

## Inductive Wireless Power Transfer: Past, Present, Future



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### Abstract

Wireless Power Transfer (WPT) has recently revived as one of the most attractive fields of research, development and innovation. An increasing number of WPT systems for some applications have already been available in the market by the new comers. More enthusiastic and fast-growing startups are active in the field toward developing innovative systems. In this Keynote, an overview of Inductive WPT is presented. Starting from the very basic law of electromagnetic induction and a simple pair of inductive coils, the essential requirements of a practical WPT are discussed. Different parts of an effective WPT system, including the electromagnetic link, the power electronic converters, the resonance compensators, and the control system are briefly described and their various topologies are mentioned with their pros and cons. An emphasis is placed on high power applications and Dynamic WPT for moving objects, particularly electric vehicles. Major challenges of WPT together with the corresponding research are listed. Selective applications are reviewed with an eye on the status of their market. Finally, a prospect of future developments in the area of WPT including the needs and opportunities for multidisciplinary and interdisciplinary research in Power, Control, Electronics, AI, Communication, and IT is roughly presented.

### Biography

Sadegh Vaez-Zadeh is a professor of Power Engineering Department and Control Engineering Department and the director of Advanced Motion Systems Research Laboratory at the University of Tehran. His research interests include Electrical Machines and Drives, Contactless Power Transfer, Renewable Energy, and Energy Policy. In these areas, he has contributed to novel high efficiency Permanent Magnet Motors, introduced Combined Control method for Electric Machines and Power Electronic Converters, and led the development of high efficiency Wireless Power Transfer systems. He is the author of *Control of Permanent Magnet Synchronous Motors*, OXFORD University Press, 2018. Dr. Vaez-Zadeh is an Editor of the IEEE Transactions on Energy Conversion, the IEEE Transactions on Sustainable Energy, and a Subject Editor of IET Renewable Power Generation. He has been active in many conferences as General Chair, Keynote Speaker, Member of Technical and Steering Committees, etc. He has served the Power Electronics Society of Iran as the Founding President, and currently holds the INSF Chair of Wireless Power Transfer. He has received several awards domestically and internationally for his technical Contributions.



دکتر محمد جمشیدی

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## چکیده

مدتی است که اطلاعات زیادی در تمام جنبه های زندگی ما جمع شده است. پیشرفت در فن آوری حسگر، اینترنت، ارتباطات بی سیم و حافظه ارزان قیمت همه در انفجار "داده های بزرگ" نقش داشته است. System of Systems (SoS) یکپارچه سازی سیستم های مستقل عملیاتی و غیر همگن برای دستیابی به هدفی بالاتر از مجموع قطعات است. SoS امروز همچنین به وجود "داده های بزرگ" غیرقابل کنترل کمک می کند. تلاش های اخیر رویکرد امیدوارکننده ای را ایجاد کرده اند، "تجزیه و تحلیل داده"، که از ابزارهای یادگیری ماشین از محاسبات آماری و نرم (SC) مانند تجزیه و تحلیل م component لفه های اصلی (PCA)، خوشه بندی، منطق فازی، محاسبات عصبی، محاسبات تکاملی، شبکه های بیسی، معماری های عمیق و یادگیری عمیق، و غیره مدل پارامتری برای "داده های بزرگ". این سخنرانی اصلی سعی در ایجاد پلی بین SoS و Data Analytics برای ایجاد مدل های قابل اعتماد برای چنین سیستم هایی دارد. یک مشکل پیش بینی انرژی فتوولتائیک از یک شبکه میکرو SoS، پیش بینی ترافیک و سیستم وسایل نقلیه مستقل برای مطالعات موردی ارائه می شود. این ابزارها برای استخراج یک مدل غیرخطی برای BIG DATA تولید شده توسط SoS استفاده خواهد شد.

