June 26, 2021

1:45-2:15pm: Mr. Yongdong Liu

Title: China's Electric Vehicle Wireless Charging Process

Abstract: Wireless charging technology is at the forefront of industrialization. With the introduction of intelligent networked vehicles and high-end vehicles, wireless charging technology has broad market potential. This Plenary will introduce the whole situation and development steps of the electric vehicle wireless charging industry, focusing on the planning and construction of the electric vehicle wireless charging standardization, moreover, the keynote will also introduce the overview of the existing published electric vehicle wireless charging standards.

Bio:

Mr. Yongdong Liu is the director of Standardization Center of China Electricity Council, Secretary-General of the Energy Industry Standardization Technical Committee for Electric Vehicle Charging Facilities, chairman of the Energy Industry Wind Power Grid-Connected Standardization Sub-Technical Committee, and chairman of the CEC Energy Internet Standardization Technical Committee. He has been responsible for power standardization for a long time, is familiar with the power system, promoted the establishment of my country's UHV standard system, carried out comprehensive standardization of smart grids, and took the lead in completing the construction of China's electric vehicle charging facilities standard system. Organize the international standardization of China's electric power, and promote the construction of the English version of China's electric power standards.

2:15-3:50pm: Prof. Hiroshi Fujimoto, Mr. Osamu Shimizu, Prof. Takehiro Imura, Prof. Yoichi Hori

Title: Ultimate Car System in 100 Years

Abstract:

1. *In-wheel Motor Project for DWPT* (Prof. Hiroshi Fujimoto): In our laboratory, a second-generation wireless in-wheel motor (W-IWM2) having the capability of dynamic wireless power transfer (D-WPT) on its wheel side has been developed. The D-WPT technology can drastically extend the driving range of electric vehicles. In addition, a lithium-ion capacitor (LiC) is installed at the wheel side of the W-IWM2. The LiC can effectively charge the regenerative breaking energy. The W-IWM3, which is an evolution of the W-IWM2, is also developed to reduce the size and to increase the power. This talk introduces the development of the W-IWM2 and W-IWM3 with the experimental results.

2. *Motor Design for DWPT* (Mr. Osamu Shimizu): We developed in-wheel motor system which integrates motor drive system and dynamic wireless power transfer system named 3rd generation wireless in-wheel motor. This speech focuses on the motor design for future electric vehicles includes the design of 3rd generation wireless in-wheel motor.

3. *Road Design for DWPT* (Prof. Takehiro Imura): The development of technology for embedding coils in roads is important for dynamic wireless power transfer (DWPT). When embedding coils in a road, it is necessary to ensure both the electrical and mechanical properties required for DWPT. In this study, the electrical characteristics of the coil were evaluated before and after burying it. Further, we evaluated the mechanical strength of the road before and after the coils were buried using the falling weight

deflectometer test. I will introduce these DWPTs topics that were conducted at the University of Science.

4. *Concept of Motor/Capacitor/Wireless* (Prof. Yoichi Hori): Motor, Capacitor and Wireless will be the key technologies for cars in the future, instead of Engine, Battery and Quick charge. This section summarizes the three keynote speeches here and proceeds to Q&A session.

Bio:

Hiroshi Fujimoto received the Ph.D. degree in the Department of Electrical Engineering from the University of Tokyo in 2001.

In 2001, he joined the Department of Electrical Engineering, Nagaoka University of Technology, Niigata, Japan, as a research associate. From 2002 to 2003, he was a visiting scholar in the School of Mechanical Engineering, Purdue University, U.S.A. In 2004, he joined the Department of Electrical and Computer Engineering, Yokohama National University, Yokohama, Japan, as a lecturer and he became an associate professor in 2005. He had been an associate professor of the University of Tokyo from 2010 to 2020 and became a professor from year 2021.

He received the Best Paper Awards from the IEEE Transactions on Industrial Electronics in 2001 and 2013, Isao Takahashi Power Electronics Award in 2010, Best Author Prize of SICE in 2010, The Nagamori Grand Award in 2016, and First Prize Paper Award IEEE Transactions on Power Electronics in 2016.

