



GRAPES

GRid-connected Advanced Power Electronic Systems

GRAPES Mission

people.uwm.edu/grapes

The mission of the center is to accelerate the adoption and insertion of power electronics into the electric grid in order to improve system stability, flexibility, robustness, and economy. We expect to accomplish that mission by focusing on the following main objectives:

- To develop new technologies for advanced power electronic systems in the areas supporting grid connected distributed energy resources, power steering and routing devices, and intelligent load-side devices
- To develop the software and tools for controlling embedded- and grid-connected power electronics to benefit the grid as well as controlled loads
- To educate engineers who understand the power electronic technologies important to the member companies

GRAPES is partially funded by the Industry/University Cooperative Research Center program of the National Science Foundation, while industry members fund the bulk of our research. Our work with industry focuses on improving power electronics technology and integrating it with the needs of industry and of the power grid as a whole.

Research will concentrate on design, development, evaluation, control, and standardization of grid-connected power electronic equipment on both the supply and load side of power systems. Relevant research areas include:

- Power systems, including off-grid systems such as in transportation systems (ships, planes, trains, automobiles)
- Power electronics devices, characterization, modeling
- Simulation methods and environments for multidisciplinary dynamic systems

GRAPES Sample Projects

- **SiC-Based Direct Power Electronics Interface for Battery Energy Storage System into Medium Voltage Distribution System (13.8 kV)**
- **Coordinated optimal Voltage Regulation for the Next-Generation Distribution Grids with Extremely High Penetration of PV Generation**
- **Distributed Energy Resources: A Distributed Autonomous Control Concept and Architecture for Microgrids**
- **Optimized Gate Drivers for High Voltage Power Devices**
- **Multi-port solid-state transformer for microgrids and distribution systems**

An NSF Industry/University Cooperative Research Center



“Graduated Projects”

- **13.8-kV Unbalanced Current Static Compensator:** An EPRI tailored collaboration project with Southern Company and Arkansas Electric Cooperative Corp.
- **High Step-Up/Down Transformerless Modular-Multilevel DC-DC Converter**



College of Engineering & Applied Science

Center for Sustainable Electrical Energy Systems: This center brings together the capabilities of existing Laboratories and Centers within UWM College of Engineering & Applied Science to enhance the collaborations within UWM and with other groups and organizations. Major research and education areas of the center include power electronics, microgrids, energy storage, protection, and cybersecurity.

- Three labs with over 5000 sq-ft and over 500kVA power supply capabilities (three-phase 480 and 208)
- Full packages of MATLAB/Simulink, PSIM, PSS/E, and PSCAD
- Hardware in loop setups with National Instrument Compact RIO, Typhoon, and OPAL RT
- High power AC and DC sources, oscilloscopes with high voltage and high current probes, power electronics converters and devices
- Two synchronous generators 63 kVA, 100hp dyno, and high power loads
- 50kW solar PV and 12kW wind turbine
- 114kW Li-Ion storage and two 45kW natural gas generators

Leverage for Participating Industry

- Leverages existing Navy, DOE, and DOD programs at UWM
- Establishment of a smart and connected energy and water systems, Air Force
- Extremely compact 500 kW, 2000 Hz inverter for high speed permanent magnet synchronous machines, DOE
- Electric ship initiative, architecture, protection, and energy management; US Navy
- Hybrid and compact integrated energy storage systems
- UWM campus-wide Connected Systems Institute (CSI) with focus on Industrial Internet of Things