## بیوگرافی

محمد جمشیدی یک F-IEEE، F-ASME، F-AIAA، F-AAAS، F-NYAS، F-TWAS است. وی BSEE (Cum Laud) را در دانشگاه ایالتی اورگان در سال ۱۹۶۷ دریافت کرد، کارشناسی ارشد و دکتری. در EE از دانشگاه ایلینوی در Urbana-Champaign به ترتیب در ژوئن ۱۹۶۹ و فوریه ۱۹۷۱. وی دارای مدرک دکترای افتخاری از دانشگاه واترلو، کانادا، ۲۰۰۴، دانشگاه فنی کرت، یونان، ۲۰۰۴ و دانشگاه اودلار یوردو، باکو، آذربایجان در سال ۱۹۹۹ است. در حال حاضر، وی استاد برجسته وقف لوچر براون در دانشگاه تگزاس است، سان آنتونیو، TX، ایالات متحده آمریکا. وی ۱۰ سال به ناسا مشاوره داده و به عنوان مهندس ارشد یا دانشمند مراجعه کننده در IBM، GM و Siemens کار کرده است. وی در حال حاضر درگیر تحقیق در مورد سیستم مهندسی سیستم با تأکید بر رباتیک، هواپیماهای بدون سرنشین، سیستم های بیولوژیکی و انرژی پایدار، یادگیری ماشین و کاربردهای هوش مصنوعی در کنترل و ناوبری است.

## The next Generation Wireless Technologies and the Role of Optical Wireless



**Professor Zabih (Fary) Ghassemlooy**

Head of Optical Communications research Group, Northumbria University, UK

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### Abstract

The world that we are living in is changing at a rapid speed and is becoming fully automated and data-centric, where billions of devices used at homes, offices, industry, cities, environments, etc. are expected to inter-connected and operated using machine learning via local- and public-based cloud networks. The future Internet of thing (IoT) will require a global telecommunication network (most importantly wireless networks) with sufficient bandwidth for transferring massive amounts of data at very high speeds over very reliable links. Fifth and sixth generation (5/6G) wireless networks are aiming to address this challenge by offering full realization of the IoT paradigm by connecting people-to-people, vehicle-to-vehicle, , machine-to-machine, sensors-to-infrastructure, etc. To address these challenging demands, radically new telecommunication networks are required with key features of utilising new unused spectrums, disruptive technologies, machine learning, enabling technologies, energy efficiency, etc. This talk will give an overview of the 5G/6G and their implications in future telecommunications networks and focus on the role of optical wireless technology particularly the visible light communications.

### Biography

Professor Zabih (Fary) Ghassemlooy, Fellow, SOA; Fellow, IET; Senior Member, IEEE; Member, ACM), CEng, Google Scholar Citation: 15555, Google Scholar h-index: 53 and i10-index: 328. BSc (Hons.), MMU, (1981), MSc (1984) and PhD (1987) from Manchester Univ., UK. 1987-88 a Post-Doctoral Research Fellow at City Univ., UK. 1988-2004 at Sheffield Hallam University, UK, and 2004 joined Faculty of Engineering and Environment, Northumbria University, UK as the Associate Dean for Research and Innovation, and currently is the Head of Optical Communications Research Group. A Research Fellow (2016-) and a Distinguished Professor (2015-) at Chinese Academy of Science. Visiting Professor at the University Tun Hussein Onn Malaysia (2013-17), Huaqiao University, China (2017-18), Technical University of Prague, Czech Republic (2019), Technical University of Graz, Austria (2018). He was the Vice-Chair of EU Cost-Action IC1101 (2011-16) and is the Vice- Chair of Cost Action NEWFOCUS (CA19111), 2020-24. Research interests include optical wireless communications (OWC), free space optics, visible light communications, optical camera communications, hybrid RF-OWC, with many funded research projects from Research Councils (UK, EU) and industries, and in collaboration with many leading research groups in UK, Europe, Far- and Middle-East. Over 940 publications (373 journals (IEEE, IET, IoP, SOA, Elsevier, ..), 8 books), over 100 keynote/invited talks, supervised 10 Research-Fellows and 66-PhDs. He is the Chief Editor of British J. of Applied Science and Technology and International J. of Optics and Applications, Associate Editor of few journals (IEEE, IET, etc.), and Co-guest Editor of many special issues on OWC. He is Vice-Cahir of OSA Technical Group of Optics in Digital Systems (2018-); Chair of IEEE Student-Branch at Northumbria University (2019-). 2004-06 was IEEE UK/IR Communications Chapter Secretary, Vice-Chair (2006-2008), Chair (2008-11), and Chair of IET Northumbria Network (2011-15). He is the founder and chair the IEEE/IET International Symposium on Communications Systems, Networks and DSP, West Asian Symposium on Optical and mmW Wireless Communications, South American Colloquium on Visible Light Communications, and co-founder of a number of international events including Workshop on Optical Wireless Communications in IEEE ICC since 2015, colloquium on OWC in CSNDSP since 2004, and international Workshop on OWC since 2015. He is a member of international technical committee of a very large number of international conferences. He is the Vice-Cahir of OSA Technical Group of Optics in Digital Systems (2018-).