His interests are in control engineering, motion control, nano-scale servo systems, electric vehicle control, motor drive, visual servoing, and wireless motors. Dr. Fujimoto is a senior member of IEE of Japan and IEEE. He is also a member of the Society of Instrument and Control Engineers, the Robotics Society of Japan, and the Society of Automotive Engineers of Japan.

Osamu Shimizu worked as an associate at Toyota Motor Corporation, Sim-Drive Co., Ltd., Honda R & D Co., Ltd. in 2009-2017. He joined Nagoya University in 2017. From 2018 He joined Graduate School of Frontier Science at University of Tokyo as a project assistant professor and became a project lecturer from year 2021. His current research interests are and design and control of electric vehicle driving system and wireless power transfer.

Takehiro Imura joined the University of Tokyo in 2010 as a Research Associate and has been a Project Lecturer since 2015. In 2019, he joined the Tokyo University of Science, as an Associate Professor. His current research interests include wireless power transfer using magnetic resonance coupling and electric resonance coupling.

Yoichi Hori received Ph.D. degrees in Electrical Engineering from the University of Tokyo in 1983, and joined the Department of Electrical Engineering. He later became a Professor at the same university. In 2008, he moved to the Department of Advanced Energy. In 2021, he retired and is now a professor at Tokyo University of Science. His research fields are control theory and its industrial applications to motion control, mechatronics, electric vehicles, etc. He is an IEEE Life Fellow. He is the past President of IEEJ-IAS, the past President of WEVA, and is now the Vice-President of JSAE.

3:50-4:20pm: Tea Break

4:20-4:50pm: Prof. Grant Covic

Title: Electric Vehicle Wireless Charging Systems for both a Stationary and Dynamic Future

Abstract: The ability to provide power without wires was imagined over a century ago, but assumed commercially impractical and impossible to realise. However for three decades the University of Auckland has been at the forefront of developing and commercialising highly resonant inductive power transfer systems alongside its industrial partners. This research has proven that significant wireless power can be transferred over relatively large air-gaps efficiently and robustly. Early solutions were applied in industrial applications to power moving vehicles in clean room systems, roadway lighting and industrial plants, but more recently this research has helped improve technology that has the ability to impact us directly at home and around our cities.

Bio:

Grant A. Covic received his BE (Hons), and PhD degrees in Electrical and Electronic Engineering from The University of Auckland (UoA), New Zealand in 1986 and 1993 respectively. He was appointed as a full time Lecturer in 1992, a Senior lecturer in 2000, an Associate Professor in 2007 and to Professor in 2013 within the Department of Electrical, Computer, and Software Engineering at the UoA, New Zealand. In 2010 he co-founded (with Prof. John Boys) a new global start-up company “HaloIPT” focusing on electric vehicle (EV) wireless charging infrastructure, which was sold in late 2011. During this time HaloIPT received the Clean Equity Monaco award for excellence in the field of environmental engineering and two NZ clean innovation awards in the emerging innovator and design and engineering categories.

Grant was awarded the New Zealand Prime Minister’s Science Prize, the Vice Chancellors commercialisation medal and the KiwiNet research commercialisation awards for scientific research which has seen outstanding commercial success. He is a Fellow of both Engineering New Zealand and the Royal Society of New Zealand, was a Distinguished Lecturer for the IEEE Transportation Electrification Community 2016-2019, and is presently active on the steering committee for wireless power week.

His research and consulting interests include power electronics, electric vehicle battery charging and resonant inductive power transfer (IPT) from which he has published more than 200 refereed papers in international journals and conferences. He holds a number of patent families with many more pending, from which licenses in specialized application areas of IPT have been granted around the world. Presently he

heads inductive power research at the UoA, is directing a government funded research program on stationary and dynamic wireless charging of EVs within the road, while also co-leading the interoperability sub-team within the SAE J2954 wireless charging standard for EVs.

4:50-5:20pm: Prof. Paul Mitcheson

Title: ISM band IPT: Approaches and Applications

Abstract: Most existing commercial IPT operates at around 100 kHz and confirms to the Qi or the SAE standards. MHz based IPT in the ISM bands has become possible through the use of WBG devices and is backed by the Air Fuel Alliance. MHz operation allows intrinsically better performance of the magnetic link, and lighter transmit pads and pick-ups, but it is also challenging to operate the power hardware at these frequencies.

