June 27, 2021

8:30-9:00am: Prof. Fred C. Lee

Title: Omnidirectional Wireless Power Transfer System

Abstract: Wireless power transfer has gained popularity in consumer electronics in recent years. Most of the coupled coils in these systems are built in a form of planar structure with close alignment between transmitter coil and receiver coil to facilitate directional power transfer. A three–dimensional (3D) coil structure is proposed. With appropriate modulation current flowing through each transmitter coil, the magnetic field rotates in a 3D space. This charging platform can provide energy transfer in multiple devices simultaneously without any specific alignment between the transmitter coil and receiver coils. In this omnidirectional power transfer approach, the transmitter and receiver coils are loosely coupled. In order to achieve an efficient power transfer, the carrier frequency much be sufficiently high, normally beyond a few Mega Hertz range. This can only be realized with resonant topologies operating under zero-voltage switching.

The specific requirements in an omnidirectional WPT system are identified as such, that the efficient power transfer is realized independent from: 1) coupling coefficient between transmitter coil and multiple receiver coils, especially in the case of weak coupling; 2) output voltage should be load independent; 3) load independent transmitter coil current; 4) the transmitter is always operated at maximum efficiency power transfer. A 6.78 MHz operating frequency is selected for the carrier frequency in order to meet the AirFuel standard. To satisfy all the requirements mentioned above, a specific LCCL-LC resonant converter is proposed which always operates in ZVS with a relatively high gain. To further improve the charging cycle efficiency, a mechanism has been developed to identify the position and field orientation of each receiver coil in the charging bowl. Subsequently, the charging profile can be customized to facilitate most efficient energy transfer.

Another important design consideration of the WPT operating at 6.78MHz is the safety issue related to human exposure of electromagnetic fields (EMF). A double layer shield structure, including a magnetic layer and a conductive layer, are employed in a three-dimension charging platform to reduce the stray magnetic field to a safety level.

Bio:

Dr. Lee is a University Distinguished Professor Emeritus at Virginia Tech. He is a member of the U.S. National Academy of Engineering, an academician of Taiwan's Academia Sinica, and a foreign member of the Chinese Academy of Engineering, China. Dr. Lee founded the Center for power electronics and led a program that encompasses research, technology development, educational outreach, industry collaboration, and technology transfer. To date, more than 230 companies worldwide have benefited from this industry partnership program.

Dr. Lee has supervised to completion 88 Ph.D. and 93 M.S. students. He holds over 100 US patents, and has published over 330 journal articles and more than 760 refereed technical papers. His research interests include high-frequency power conversion, magnetics and EMI, distributed power systems, renewable energy, power quality, high-density electronics packaging and integration, and modeling and control.

Dr. Lee is a fellow of the US National Academy of Inventor, and the recipient of the 2015 IEEE Medal in Power Engineering "for contributions to power electronics, especially high-frequency power conversion."

9:00-9:30am: Dr. Sanjay Gupta

Title: Rise of Wireless Power – Achieving the Vision of a Cord-Free World

Abstract: It's an exciting time to be in wireless power. First generation technologies have paved the way, and new technologies are becoming standardized and gaining traction rapidly. Magnetic Resonance and RF power will improve the user experience and open doors to applications that were unthinkable a few short years ago. These emerging technologies enable rapid charging of multiple devices simultaneously and eliminate the need for precise positioning.

In this presentation, Sanjay Gupta Ph.D, President of AirFuel Alliance, will address the next generation technologies including (i) the wide range of applications they enable, (ii) the technical advancements in semiconductors that are essential to enabling commercialization, and (iii) the latest on the global standards essential multi-vendor interoperability and rapid technology adoption.

Bio:

Sanjay Gupta, Ph.D is President and Chairman of the AirFuel Alliance, a global coalition of innovative companies who are committed to a world where we can power up without plugging in. Under Dr. Gupta's leadership, AirFuel Alliance develops standards for leading edge wireless power technologies and accelerates their adoption. (www.airfuel.org)

Sanjay Gupta is an entrepreneurial technology executive with expertise in conceptualizing and launching innovative hardware, firmware, and software systems solutions. He has broad experience identifying market opportunities to create revenue-generating products, developing and implementing product strategy, and establishing market leadership. Recognized for creating engaging user experiences, building and maintaining product/technology roadmaps, and developing and leading global organizations, Dr. Gupta is a collaborative leader, highly effective in fast-moving matrixed organizations in diverse markets and industries, including consumer electronics, telecommunications, wearables, and Internet of Things (IoT).

