Power Electronics and Electric Machinery Research Center Overview

- The Oak Ridge National Laboratory's (ORNL) Power Electronics and Electric Machinery Research Center (PEEMRC) is the Department of Energy's premiere broad-based research center for power electronic and electric machinery development. During this decade, the Center has dramatically advanced the technology of soft-switched inverters, multilevel inverters, DC-DC converters, motor control techniques, and efficient, compact electric machines.

Areas of Expertise
- Advanced Power Electronics
- Electric Machines
- Thermal Control
- Power Quality and Utility Interconnection

Description

- PEEMRC is designated as a National User Facility. The designation encourages collaborative efforts between the PEEMRC, industry, and academia. The most advanced analysis, simulation, and design software is available to the PEEMRC staff to implement state-of-the art circuit and motor designs. The PEEMRC provides a broad-based capability to generate data and analyze advanced power electronic and electric machinery devices. These capabilities are provided at the user's expense.

Personnel

- PEEMRC consists of more than 35 staff members and collaborates with numerous researchers in industry and academia. Staff members hold advanced degrees in electrical engineering, mechanical engineering, nuclear engineering, and physics. Most are active members of professional societies such as the IEEE, IEE, ASME, and SAE, and hold leadership positions in these organizations.
- Since 1990, 42 patents have been granted with several more pending. Researchers have published more than 300 technical papers with more than 60 papers published in IEEE Transactions of the following societies: Power Electronics, Industry Applications, Energy Conversion, Power Delivery, Industrial Electronics, Instrumentation and Measurement, and Magnetics.

Facilities and Equipment

- The laboratory area of the PEEMRC is located in the recently constructed National Transportation Research Center (NTRC) and has more than 9,000 square feet of space for developing, building, and testing the next-generation prototype power electronics and electric machine technologies. Staff members use and develop the latest analysis, simulation, and modeling software to develop designs prior to hardware implementation.

Points of Contact:

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OAK RIDGE NATIONAL LABORATORY — FACT SHEET

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Power Electronics and Electric Machinery Research Areas

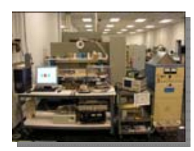
Advanced Power Electronics
- Advanced soft-switching inverter topologies
- Packaging technologies for EMI minimization as well as space and weight reduction
- DSP-based control technologies for motor drives
- Electric, hybrid electric, plug-in hybrid, and fuel cell vehicle traction drives
- Motor-assisted turbochargers and auxiliary drives
- Multilevel inverters for high voltage and/or high power motor drives
- Silicon carbide-based power electronics and high temperature packaging
- Testing, characterization, and modeling of power devices
- Modeling and simulation at the device, module, and system levels
- DC-to-DC converter

Electric Machines

- Radial and axial gap permanent magnet machines
- Switched reluctance and synchronous reluctance machines
- DC homopolar and soft-commutated machines
- Superconducting motors, generators, and transformers
- Field weakening and enhancement techniques
- Advanced manufacturing technologies for electric machines
- Finite element analysis of electromagnetics, mechanical stresses, and thermal analysis

Thermal Control
- Direct cooling of electronic devices and systems
- Single-phase and two-phase cooling
- Coolant compatibility and comparison studies
- Hybrid electric vehicle drive train module and system-level thermal control R&D
- High temperature packaging techniques

Power Quality and Utility Interconnection



- Utility grid interface inverters for distributed energy resources such as fuel cells, solar cells, or microturbines
- STATCOMs for reactive power compensation
- Active power filters for harmonic compensation
- Multilevel converters for utility applications such as static var generation, voltage regulation, harmonic compensation, back-to-back intertie of two asynchronous systems, HVDC applications, and distributed generation/utility interfaces
- Development of novel techniques to calculate active and reactive power under unbalanced or nonlinear conditions

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