical Implantable Devices (invited)**
- 13:20-13:45 E. Y. Chow, H. Joshi, A. Wilats, D. Thompson, K. Cotton, S. Nair, C. Warren, B. Tomayko, L. Bu, A. Jones, A. Adkins, A. Shen, M. Morris, B. Byerman, Cyberonics, Inc., Houston, United States
- WP2-2 Hybrid Circuit for High Performance Wireless Medical Systems**
- 13:45-14:00 X. Cheng, Y. Yoon, University of Florida, Gainesville, United States
- WP2-3 Implantable Intraocular Pressure Monitoring Systems: Design Considerations (invited)**
- 14:00-14:25 M. Arsalan, M. H. Ouda, L. Marnat, A. Shamim, K. N. Salama, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia
- WP2-4 Temperature Pattern Control Within A Monopole Array Used for Interstitial Microwave Hyperthermia**
- 14:25-14:40 W. Zhao, W. Che, Y. Chang, Y. Juan, Nanjing University of Science and Technology, Nanjing, China
- WP2-5 Recent Wireless Body Sensors: Design and Implementation (invited)**
- 14:40-15:05 M. R. Yuce, Monash University, Melbourne, Australia
- WP2-6 Data Rate Enhancement Method for Body Channel Frequency Selective Digital Transmission Scheme**
- 15:05-15:20 C. Ho, X. Liu, M. Je, Institute of Microelectronics, A*STAR, Singapore, Singapore, Singapore

15:40-17:00 Wednesday, December 11

Session: WP3

Microwave imaging for biomedical applications (II)

Room: Jupiter III

Chairs: Dau-Chyrh Chang, Oriental Institute of Technology, Taiwan
Michael Ong, Institute for Infocomm Research, Singapore

WP3-1 Microwave-acoustic correlated imaging and circuit modelling of biological tissues (invited)

15:40-16:05 F. Gao, X. Feng, Y. Zheng, Nanyang Technological University, Singapore, Singapore

WP3-2 Tradeoff Study of Microwave Imaging for Biomedical Application (invited)

16:05-16:30 D. Chang¹, L. Fang², W. Fang², C. Lee³, ¹Oriental Institute of Technology, New Taipei, Taiwan, ²National Taiwan University of Science and Technology, Taipei, Taiwan, ³Yuan Ze University, Taoyuan, Taiwan

WP3-3 Combining Microwave Imaging and Diffusion Optical Tomography for Breast Tumor Detection

16:30-16:45 K. Agarwal, X. Chen, National University of Singapore, Singapore, Singapore

WP3-4 Enhancement Factor for Electrical Near-Field on Perturbation Slit Nano Structure with Peak Resonance at 30 THz

16:45-17:00 M. Ismail^{1,2}, M. Esa^{1,2}, N. Murad^{2,1}, N. NikAbd. Malik^{2,1}, S. Hamzah^{2,1}, M. Mohd. Yusoff^{2,1}, ¹Universiti Teknologi Malaysia, UTM Johor Bahru, Malaysia, ²Universiti Teknologi Malaysia, UTM Johor Bahru, Malaysia

15:40-16:50 Wednesday, December 11

Session: WP4

Wireless power for on-/in-body devices (II)

Room: Venus I

Chairs: Hon Tat Hui, National University of Singapore, Singapore
Sheng Sun, Hong Kong University, China

WP4-1 MEMS/NEMS Based Enabling Technologies for Self-Sustained (invited)

15:40-16:05 C. Lee, National University of Singapore, Singapore, Singapore

WP4-2 Design of High-Efficiency Inductive Power Transfer Coils for Biomedical Implants

16:05-16:20 X. Zhang, R. Xue, K. Cheng, J. Cheong, C. Ho, L. Yao, C. He, M. Je, Institute of Microelectronics, Singapore, Singapore

WP4-3 Effective Material Parameter Calculation for Layered Metamaterial Structures and its Application in Antenna Design

16:20-16:35 D. Li, E. Li, Institute of High Performance Computing, A*STAR, Singapore.

WP4-4 Numerical Assessment Method for Implantable Cardiac Pacemaker EMI Triggered by 10MHz-band Wireless Power Transfer Coils

16:35-16:50 T. Suzuki, T. Hikage, T. Nojima, Hokkaido University, Sapporo, Japan

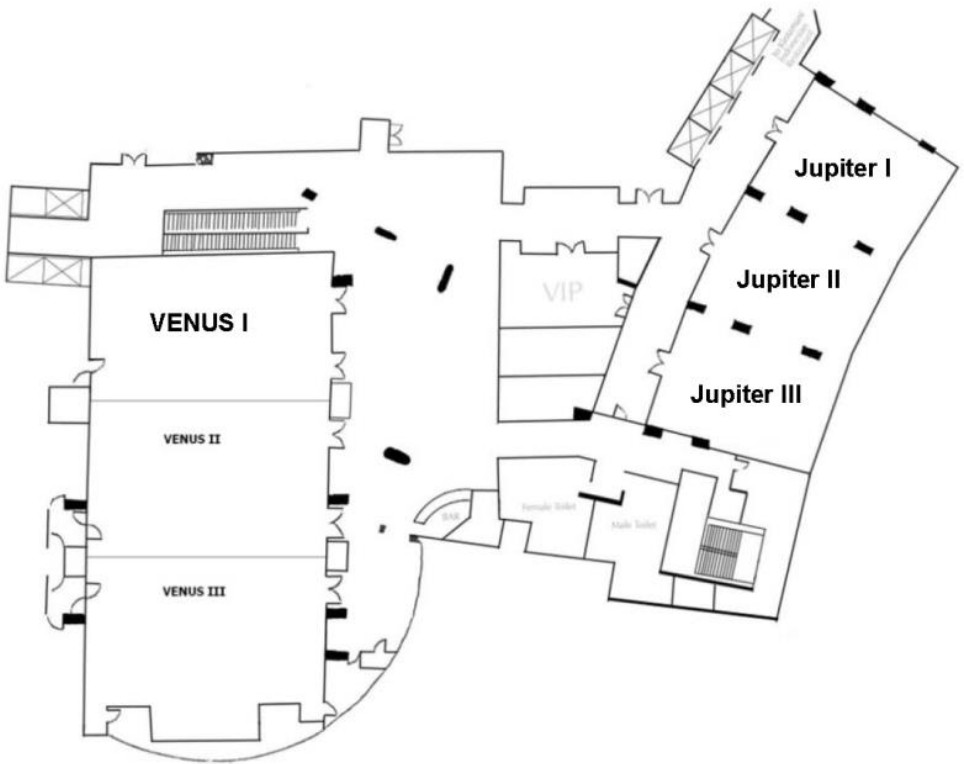
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Floor Plan

3rd Floor



Exhibitors

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MEDs

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Exhibition Location and Hours

Exhibition is located in the room Jupiter I, level 3. Exhibition hours are:

December 09, 2013 (Monday) 13:30–17:00

December 10, 2013 (Tuesday) 10:00–17:00

December 11, 2013 (Wednesday) 10:00–15:00

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