

Missouri S&T's Wide Ranging Power Program Covers The PE Spectrum

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Missouri University of Science and Technology (Missouri S&T, formerly the University of Missouri-Rolla), is the engineering-focused campus of the University of Missouri System. The school's current enrollment is approximately 7500 students (including extended learning) of which about 1850 are graduate students. At the undergraduate level, there are 15 accredited engineering degree programs. What's more, approximately 80% of all students are in engineering programs. One of the largest departments on campus is the electrical and computer engineering department, which has approximately 650 students and 31 tenured or tenure-track faculty members.

This department offers a graduate curriculum in power engineering that includes senior/graduate courses in extra high-voltage engineering, distribution systems, power quality, electric drive systems, power systems, power electronics (PE), and photovoltaic systems. Courses at the graduate level include advanced electric machines, computational methods for power systems, electric and hybrid vehicles, advanced power electronics, and power system reliability, operations, protection, and stability.

There are new courses in development as well. These include a senior/graduate course in electric drive vehicles and a graduate course in power electronics design. This comprehensive set of courses allows graduate students both to delve deeply into a particular topic and to broaden their experience across the spectrum of power electronics, power systems, and electric machines.

Who's Here?

The power electronics program at Missouri S&T covers a broad range of topics, ranging from Navy shipboard power systems to energy harvesting to power converter control. Including myself, there are three faculty with a primary focus on power electronics. Dr. Keith Corzine has extensive experience with Navy systems, multilevel inverters, and a variety of other projects oriented toward electric machines and dc-ac converters. Dr. Mehdi Ferdowsi has a primary emphasis on electric drive vehicles (including hybrid electric vehicles), which includes projects involving multi-input power converters and battery modeling. And I work primarily on photovoltaic power converters, as well as other energy harvesting devices such as hydrokinetic systems.

In addition, there are three faculty with related interests. Dr. Badrul Chowdhury has projects involving renewable energy resources, both wind and solar. Dr. Mariesa Crow (also the founding Director of the Energy Research & Development Center) has active projects involving microgrid controls and FACTS devices. Dr. Kumar Venayagamoorthy (the Founder and Director of the Real-Time Power and Intelligent Systems Laboratory) has active projects primarily developing advanced computational algorithms for smart grid applications.

Electric Vehicle Test Facilities

Missouri S&T's research facilities for power electronics and electric machine projects are extensive. Occupying just over 5000 sq. ft., the Emerson Electric Company Machines and Drives Laboratory includes six general-purpose dynamometers rated at 20 hp, a new two-dynamometer system designed to emulate an electric drive vehicle (EDV), and more than 20 additional workstations for electronics-oriented projects. Each general-purpose dynamometer includes a 20-hp dc machine with a computer-controlled regenerative drive and a set of 18 IGBTs that can be configured as a multi-level inverter to drive the machine under test. The laboratory is partitioned into two rooms, with the machine-oriented research separated from the purely electronics-oriented research (for safety and convenience).



The Emerson Electric Company's Drives Laboratory offers access to general-purpose dynamometers and a two-dynamometer system for emulating electric vehicles.

Collaborative Projects

The power faculty at Missouri S&T are involved in two major collaborative projects. The FREEDM (Future Renewable Electric Energy Delivery and Management) Systems Center is a National Science Foundation-sponsored Engineering Research Center focused on devices, subsystems, and systems-level control for future distribution systems. Established in 2008, the FREEDM Systems Center includes five core universities (North Carolina State University, Arizona State University, Florida A&M University, Florida State University, and Missouri S&T), two international universities (RWTH Aachen and ETH Zurich), and a growing industry collaboration and innovation program. For its part in this project, the faculty at Missouri S&T are focused on system-level analysis and control and on solid-state transformer hardware design.

Meanwhile, our faculty are also involved in a separate program on educational advancements for EDVs. Sponsored by the Department of Energy, this program incorporates a wide range of opportunities through collaboration with the University of Central Missouri, Linn State Technical College, and St. Louis Science Center. Both of these collaborative projects position Missouri S&T at the forefront of power systems, power electronics, and electric vehicle research and education.

About The Author



Dr. Jonathan Kimball received a BS from Carnegie Mellon in 1994 and an MS from the University of Illinois at Urbana-Champaign in 1996. He then worked in industry, first for Motorola (designing IGBT modules) and then for Baldor (designing industrial motor drives). Kimball returned to the University of Illinois as a research engineer in 2003. He subsequently co-founded SmartSpark Energy Systems (now named SolarBridge Technologies). After receiving a PhD from Illinois in 2007, he joined Missouri S&T as an assistant professor. Kimball's research interests include photovoltaic systems, hydrokinetic energy, and digital control of power converter systems.