TEXAS A&M UNIVERSITY
Department of Electrical & Computer Engineering

Friday, October 22, 2021 | 11:30 – 12:30 p.m. Central

Meeting Location: ETB 1020 | Zoom: ttps://tamu.zoom.us/j/95036934404?pwd=ZU0wWnZXaFFHa3NsaTVITEU3OTU0UT09

Integrated Permanent-Magnet-Synchronous-Generator-Rectifier Architecture for Offshore Wind

Abstract

High efficiency, power density, and reliability are critical in megawatt-class wind energy conversion systems. Operating over a limited speed range, the generator ac output is usually rectified first to dc, enabling subsequent connection to an electric grid. Conventional high-power ac-to-dc conversion architectures rely on fully controlled power-electronic switches, making the system bulky, lossy, and less reliable. Our objective is to create the world's most efficient, reliable, and compact wind energy conversion system through an alternative approach: integrating a multi-port permanent-magnet synchronous generator (PMSG) with series-stacked power converters made of active and passive rectifiers. The active rectifier, made of fully controlled power-electronic switches such as IGBTs or SiC MOSFETs, regulates the dc bus voltage while passive rectifiers, made of diodes, process the bulk of the power. The passive rectifiers operate with a high input power factor by eliminating the filter capacitors at the dc output. Theoretical analysis shows that the active rectifier processes only a maximum of 25% of the rated power while the PMSG operates in a speed range similar to the conventional doubly-fed induction generator—the workhorse of the modern wind power industry.

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Arijit Banerjee is an Assistant Professor with the Department of Electrical and Computer Engineering, the University of Illinois at Urbana-Champaign, where he holds the M. Stanley Helm Fellowship. He received the B.E. degree from the Indian Institute of Engineering Science and Technology, Shibpur, India, in 2005, the M.Tech. degree from the Indian Institute of Technology Kharagpur, Kharagpur, India, in 2007, and the Ph.D. degree from the Massachusetts Institute of Technology, Cambridge, MA, USA, in 2016. Before joining MIT, he was with the Power Conversion Systems Group, General Electric Global Research Centre, Bangalore, where he was working on monitoring and diagnostics of electromechanical systems using electrical signatures. From 2006 to 2007, he was a Visiting Student with the Institute for Power Electronics and Control of Drives, Technische Universitat Darmstadt, Germany, through a German Academic Exchange Service (DAAD) Fellowship. His research interests include analysis, design, control, and diagnostics of electromechanical energy conversion systems. He is a recipient of the National Science Foundation CAREER Award in 2020 and the 3M Non-Tenured Faculty award in 2021. He received the Grainger College of Engineering Everitt Award for Teaching Excellence in 2020 and UIUC ECE Ronald W. Pratt Faculty Outstanding Teaching Award in 2019. He is a Senior Member of the National Academy of Inventors (NAI) as well as IEEE. He holds 17 issued patents.