At Motorola Mobility, Dr. Gupta developed and delivered multi-generation product and system solutions for a USD 1B business bringing 80+ new products to market every year and led global organizations of 100's of people in Asia, Europe, and the US.

Dr. Gupta has a track record of 'industry firsts', such as mixed signal wireless charging ASIC, Dell Laptop with wireless charging, Android smartwatch and fitness monitoring ecosystem, and first smartphone with Wi-Fi and Voice Over IP.

9:30-10:00am: Prof. Joshua Smith

Title: TBD

Abstract: TBD

Bio: TBD

10:00-10:20am: Tea Break

10:20-10:50am: Prof. Chris Mi

Title: Application of wireless power transfer in electric aircraft, railway, ships, and road vehicles

Abstract: Wireless power transfer (WPT) technology offers significant improvement in convenience and safety and has found many applications, such as electric vehicle (EV), implanted medical devices, mobile devises, under water vehicles, industrial automation equipment, robots, and automatic guided vehicles, etc. Both capacitive and inductive wireless power transfer technologies have been investigated for various applications. Experiments have shown that tens or even hundreds of kilowatts of power can be transferred over 200 mm distance with an efficiency of 97% (DC-DC) or more, and an alignment tolerance of up to 300mm.

In this presentation, we will first look at the basic principle of WPT. Then we will show that safety is still one of the major concerns of WPT system for both inductive and capacitive power transfer, especially for high-power applications. Then, we will discuss two unique topologies developed by the research group of Prof. Mi, including the double-sided LCC topology and the LCLC topology for capacitive wireless power transfer. Finally, we will show some case studies that involve electric aircraft, railway, ships, and road vehicles.

Bio:

Chris Mi is a fellow of IEEE and SAE, Professor and Chair of the Department of Electrical and Computer Engineering, and the Director of the US DOE-funded GATE Center for Electric Drive Transportation at San Diego State University, San Diego, California, USA. He was previously a professor at the University of Michigan, Dearborn from 2001 to 2015. He received the B.S. and M.S. degrees from Northwestern Polytechnical University, Xi'an, China, and the Ph.D. degree from the University of Toronto, Toronto, Canada, all in electrical engineering. Previously he was an Electrical Engineer with General Electric Canada Inc. He was the President and the Chief Technical Officer of 1Power Solutions, Inc. from 2008 to 2011.

His research interests are in electric and hybrid vehicles. He has taught tutorials and seminars on the subject of HEVs/PHEVs for the Society of Automotive Engineers (SAE), the IEEE, workshops sponsored by the National Science Foundation (NSF), and the National Society of Professional Engineers. He has delivered courses to major automotive OEMs and suppliers, including GM, Ford, Chrysler, Honda, Hyundai, Tyco Electronics, A&D Technology, Johnson Controls, Quantum Technology, Delphi, and the European Ph.D School. He has offered tutorials in many countries, including the U.S., China, Korea, Singapore, Italy, France, and Mexico. He has published more than 300 articles and delivered more than 100 invited talks and keynote speeches and as a panelist in major IEEE and SAE conferences.

Dr. Mi is the recipient of the "Distinguished Teaching Award" and "Distinguished Research Award" of the University of Michigan Dearborn. He is a recipient of the 2007 IEEE Region 4 "Outstanding Engineer Award," "IEEE Southeastern Michigan Section Outstanding Professional Award." and the "SAE Environmental Excellence in Transportation (E2T) Award." He was also a recipient of the National Innovation Award and the Government Special Allowance Award from the China Central Government. He received three Best Paper Awards from IEEE Transactions on Power Electronics and two Power Electronics Prize Letter Awards. In 2019, he received the IEEE Power Electronics Emerging Technology Award.

Dr. Mi was the Chair (2008-2009) and Vice-Chair (2006-2007) of the IEEE Southeastern Michigan Section. Dr. Mi was the General Chair of the 5th IEEE Vehicle Power and Propulsion Conference, Area Editor of IEEE Transactions on Vehicular Technology, associate editor of IEEE Transactions on Power Electronics, Associate Editor of IEEE Transactions on Industry Applications. He is the topic chair for the 2011 IEEE International Future Energy Challenge and the General Chair for the 2013 IEEE International Future Energy Challenge. Dr. Chris Mi is a Distinguished Lecturer (DL) of the IEEE Vehicular Technology Society.