## Why Engineers are Critical to Cyber Security



**Professor Vijay Varadharajan**

**Global Innovation Chair in Cybersecurity College of Engineering, Science and Environment**

### **Abstract**

This talk will consider the trends and challenges in cyber security and why it is important for engineers to have cyber security knowledge and skills. As engineers play a key role in building and maintaining complex systems and infrastructures, it is critical for engineers of the future to understand cyber security more than ever, especially electrical and computer engineers at the forefront of this change.

We will look at the developments in the technology space and how technologies such as the Internet of Things (IoT), cloud infrastructures, autonomous systems, and machine learning and data analytics are shaping up the cyber space. We will examine the major security and privacy challenges posed by the dramatic growth in the deployment of these technologies in various business sectors such as healthcare, transportation and utilities. We will see that this requires the development of new security and trust techniques and their implementation to counteract emerging cyberattacks, and engineers have a critical role to play in developing systems that are resilient to ensure continuous provision of critical services.

## Mechatronic Dampers for Automotive and Energy Conversion



**Professor Mehrdad Moallem**

**Simon Fraser University Professor, School of Mechatronic Systems Engineering**

**Web site: [https://www.sfu.ca/mechatronics/people/faculty/mehrdad\\_moallem.html](https://www.sfu.ca/mechatronics/people/faculty/mehrdad_moallem.html)**

### **Abstract**

Due to their large weight, size, and insufficient damping, hydraulic dampers are not suitable for applications such as ultra-light electric vehicles. More effective suspension systems have been developed by utilizing active or semi-active damping mechanisms. We have investigated the idea of regenerative damping, in which the vibration energy can be recuperated into battery charge using electromechanical systems, rather than wasted as heat in regular dampers. A proof-of-concept regenerative damper is presented which allows translational mechanical vibrations to be converted into battery charge using a three-phase boost converter. A pseudo-resistor behavior was enforced across the electric machine through nonlinear power electronics control, resulting in mechanical damping with an energy regenerative function. A regenerative shock absorber sized for a passenger car with a damping coefficient of 1720 Ns/m and a mechanical conversion efficiency between 70%-80%, which is considerably higher than other mechanisms reported in the literature has been achieved.

## 5G promises for IoT



**Dr. Reza Vahidnia**

**Faculty - British Columbia Institute of Technology IoT Strategy Consultant - MCI R&D Research Center**

### **Abstract**

Almost every industry can be transformed with cellular IoT. The connectivity needs of all industries can be addressed by four multi-purpose IoT segments, which efficiently co-exist in one 5G network. These segments are Massive IoT, Broadband IoT, Critical IoT and Industrial Automation IoT. In this presentation, the key enablers for 5G cellular IoT and the evolution plan for addressing all 5G-IoT uses cases are discussed.

## Beyond 5G: Road to 6G networks



**Dr. Vahid Shahmansouri**

عضو هیات علمی دانشگاه تهران و مرکز تحقیق و توسعه همراه اول

### **Abstract**

Many efforts and initiatives from academia and industry have started to look beyond 5G and conceptualize next-generation 6G wireless system that can truly support diversified applications ranging from autonomous systems to real-time interactive services. In this talk, the primary drivers and technological trends beyond 5G towards 6G are discussed and potential 6G use cases are explored. After reviewing standardization efforts related to 6G networks, the talk concludes by providing recommendations for the roadmap towards 6G.

تحول دیجیتال و هوشمندسازی در صنعت فولاد



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