Multilevel Inverter Topologies and Their Applications to Power Grids

Dr. Fang Z. Peng

Department of Electrical & Computer Engineering
Michigan State University

Abstract
Multilevel converters and inverters have become the enabling power conversion technology for high voltage, high power applications in today’s power systems and large motor drives. The multilevel concept was established in the early 1990s when the diode-clamped multilevel inverter, the capacitor-clamped (or flying capacitor) multilevel inverter, and the cascade multilevel inverter were proposed. In this talk, we will focus on our research experience in developing the cascade multilevel inverter topologies and their system configurations for power system applications. More particularly, we will 1) first review the traditional high power conversion technology and its problems; 2) address the needs to eliminate zig-zag transformer required in the traditional technology; and 3) discuss the technical challenges and limitations of the cascade multilevel inverters and our innovations/breakthroughs on how to configure the cascade multilevel inverters to overcome their problems and limitations. These research breakthroughs have made the cascade multilevel inverters a perfect topology for power system/grid applications such as FACTS devices. For example, many STATCOMs based on the cascade multilevel inverter have been installed around the world. Finally, we will summarize our multilevel inverter research highlights including our most recent breakthrough: an ARPA-E project on transformer-less unified power flow controller based on multilevel inverters.

Biography of Speaker
Fang Zheng Peng received the B.S. degree in electrical engineering from Wuhan University, China, in 1983 and the M.S. and Ph.D. Degrees in electrical engineering from Nagaoka University of Technology, Japan, in 1987 and 1990, respectively.

He joined Toyo Electric Manufacturing Company, Ltd., from 1990 to 1992 as a research scientist, was engaged in research and development of active power filters, flexible ac transmission systems (FACTS) applications and motor drives. From 1992 to 1994, he worked with Tokyo Institute of Technology as a Research Assistant Professor, initiated a multilevel inverter program for FACTS applications and a speed-sensorless vector control project. From 1994 to 2000, he worked for Oak Ridge National Laboratory (ORNL), as a Research Assistant Professor at University of Tennessee, Knoxville from 1994 to 1997 and was a staff member, Lead (principal) Scientist of the Power Electronics and Electric Machinery Research Center at ORNL from 1997 to 2000. In 2000, he joined Michigan State University as an Associate Professor and now a full professor of the Department of Electrical and Computer Engineering.