IEMDC 2021

IEMDC 2021 KEYNOTE SPEAKER

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BIO

Dr. Ronghai Qu received his B.E. and M.S. degrees from Tsinghua University, and the Ph.D. degree from University of Wisconsin-Madison. He had been with GE Global Research Center from 2003 to 2010. He was the recipient of 11 GE GRC awards including EPST Technical Achievement Award. In 2010, he joined Huazhong University of Science & Technology, Wuhan, China, where he is currently a professor, the member of academic degrees committee, and director of State and Province Joint Engineering Research Center of Novel Electrical Machines. He is also a member of ICEM AdCom and the chair of IEEE IAS Wuhan Chapter. His research interests include Design and Drive of Electrical Machines. He has published over 390 technical papers including 12 award papers and holds over 170 patents. Dr. Qu is an IEEE Fellow, and IAS Distinguished Lecturer for 2019-2021, and one of the winners of IAS Outstanding Member Awards in 2019.

ABSTRACT

Flux Modulation Machines – Innovation & Beyond

Electrical Machine, as an energy conversion device between electric and mechanical energy, plays an important role in industrial development. Nowadays, the rapid development of emerging industries, such as wind power generation, electrical ship propulsion, new energy vehicles and industrial robotics, has put ever-increasing demand on torque capability of electrical machines, specially permanent magnet (PM) machines.

For the regular machines, the pole-pairs of machine stators and rotors are identical, where the torque is produced by the single working harmonic from the rotor and stator magnetic fields. During the last hundred years, numerous studies have been done to enhance the working harmonics and weaken the non-working harmonics, so as to acquire the sinusoidal air-gap magnetic fields and improve the quality of torque.

The presentation will provide a view on electrical machines from the third eye -Flux Modulation point of view. As a new type of machine, the flux modulation PM machines, have drawn more and more attention due to their great torque density capability. Compared with regular PM machines, the pole-pairs of armature windings and rotor PMs in flux modulation machines are different, where the torque is generated by multiple working harmonics of PM magnetic fields and armature magnetic fields. Under the same electric and magnetic loadings, the flux modulation machines can acquire nearly double torque density of regular PM machines. This presentation will introduce flux modulation fundamental operation principles, machine main features, and topologies including multiple magnetomotive force harmonic machines, multiple permeance harmonics machines and double-modulation machines. Applications, challenges, and research opportunities will be discussed as well.

It should be noticed that advantages of magnetic field modulation is being gradually recognized as more research work is done, which provide a new perspective to guide the machine design. We might find ourselves in the revolution of machine theory and shaping machine industry.