INTERNSHIPS AND RESEARCH PROJECTS

Written by: Imperix ltd, Rte des Ronquos 23, 1950 Sion, Switzerland
Addressed to: Any R&D-performing academic institution or industrial company

1. APPLIED PROJECTS IN POWER ELECTRONICS

CONTROL OF A DOUBLY-FED INDUCTION GENERATOR (DFIG) FOR WIND TURBINES

Motivations: Imperix wishes to develop application examples that demonstrate the capabilities of its digital controllers in various types of applications.

Objectives: Implement with the B-Box RCP a working example of a complete closed-loop vector control for an DFIG. This includes the coding of the converter control as well as its practical validation on a Hardware-In-the-Loop (HIL) simulator.

Skills: A solid knowledge of power electronics and drives is required.

Level: This project is available to master-level students only.

MODELING OF IMPERIX POWER CONVERTER PRODUCTS

Motivations: Imperix would like to develop accurate simulation models of its power modules, as well as of the resulting power converters. To this end, functional aspects should be taken into account, as well as conduction and switching losses.

Objectives: Follow-up on a measurement campaign in order to extract real-life parameters for each type of power module, as well as for complete converter systems. In the end, the student should contribute to implementing a PLECS library, which may also be transformer as a Simulink (Simscape) library.

Skills: A good general knowledge of power electronics is recommended.

Level: This project is targeting any student interested in both modeling and experimental activities.

OPERATION OF SOLAR INVERTERS UNDER GRID FAULT CONDITIONS (HIL)

Motivations: Imperix supports most major Hardware-in-the-loop (HIL) solutions from the market and wishes to develop application examples. One such example is to study the behavior of a solar inverter under grid fault conditions, such as single-phase to ground faults or blackout.

Objectives: Extend the existing solar inverter example from the company's knowledge to include low voltage ride through (LVRT) and anti-islanding detection capabilities. The control code must work both on Simulink and PLECS, and will be validated with on-line simulations on an RT Box 1 from Plexim. The student is expected to write two articles on the knowledge base to explain their work.

Skills: Some prior knowledge of power electronic control and design is required.

Level: This project should be addressed by a master student.

DOWNSCALED POWER ELECTRONIC TEST BENCH FOR DEMONSTRATION PURPOSES

Motivations: Imperix often attends international conferences on power electronics. A small portable demo test-bench would allow the company to showcase the main functionalities of its products. This demo bench could be about the size of a large briefcase.

Objectives: Design a low power (30-100W) demo test-bench. It should include at least one motor, a load (passive or active), and some light indicators. The student is also expected to implement the corresponding control software algorithms.

Skills: Some basic knowledge in mechanical design are required.

Level: This project can be addressed by a bachelor or master-level student.

WATER-COOLING SYSTEM FOR HIGH POWER CONVERTERS

Motivations: Imperix wishes to extend the capabilities of its laboratory to higher power systems that require water cooling. Applications up to 350-400kW are targeted.

Objectives: Implement a flexible water cooling unit, which can be used with modified imperix power modules or third-party water-cooled converters. Run a back-to-back DC/DC or DC/AC test system and validate the performance of the implemented setup.

Skills: Some basic knowledge in mechanical design are required.

Level: This project can be addressed by a bachelor or master-level student.

20KW BRIDGED CLASS-D AUDIO AMPLIFIER

Motivations: Imperix wishes to explore alternative applications for its upcoming power products.

Objectives: Implement a class-D bridge-type audio amplifier using imperix power modules and filters. A switching frequency of >200kHz is considered. Evaluate the potential benefits of closed-loop voltage control (FPGA-based) on the overall system performance. Qualify the achieved results in terms of BW, THD, SNR, etc.

Skills: Some familiarity with feedback control is essential. Prior experience with digital control using FPGA would be great.

Level: This project is best addressed by a master student.

THREE-PHASE FOUR QUADRANT GRID EMULATOR

Motivations: Imperix wishes to explore the possibility to use its three-phase inverters as grid emulator. This calls for advanced control, notably in order to support low harmonic distortion or harmonic injection, as well as operation under unbalanced loads.

Objectives: Develop closed-loop voltage control for a three-phase inverter operated as a four quadrant grid emulator. Simulate the proposed approach first, assuming an execution rate of 400kHz (2.5µs). Evaluate the pros and cons of higher and lower rates. Implement experimental validation using existing imperix products.

Skills: Some familiarity with feedback control is essential. Prior experience with grid-connected inverters would be great.

Level: This project is intended for a master-level student.

AUTOMATED IDENTIFICATION OF MACHINE PARAMETERS FOR MOTOR DRIVES

Motivations: Imperix wishes to develop a Simulink-based automated machine parameters identification protocol for both permanent magnet and induction motors. This protocol could eventually serve for self-testing and -commissioning procedures.

Objectives: Extend the existing Field-Oriented Control (FOC) examples to include autonomous identification of the machine parameters. This includes the coding of the converter control as well as its practical validation on a motor testbench.

Skills: Good prior knowledge of power electronic drives and their control is required.

Level: This project is best addressed by a master student.