Keynote speakers

Plan: First Day 13/12/2022

Operational Security and Control Challenges in Smart Energy Systems

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The development of innovative cybersecurity technologies, tools and methodologies that advance the energy system's ability to survive cyber-attacks and incidents while sustaining critical functions, is needed for the secure operation of utilities, industrial systems, smart homes and transportation systems. It is essential to verify and validate the ability of the developed solutions and methodologies so that they can be effectively used in practice. The development of solutions to mitigate cyber vulnerabilities throughout the energy delivery system is essential to protect hardware assets. It will also make systems less susceptible to cyber threats and provide reliable delivery of electricity if a cyber incident occurred.

In this talk, we will describe how the developed solution can protect the power grid, industrial systems, smart homes and transportation systems and infrastructures from cyber-attacks as well as build cybersecurity protection into emerging power grid components and customer based services. This includes micro-grid and demand-side management components as well as protects the network (substations and productivity lines) and data infrastructure to increase the resilience of the energy delivery systems against cyber-attacks.

The development of secure operation and cybersecurity capabilities in energy systems should span over multiple strategies; in the near term, midterm and long term. The continuous security state monitoring across cyber-physical domains is the goal in the near term. The development of continually defending interoperable

components that continue operating in degraded conditions is required in the midterm. The development of methodologies to mitigate cyber incidents to quickly return to normal operations is necessary for all system components in the long term. We will discuss R&D efforts in these research areas centered on the development of operational frameworks related to communication and interoperability, control and protection in various platforms including smart homes and electric vehicles.

One of the emerging research areas is the scalable cloud-based Multi-Agent System for the control of large scale penetration of Electric Vehicles (EVs) and their infrastructure into the power grid. This is a system that is able to survive cyber-attacks while sustaining critical functions. This framework's network will be assessed by applying contingencies and identifying the resulting signatures for detection in real-time. As a result, protective measures can be taken to address the dynamic threats in the foreseen grid-integrated EV parks where the developed system will have an automated response to a cyber-attack.

In distributed energy management systems, the protection system must be adaptive. It is assisted by communication networks to react to dynamic changes in the microgrid configurations. In this regard, this presentation will also describe a newly developed protection scheme with extensive communication for power networks to monitor the microgrid during these dynamic changes. The robustness and availability of the communication infrastructure is required for the success of protection measures.

Biographical Sketch of Professor Osama Mohammed

Dr. Osama A. Mohammed is a Distinguished Professor of Electrical Engineering and the Associate Dean of Research at the College of Engineering and Computing, Florida International University. He is also the director for the School of Electrical, Computer and Enterprise Engineering (ECEE) at FIU and is a Director of the Energy Systems Research Laboratory.

He has researched various topics in transportation electrification, power and energy systems, design optimization, and physics-based modeling in electric drive systems, and power electronics. He is world-renowned for his contributions in these areas. He has performed significant research in electromagnetic signatures, EMI, wide bandgap devices, and movable power systems modeling and analysis. He currently has active research projects with several federal agencies in these areas. In addition, he has also completed projects in power system operation, smart grid distributed control and interoperability, cyber-physical systems, and co-design of cyber and physical components for future energy systems applications. He has published more than 850 articles in refereed journals, and other IEEE refereed international conference records. Professor Mohammed holds 19 patents. His publications are highly cited, and his presentations are frequently invited, at research, academic and industrial organizations, and conferences worldwide. He also authored a book and several book chapters. Dr. Mohammed is a Fellow of the National Academy of Inventors, a Fellow of IEEE and a Fellow of the Applied Computational Electromagnetic Society. He received the prestigious IEEE Power and Energy Society Cyril Veinott Electromechanical Energy Conversion Award, the 2012 Outstanding Research Award from Florida International University, the 2017 outstanding doctoral mentor, and the university distinguished Professor honors in 2018.

Plan: Second day 14/12/2022

Hydrogen in Electricity's Future

Dr Ahmed F. Zobaa, DSc, FIET, FEI, FCIBSE, FIMechE, FAAS, SMIEEE

From the current global energy map, coal leads electricity production with more than 37%, natural gas with 24%, and petroleum with about 3% renewable energies with more than 26%, and nuclear energy with 10%.

