

## Special Session Title

# AI BASED FAULT DETECTION, DIAGNOSIS AND RELIABILITY ASSESMENT IN POWER ELECTRONIC CONVERTERS

**Abstract** Power electronic converters are critical components in modern electrical systems, enabling efficient energy conversion and control in applications such as renewable energy systems, electric vehicles, industrial drives, and smart grids. However, these systems are prone to faults due to thermal stress, switching failures, component degradation, and external disturbances. Unaddressed faults can lead to system downtime, reduced efficiency, and catastrophic failures. Traditional fault diagnosis and reliability assessment methods often rely on rule-based or model-based approaches, which may struggle with complex, nonlinear, and dynamic systems. Artificial Intelligence (AI) techniques, such as machine learning (ML) and deep learning (DL), offer significant potential for improving fault diagnosis, reliability assessment, and fault detection in power electronic converters. By using data-driven approaches, AI can enhance the accuracy, speed, and adaptability of fault detection systems, enabling predictive maintenance and improved system reliability. This SS proposal will encompass the development in the integration of AI techniques into fault diagnosis, reliability assessment, and fault detection for power electronic converters.

## Special Session Topics

Topics of interest to this Special Session, include but not limited to the following;

- ✚ AI-based fault diagnosis in power electronic converters.
- ✚ Machine learning and deep learning models for fault classification.

- ✦ Detection of open circuit, short-circuit, and intermittent faults.
- ✦ Data-driven approaches for identifying parameter degradation in power electronic converters.
- ✦ Real-time monitoring and early fault detection systems.
- ✦ AI-based anomaly detection in high-voltage and high-power power electronic converter based applications.
- ✦ Edge computing and IoT-enabled fault detection.
- ✦ Meta-learning approaches for real-time fault-tolerant operation of power electronic converters
- ✦ Federated learning for distributed fault diagnosis in power electronic converters
- ✦ Reliability and lifetime prediction of power electronic converters, degradation and ageing.
- ✦ Prognostic health management (PHM) using AI models
- ✦ Remaining useful life (RUL) estimation of power converters with deep learning
- ✦ Emerging trends in wide-bandgap semiconductor devices.
- ✦ AI-driven fault-tolerant control for power electronic converters.
- ✦ Adaptive control techniques under fault conditions.
- ✦ Dynamic power distribution and thermal management in power electronic converters using AI techniques.

## Author Bios and Pics

### Short Bio of special session organizers



**ATIF IQBAL** (Fellow, IEEE) received the B.Sc. and M.Sc. degrees in electrical engineering from Aligarh Muslim University (AMU), Aligarh, India, in 1991 and 1996, respectively, the Ph.D. degree from Liverpool John Moores University, Liverpool, U.K., in 2006, and the D.Sc. degree (Habilitation) in control, informatics, and electrical engineering from Gdańsk University of Technology, Gdańsk, Poland, in 2019. He is currently a Full Professor with the Department of Electrical Engineering, Qatar University, Doha, Qatar, and a former Full Professor with the Department of Electrical Engineering, AMU. He is a Honorary Adjunct Professor with M. A. American University, Nigeria, and Bharath University, India. He is also an Adjunct Faculty Member with the Community College, Doha. He has been listed in the Top 2% Highly Cited Scientists of the World (Stanford University, USA), since 2019. He has published widely in international journals and conferences on his research findings related to power electronics, variable speed drives, e-mobility, smart grids, complex energy transitions, micro and nano grids, and renewable energy sources. He has authored or co-authored more than 600 research articles, eight patents, four books, and several chapters in edited books. He has supervised several large research and development projects worth several million USD. He has supervised 21 Ph.D. students. He is a fellow of IET (U.K.), IE (India), and AIAA (Asia Pacific). He was a recipient of the Outstanding Faculty Merit Award, from 2014 to 2015, and the Research Excellence Awards at Qatar University, in 2015 and 2022. He has received a Research Excellence Award from the College of Engineering, Qatar University, in 2019. He has received several best research papers awards at top international conferences. He is serving as the Vice-Chair of the IEEE Qatar Section. He is an Associate Editor of IEEE TRANSACTION ON INDUSTRIAL ELECTRONICS and Editorial Board Member of IEEE ACCESS.





