

COLOGNE INSTITUTE FOR RENEWABLE ENERGY



Cologne Institute for Renewable Energy at Cologne University of Applied Sciences

The Cologne Institute for Renewable Energy (CIRE) is an association of currently 17 Professors plus Scientists within the fields of electrical engineering, mechanical engineering and resource management.

With 17 disciplines under one roof, CIRE combines interdisciplinary research and teaching dedicated to the technology and the implementation of renewable energy. CIRE activities include a strong focus on Power Electronics and Electrical Drives with Prof. Lohner (Automation Engineering and Electrical Drives), Prof. Waffenschmidt (Electrical Grids) and Prof. Dick (Power Electronics and Electrical Drives) sharing laboratories, conducting research and common publications.

Converter Modulation and control Techniques

A research focus is on (resonant) DC-DC converters, e.g. as maximum power point tracker for PV. A major contribution was



a H-Bridge modulation strategy. It combines both pulse-frequency and phase-shift modulation improving the controllable voltage gain of a LLC-resonant circuit by less frequency variation. Pulse patterns are programmed directly on a flexible FPGA platform acting as rapid prototyping system for our setups. Various PFC and DC-AC circuits are controlled by the same platform, including a 4-quadrant operation of an H-Bridge. Latter consists of Low-Side fast switching MOSFET's operating against SiC diodes, and of 50Hz operated High-Side IGBT's.

Magnetics

Inductive wireless-power systems for consumer applications are analyzed with

special regard to the magnetic shielding material. Furthermore, a 500W wireless power transfer system was set up as part of the 2015 IEEE International Future Energy Challenge Competition.

A research project is on coupled inductors with H-Bridge being supposed to show material savings compared to classical inverter-legs with inductive output.



Such systems are analyzed in combination with the use of wide-bandgap power semiconductor devices.

Drives / Electromobility

A novel drive train concept based on the doubly rotating electrical machine is demonstrated as depicted. It allows a major increase in overall system efficiency in contrast to conventional drive train structures due to the connection of electric powertrain, double rotating electric motor and combustion engine, optimized for a certain operating point in terms of energy efficiency (2,9 l/100km, calculated from internal, not calibrated measurements of a 100km ride).