Prof. Fei Gao is currently the Deputy Director of the French national CNRS research institute FEMTO-ST and a Full Professor at the School of Energy and Computer science of the University of Technology of Belfort-Montbeliard (UTBM), Belfort, France. He was an Associate Professor at the same university between 2011 and 2017, and was a member of French National University Council (CNU) between 2016 and 2017. He received respectively from UTBM the Master's degree in electrical and control system engineering in 2007, and the PhD degree in renewable energy with distinguished Youth Doctor Award in 2010. His main research fields include fuel cells for transportation, real-time simulation technology for modern power electronics and energy storage systems, analysis of electrochemical aging phenomena and multi-physical modelling. He is the holder of the French research expertise bonus (PEDR) by the French Ministry of Higher Education and Research, the fellow of IET and the senior member of IEEE. He is the chair of fuel cell system architecture optimization research axis of the national Fuel Cell Research Lab (FR CNRS) in France, and he was the head of the energy production division at the School of Energy and Computer science of UTBM between 2012 and 2019. He is the Editor-in-Chief (2019-2021) of IEEE Industrial Electronics Technology News (ITeN), and an associate editor of IEEE Transactions on Industrial Electronics (TIE), IEEE Transactions on Industry Applications (TIA), IEEE Transactions on Transportation Electrification (TTE) and IEEE Open Journal of Industrial Electronics Society (OJIES). He is nominated in 2017 as Conferences Committee Chair of IEEE Transportation Electrification Community. From 2019 he serves as Secretary of the Technical Committee on Vehicle and Transportation Systems (TC4) of IEEE Power Electronics Society (PELS). He was elected respectively in 2013 as Secretary, in 2016 as Vice-Chair and in 2018 as Chair of the Technical Committee on Transportation Electrification (TCTE) of IEEE Industry Electronic Society (IES). He serves also as technical track chair and member of organizing committee for more than 30 IEEE international conferences (IECON, ITEC, APEC, ISIE, ICIT, etc.).

Prof. Gao has been invited to give talks, tutorials, short courses, keynote speaks in 14 international events (conferences, PhD. Schools, etc.). Some recent ones are listed below:

− Tutorial at IEEE 2nd International Conference on Smart Power & Internet Energy Systems 2020 (SPIES), "Fuel Cell Technology for Transport Applications", Bangkok, Thailand, June 2020

− Online webinar of IEEE Power Electronics Society, "Real time simulation methods of power electronic systems", IEEE, USA, January 2020

− Short course at EU Marie-Curie Program INNOVATIVE PhD School, "Fuel cell for aerospace solutions", Nottingham, UK, July 2019

− Short course at European PhD School, "Fuel Cell Technology for Automotive Applications", Gaeta, Italy, May 2019

− Keynote speech at IEEE Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles (ESARS) and International Transportation Electrification Conference (ITEC) Europe, "New Era of Fuel Cell Electric Vehicles", Nottingham, United Kingdom, November 2018

Contact email address: fei.gao@utbm.fr

Topic 1: Fuel cell technology for transportation electrification

Abstract:

This lecture focuses mainly on the proton exchange membrane (PEM) fuel cell technology which has been used specially in transport applications. The PEM fuel cell fundamentals, such as its physics, structure, power characteristics, efficiency, will be presented and discussed. The fuel cell system with its key ancillary components, such as air compressor, hydrogen tank, power converter, will also be introduced. Different powertrain configurations with fuel cells in transport applications will be discussed and shown with real examples around the world. An emphasis on the fuel cell economic aspects and a short introduction to hydrogen economy will be given at last.

Topic 2: Real time simulation challenges for modern power electronic systems

Abstract:

In this lecture, a general introduction of real time simulation technology for modern power systems and its challenges are firstly given. State-of-art modeling approaches for power electronic switches, as well as electric network formulations of power electronic systems are then presented. Their advantages and drawbacks are discussed with commercial examples. The main hardware implementation platforms (CPU and FPGA) for real time simulation models are also compared. At last, an example about how to implement a Floating Interleaved Boost Converter model in real time simulation platform for controller Hardware-in-the-Loop application is provided using the previously presented techniques.

Topic 3: Hardware-in-the-Loop solver techniques for proton exchange membrane fuel cell models

Abstract:

This lecture focuses on the key techniques of developing and implementing PEM fuel cell models for real time Hardware-in-the-Loop applications. After a short introduction of current Hardware-in-the-Loop technology, the fuel cell model structure, as well as the physical phenomena inside of fuel cell will be analyzed in the context of real time simulation. The key factors, such as real time model accuracy, efficiency, and stability, will be presented and discussed in detail. Several applied methods to convert a conventional fuel cell model to a real time one will be introduced. At last, a fuel cell emulator design for Hardware-in-the-Loop applications will be presented with its industry applications.

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