In this talk I will describe the approach we have taken to IPT in my lab, covering inverters, rectifiers, magnetic link and FoD, and discuss some of the applications that we hope to enable as part of our new spinout company Bumblebee Power, a spinout from Imperial College London (www.bumblebeepower.com)

Bio:

Paul D. Mitcheson (SM'12) received the M.Eng. degree in electrical and electronic engineering and the Ph.D. degree in micro-power motion-based energy harvesting for wireless sensor networks from Imperial College London, London, U.K., in 2001 and 2005, respectively. Prof. Mitcheson is currently a Professor in Electrical Energy Conversion with the Control and Power Research Group, Electrical and Electronic Engineering Department, Imperial College London. His research interests include energy harvesting, power electronics, and wireless power transfer to provide power to applications in circumstances where batteries and cables are not suitable. His research has been supported by the European Commission, Engineering and Physical Sciences Research Council, and several companies. Prof. Mitcheson is a Fellow of the Higher Education Academy and is on the executive committee of the UK Power Electronics Centre. He was general co-chair of IEEE Wireless Power Week in 2019 in London, UK.

5:20-5:50pm: Prof. Nejila Parspour

Title: Wireless Power Transfer – Impacts on E-Mobility

Abstract: Electromobility in combination with renewable energy sources is a very promising alternative to maintain the mobility of people and goods while reducing emissions and conserving the resources of our planet. In this context, using wireless power transfer, in particular for near field applications („inductive power transfer"), is a key technology. Inductive power transfer is expected to have a significant impact on the future mobility. This will not be limited to charging methods. After recapping the physical principles and mathematical-technical relationships for inductive power transfer I will focus in my presentation on the inductive charging of electrical vehicles both while driving and parking. Furthermore, I will discuss the influence of inductive power transfer on the power train by introducing novel concepts for an e-motor and a low voltage battery system.

Bio:

Nejila Parspour is Professor of Electrical Energy Conversion at the University of Stuttgart and director of the Institute of Electrical Energy Conversion. She received her Master in electrical engineering in 1991 and her PhD in 1995, both from Technical University of Berlin. Before joining the University of Stuttgart, she collected 5 years of industrial experience at Philips and 6 years of scientific experience at the University of Bremen. Her research and teaching activities are in the field of electrical machines and drives with a focus on machine design and in the field of contactless energy transfer with a focus on inductive charging systems.

5:50-6:20pm: Dr. Morris Kesler

Title: Wireless Charging for Electric Vehicle: Moving to the Mainstream

Abstract: The desire for wireless charging of electric vehicles has been around for at least a decade and is now poised to move onto mainstream electric vehicles (EVs). Interest in EVs and in electric mobility in general has never been greater, and automakers and other E-mobility companies are investing heavily in new platform development. Wireless charging technology is ready to make charging these platforms a simple, hassle-free experience and even enable new opportunities for mobility and autonomy. The first standard development activities for EV wireless charging culminated in 2020 with the publication of the SAE J2954 standard for wireless charging of light duty vehicles. In addition, portions of the GB/T 38775 standard for EV wireless charging have also been released. This opens the door for broad deployment, providing a means for creating systems that are interoperable across different manufacturers and vehicle types, and makes public wireless charging infrastructure possible. However, a wireless power product involves much more than just power transfer. In this presentation we will review requirements for a practical EV wireless charging system, explore key system considerations and solutions, and look at where the technology is headed as we move into the age of E-mobility.

Bio:

Dr. Morris Kesler is the Chief Technology Officer at WiTricity Corporation where he leads research and development activities in wireless power technology. He joined WiTricity in 2007 and has served as Chief Engineer and vice president of research and development. Dr. Kesler also worked at the Georgia Tech Research Institute where he led research programs in electromagnetic scattering, antenna arrays, novel antenna structures and photonic band-gap materials. He holds over 100 patents and has published over 40 technical journal and conference papers. He holds B.S., M.S., and Ph.D. degrees from the Massachusetts Institute of Technology in Electrical Engineering and Computer Science.