Hui Zhao (Member, IEEE) received the bachelor's and master's degrees in electrical engineering from the Huazhong University of Science and Technology, Wuhan, China, in 2010 and 2013, respectively, and the Ph.D. degree in power electronics from the University of Florida, Gainesville, FL, USA, in 2018. In 2013, he had a Internship with the General Electric Global Research Center. From 2018 to 2021, he was a Postdoctoral Research Associate with the University of Cambridge, Cambridge, U.K. He is currently a professor with Fudan University, Shanghai, China. His research interests include the modelling and driving of power devices, electromagnetic interference, and high-power density power converters.



N.F. AB AZIZ (Senior Member, IEEE) received the Master of Engineering degree (1st class Hons.) in Electrical Engineering from University of Southampton, UK in 2006 and Ph. D. degree from Universiti Teknologi Mara, Shah Alam in 2014. She is a Professional Engineer registered with Board of Engineers Malaysia (BEM) and IEEE member since 2008. She is currently at the Department of Electrical and Electronics Engineering, at Universiti Tenaga Nasional (UNITEN), Malaysia as the Head of Programme of Board of Engineers Malaysia Graduate Assessment Programme (BEM-GAP). Nur Fadilah has published hundreds of publications in international journals and conferences, two books and several chapters in edited books. She has involved with several research and industry projects and supervised several graduated PhD and Master students. She has also co-authored several technical manuals for Tenaga Nasional Berhad (Malaysia's electric utility company) which are "A Guide for Distribution Protection Setting & Coordination", and "Testing & Commissioning Guidelines for Distribution Substation". Her research interest includes power system analysis and resilience, renewable energy, fault identification and location, distribution automation, statistical pattern recognition, Artificial Intelligent (AI) and machine learning application in power system.



**Shirazul Islam** received his B.E. (Electrical) and M.Tech. (Power System and Electrical Drives) degree in 2008 & 2010 respectively from Aligarh Muslim University, Aligarh, India. He received his PhD degree from the Indian Institute of Technology, Kanpur (IIT, Kanpur) India in 2021. Currently, he is working as a Lecturer in Qatar University. He worked as a Senior Research Assistant in the ARG01-0504-230073 entitled "Bi-level Uncertainty-aware DER Aggregation Planning including Multi-period Load Forecasting with Electrical Transportation, Renewable Resources, and



Community batteries." Qatar University, Doha, Qatar. He worked Research Assistant in the NPRP 13S-0108-200028 project entitled "Impact Assessment of EV Charging Stations and Regulation Policies for Upcoming Active Distribution Network of Qatar Utility Grid", Qatar University, Doha, Qatar from 2021 to 2024. He also served IIT Kanpur as a Senior Research Fellow in the Department of Electrical Engineering. He also worked as a lecturer in the Department of Electrical Engineering at Aligarh Muslim University, in 2010. He served as an Assistant Professor in the Department of Electrical and Electronics Engineering, at Teerthanker Mahaveer University, India. He received the Best Renewable Energy Research Project award from Kahramaa, Utility of Qatar on 02 June 2022. He has published several papers in IEEE Transactions, various reputed Journals, and International Conferences. He is a member of IEEE and a life member of IETE. His areas of interest are Electric Vehicles, Energy Transition, Electric Vehicle Charging Infrastructure, Multilevel Inverters, High Gain DC-DC Converters, Machine Learning based control of AC and DC Microgrids, Consensus-based Control of AC and DC Microgrids, Power Quality Improvement Using Machine Learning-based Methods, Constant Power Loads, Modelling of Converters, Thermal Modeling and Real-Time Simulation of Power Electronic Converters.

