



FPGA-based control platform

Tampere University (TAU) is the second largest multidisciplinary higher education institution in Finland. The Electrical Engineering Unit is a hub of expertise with roughly 150 faculty and staff members of which 16 professors and 7 tenure-track professors.

The teaching and research activities of the Power Electronic Systems group at the Electrical Engineering Unit are based on a solid understanding of electrical and electromagnetic phenomena as well as their modelling and applications. The group works in close collaboration with several national and international industrial partners and maintains an active presence in the international scientific community. The research of the group is supported by the exemplary research facilities and the well-equipped, state-of-the-art laboratory.

### Key Research Fields and Areas of Expertise

The research vision of the group is to produce knowledge that will contribute towards cheaper, more widespread and sustainable power electronics used

in power generation, power transmission/distribution and end-user applications. To this end, the main research focus has been on the modelling of power electronic systems and the development of control and modulation schemes that fully utilize the capability of the power electronic hardware by operating the system close to its physical limits. The main applications of interest relate to industrial drives, integration of renewable energy resources, and smart grids. Specifically, the main research areas are:

- Dynamic modelling of power electronic systems ranging from low to high power
  - Grid-connected converters
  - Electrical motor drives
- Advanced control algorithms for power electronic systems
  - Model predictive control
  - Feedforward techniques
  - Active damping



Drive system with three-level neutral point clamped converters in back-to-back configuration

- Optimal modulation methods
- Renewable energy applications (e.g., wind turbine systems, photovoltaic systems)
- System identification methods

### Facilities

To facilitate the research at TAU, the power electronics laboratory is equipped with up-to-date experimental research facilities. These include, but are not limited to, ac grid emulator, PV emulator, real-time system

simulators (hardware-in-the-loop (HIL) testing), powerful control platforms (FPGA-based), customizable (multilevel) converters and filters, low-voltage (LV) variable speed drive systems (both induction and synchronous machine-based).



Grid-connected power electronic system setup