

SPRING-SUMMER 2027

STUDENT PROJECT PROPOSALS

CONTROL PROJECTS IN POWER ELECTRONICS

CONTROL AND EMULATION OF RELUCTANCE MOTORS

- Motivations:** Synchronous Reluctance Machines (SynRM) and Switched Reluctance Machines (SRM) are gaining traction due to their rare-earth-free design, offering a supply-chain-resilient alternative for electric drives. However, they present significant challenges due to their highly non-linear magnetic characteristics, which often result in torque ripple and complex dynamic behavior. This project offers the opportunity to implement a SynRM or SRM emulation model and develop a control strategy to tackle these challenges directly.
- Objectives:** Review and evaluate the conventional modelling approaches and control techniques for SynRM and SRM machines. Afterwards, develop and validate a complete Power Hardware-in-the-Loop (PHIL) test bench. This advanced setup will execute the emulated motor model in real-time to drive a power amplifier, which will be physically connected to a real inverter hosting the newly developed digital control algorithms.
- Skills:** A strong interest in electrical machine modeling and control is required. Previous experience in power electronics is also required.

ADAPTIVE VIRTUAL SYNCHRONOUS GENERATOR

- Motivations:** With the penetration of renewable energy, modern power grids suffer from reduced inertia. While standard Virtual Synchronous Generators (VSGs) address this by emulating the electromechanical dynamics of traditional synchronous machines, fixed-parameter implementations often struggle to balance transient response with inertia provision. This project aims to develop an adaptive VSG control strategy that dynamically adjusts the inertia and damping parameters in real-time to optimize grid support during disturbances.
- Objectives:** Conduct a comprehensive state-of-the-art review of existing adaptive VSG control strategies to identify the most suitable approach. Implement the selected algorithm in simulation and test it experimentally on a lab-scale microgrid setup. Validate its performance under load steps, frequency deviations, and grid fault scenarios. Compare the adaptive algorithm against a conventional fixed-parameter VSG baseline.
- Skills:** Previous experience in power electronics and control is required.

REINFORCEMENT LEARNING-BASED CONTROL FOR MOTOR DRIVES

- Motivations:** Conventional control strategies such as field-oriented control with PI regulators often struggle with non-linear machine dynamics, saturation, and parameter variations. Reinforcement Learning (RL) represents a data-driven alternative that autonomously learns optimal control policies during runtime. However, transitioning from pure simulation to a real environment remains a challenge. This project aims to demonstrate if and how RL can achieve superior dynamic performance in real-world motor drive applications.
- Objectives:** Carry out a comprehensive review on the RL algorithms specifically tailored for motor control. Develop an RL-based agent within a simulation environment (Simulink or PLECS), training it to dynamically tune controller parameters for torque and speed regulation. Validate experimentally the implemented agent using the imperix electric motor drive bundle and compare transient response, robustness, and torque ripple against a conventional PI-based FOC control.
- Skills:** Some previous experience in power electronics is needed. A strong interest in control and electrical machines is required.

IMPLEMENTATION AND CONTROL OF A SOFT OPEN POINT (SOP) FOR SMART GRIDS

- Motivations:** The increasing penetration of distributed energy resources (DERs) frequently challenges traditional distribution networks, causing localized voltage violations and distribution line congestion. Soft Open Points (SOPs), offer a highly flexible solution by enabling active power routing, fault isolation, and independent reactive power compensation between adjacent distribution lines. This project aims to demonstrate how, using an SOP, advanced power routing can be achieved in real-world smart grids.
- Objectives:** Conduct a comprehensive literature review on SOP topologies and control strategies for active and reactive power flow management, focusing on voltage regulation under both balanced and unbalanced grid conditions. Develop and implement a complete system model and validated it in a experimental setup using imperix hardware. Validate the steady-state and transient performance of the SOP controller under various scenarios, such as load imbalances and feeder voltage sags.
- Skills:** Previous experience in power electronics and control is recommended.

CASCADED FINITE-CONTROL-SET MPC OF A BACK-TO-BACK MOTOR DRIVE

- Motivations:** Finite-Control-Set Model Predictive Control (FCS-MPC) selects the inverter switching state directly by minimizing a cost function over the predicted behavior of the machine. It offers fast dynamics and handles constraints and multiple control objectives in a natural way, but requires high sampling rates and substantial computational efforts. In motor drives, the mechanical dynamics are much slower than the electrical ones, which makes a cascaded predictive structure attractive: a fast inner loop controls the currents or the torque, while a slower predictive speed loop computes their references. Running each loop at its own rate, and executing the most demanding part in the FPGA of a rapid-prototyping controller, is a practical path towards high-performance predictive drive control. This project offers the opportunity to design such a cascaded scheme and validate it experimentally on two different machine types.
- Objectives:** Review the state of the art in FCS-MPC of current and torque for Permanent Magnet Synchronous Machines (PMSM) and Induction Machines (IM), as well as in cascaded predictive speed control. Design and simulate the current or torque controller for both machine types, together with a predictive speed controller in a cascaded, multi-rate structure. Implement the complete control on the imperix motor drive test bench, where a PMSM and an IM are operated back-to-back, with the cascaded control of at least one machine type executed in the FPGA and the remaining functions on the CPU. Finally, validate the controllers experimentally and compare them against conventional PI-based field-oriented control in terms of dynamic response, load disturbance rejection, current quality and execution time.
- Skills:** A strong interest in electrical machines and predictive control is required. Previous experience in power electronics is recommended, and experience with FPGA development is an asset.

YOUR PROFILE

An internship with us will suit you if:

- You are a PhD, MSc, or BSc student.
- You are looking for a 4-to-9 months on-site internship in Sion, Switzerland.
- You are seeking to work in a dynamic, fast-paced environment.
- You are self-motivated and capable of working both individually and as part of a team.
- You expect attentive supervision of your work from highly qualified engineers.
- You are looking for a position that values and makes room for your initiatives.
- You appreciate a young and friendly environment that is also serious and professional.

If you are interested in doing an internship with us, please send your CV along with a cover letter explaining your motivations and what you would bring to the team. We read every application carefully and reply within 10 days to the profiles that interest us.

Only complete applications are considered, and generic or obviously machine-generated letters are not.

Academic Contact

Dr. Irati Ibañez-Hidalgo
Internship Coordinator
internships@imperix.ch
+41 27 552 06 81



ABOUT US

Imperix is a leading global provider of high-performance control solutions and rapid prototyping hardware engineered specifically for power electronics. Founded in 2013 as a spin-off from the Swiss Federal Institute of Technology (EPFL), the company accelerates innovation by bridging the gap between numerical simulation and physical implementation.

At the core of the Imperix ecosystem is the flagship B-Box controller family, which unites robust digital processing, the intuitive Cockpit software, and automated code generation from Simulink and PLECS. These control development solutions are complemented by a comprehensive hardware portfolio encompassing modular power stages, high-fidelity sensors, fully integrated inverters, as well as hardware and software interfaces for real-time HIL/PHIL simulation. Together, these tools empower top-tier industrial and academic R&D teams to safely test advanced control algorithms on real hardware within minutes, drastically reducing time-to-market and time-to-publication.

Headquartered in Sion, Switzerland, Imperix serves a prestigious client base across more than 50 countries. By delivering specialized, modular tools for power conversion, smart grids, motor drives, electric mobility, and energy storage, Imperix stands at the forefront of the technology enabling the global energy transition.