Significant potential for further expansion of renewable energies combined with concerns about potential future natural gas supplies leads to a focus on hydrogen from electrolysis (green hydrogen) rather than from natural gas with carbon capture and storage ("blue" hydrogen).

As of 2020, most hydrogen (~95%) is produced from fossil fuels, but hydrogen produced from renewables has huge potential. To significantly contribute to the clean energy transition, "green hydrogen" must be produced at scale or blended into existing gas infrastructure reducing carbon emissions. Hydrogen can also be used for seasonal energy storage, industry decarbonisation and a renewable-powered future.

This talk will highlight how hydrogen will help in replacing fossil fuels in the future.

Ahmed F. Zobaa received his BSc (Hons), MSc, and PhD degrees in Electrical Power & Machines from Cairo University, Egypt, in 1992, 1997, and 2002, respectively. He received his Postgraduate Certificate in Academic Practice from University of Exeter, UK, in 2010, and his Doctoral of Science from Brunel University London, UK, in 2017. He was an Instructor from 1992–1997, a Teaching Assistant from 1997–2002, and an Assistant Professor from 2002–2007 at Cairo University, Egypt. From 2007 to 2010, he was a Senior Lecturer in renewable energy at University of Exeter, UK. From 2010 to 2019, he was a Senior Lecturer in power systems at Brunel University London, UK. He is currently a Reader in electrical and power engineering at Brunel University London, UK. His main areas of expertise include power quality, (marine) renewable energy, smart grids, energy efficiency, and lighting applications.

Dr Zobaa is an Executive Editor for the *International Journal of Renewable Energy Technology* and an Executive Editor-in-Chief for *Technology and Economics of Smart Grids and Sustainable Energy*. He is also an Editorial Board member, Editor, Associate Editor, and Editorial Advisory Board member for many international journals. He is a registered Chartered Engineer, Chartered Energy Engineer, European Engineer, and International Professional Engineer. He is also a registered member of the Engineering Council, UK; the Egypt Syndicate of Engineers; and the Egyptian Society of Engineers. He is a Senior Fellow of Higher Education Academy, UK; Fellow of the Institution of Engineering and Technology, Energy Institute, UK, Chartered Institution of Building Services Engineers, UK, Institution of Mechanical Engineers, UK, The Royal Society of Arts, UK, The African Academy of Sciences, and Chartered Institute of Edu

SiC Power Devices for Automotive Applications-Challenges and Opportunities

Dr. Mohamed Taha Abdelkader, University of Warwick-UK

Speaker Biography

Dr Mohamed is a Principal engineer (Associate Professor) at the school of engineering, University of Warwick. He joined the Power Electronics Applications and Technology in Energy Research (PEATR) group to lead the research team in the @FutureBeV project which is led by a well known OEM (BMW). Before Joining the PEATER group, he was a former lead engineer at Jaguar Landrover (JLR) where he lead the team to develop the drive motor and Inverter for the first Mild Hybrid Electric Vehicle(MHEV) for JLR in 2019. He has wide academic and industry experience where he has taken different positions at Warwick Manufacturing Group-UK, Ghent University-Belgium, Schneider electric-Egypt, and Cairo University-Egypt.

Abstract

Silicon Carbide (SiC) power devices are driving the next revolution for power electronics applications. Automotive application is one of the most evolved applications by the SiC capabilities. SiC devices offer many advantages, including high dielectric strength which is the enabler of high voltage applications, and high thermal conductivity which is the promoter for better thermal management, hence, high power density. By retaining a low “turn-on” resistance and switching fast, SiC devices can offer low conduction and switching losses. On the other hand, SiC devices still face many challenges. Cost is one of these challenges, nevertheless, with mass production and bigger wafer size, the cost started to reduce significantly and is expected to get reduced more. The other big question for SiC devices is reliability where the community is expecting a high reliable group of devices for all these applications. In this talk, I will discuss the challenges and opportunities for using SiC Power devices in automotive applications with a bit of focus on the reliability testing that we are developing in the reliability and robustness lab at the University of Warwick.