He is Guest Editor-in-Chief of IEEE Journal of Emerging and Selected Topics in Power Electronics - Special Issue on WPT, Guest Co-Editor-in-Chief of IEEE Transactions on Power Electronics Special Issue on WPT, Guest Editor of IEEE Transactions on Industrial Electronics - Special Issue on dynamic wireless power transfer, and steering committee member of the IEEE Transportation Electrification Conference (ITEC- Asian). He is Program Chair or General Chair of a number of international conferences, including Workshop on Wireless Power Transfer (WoW), IEEE International Electric Vehicle Conference (IEVC), and IEEE International Transportation Electrification Conference – Asia-Pacific. He is the Guest Editor of a Special Issue of the Proceedings of the IEEE - Electric and Hybrid Vehicles.

10:50-11:20am: Prof. C. K. Michael Tse

Title: Convenient Viewpoints to Higher Order Compensation in IPT Converters

Abstract: This talk presents a systematic extension of second-order compensated inductive power transfer (IPT) converters, designed for achieving load-independent current (LIC) or load-independent voltage (LIV) output, to higher order compensated IPT converters through adding an inductor or capacitor at the input or output side. We will reveal the roles of extra input-side or output-side inductors and capacitors in making the whole system less sensitive, and hence provides a fast understanding of the choice of higher order compensation circuits for applications addressing wide ranges of input variations, transformer coupling and compensation network changes.

Bio:

Michael Tse is presently Associate Vice-President (Research) and Chair Professor of Electrical Engineering at City University of Hong Kong. His research interests include power electronics and nonlinear systems. He was recipient of a number of research and invention prizes including a few Best Paper Prizes from IEEE and other journals, as well as a Grand Prize in Silicon Valley International Invention Festival (2019). In 2005, 2010 and 2018, he was selected and appointed as IEEE Distinguished Lecturer. In 2006 he chaired the IEEE CAS Technical Committee on Nonlinear Circuits and Systems. He serves and has served as Editor-in-Chief of IEEE Transactions on Circuits and Systems II, IEEE Circuits and Systems Magazine, IEICE Nonlinear Theory and Applications; as Editor of International Journal of Circuit Theory and Applications, and on the editorial board of the IEEE Proceedings. He has been appointed to honorary professorship and distinguished fellowship by a few Australian, Canadian and Chinese universities, including the Chang Jiang Scholar Chair Professor with Huazhong University of Science and Technology, Honorary Professor of Melbourne University, Distinguished International Research Fellow with the University of Calgary, and Distinguished Professor-at-Large with the University of Western Australia.

11:20-11:50am: Prof. Yue Sun

Title: Self Organized Wireless Power Transfer Grid and Key Scientific Problems

Abstract: With the booming development in the latest decades of years, numerous applications have been brought in with the study in wireless power transfer especially the Magnetically-Coupled wireless power transfer. The increase in the space ability and guarantee on the power transfer efficiency within a certain space are still an import research point in the wireless power transfer field. To resolve the wireless power supply issue in the randomly distributed multi-device group in a certain space area, the wireless power transfer grid (WPTG) has been proposed considering the random of the device distribution, the dynamics of the real-time device status and the variation of the power storage of devices, which is based on the wireless power transfer technology.

It is comprised of electrical battery-powered device nodes that is equipped with wireless power transfer capability. The multi-hop mechanism and routing theory in Internet field are combined to implement the power transfer to meet the power demand of the load node within this grid. This report will discuss some key scientific problems involved in the WPTG system.

Bio:

Sun Yue is currently a Professor of School of Automation of Chongqing University, China. He is also the director of National International Joint Center on Wireless Power Transfer Technology. In addition, he serves as a standing director of the China Power Supply Society (CPSS), the director of the CPSS Technical Committee “Wireless Power Transfer Technology and Devices”, a deputy director of the China Electrotechnical Society Technical Committee “Wireless Power Transfer Technology”, a deputy director of the Education Committee of the China Association of Automation. His current research interests include automatic control, wireless power transfer, power electronics applications, and control theory and applications.