imperix

FALL–WINTER 2026–2027

STUDENT PROJECT PROPOSALS

CONTROL PROJECTS IN POWER ELECTRONICS

RESONANT POWER CONVERTER FOR WIRELESS POWER TRANSFER

Motivations: Wireless power transfer is a technically mature technology in consumer electronics (e.g. phone or toothbrush chargers). However, major technical challenges must be overcome in high-power applications, such as electric vehicle charging. At imperix, we are eager to learn more about this topic and would like to implement a working prototype using our products.

Objectives: Design, implement, and validate a hardware prototype, as well as suitable control for a wireless power charger suitable for an electric vehicle.

Skills: Some previous experience in power electronics is recommended.

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY (EIS) FOR ELECTRIC BATTERIES

Motivations: Electrochemical Impedance Spectroscopy (EIS) is a key technique for identifying the essential characteristics of various electrochemical systems, such as batteries, supercapacitors, fuel cells, etc. With batteries, such data is notably important for State-of-Health (SoH) estimation or the early detection of potential failures.

Objectives: Implement a closed-loop-controlled current injector using available imperix equipment (e.g. TPI8032), maximizing the excitation bandwidth. Review and implement suitable fitting techniques based on state-of-the-art approaches (Kalman filters, machine learning, etc.). Conduct an experimental measurement campaign on various batteries. Relate the obtained results to the system's physics.

Skills: Some prior knowledge in control and signal processing is required. Interest in electro-chemistry is required.

OPTIMIZATION-BASED ROBUST CONTROL DESIGN USING H-INFINITY LOOP SHAPING

Motivations: In power electronics and distributed generation (e.g. microgrids), model-based control is the dominant design approach. However, the controlled systems (i.e. plants) can be significantly impacted by parameter variations or operating conditions (indirect consequence of under-modeling). In some cases, this leads to insufficient robustness. H-infinity loop shaping can be an attractive solution to these challenges, especially when based on non-parametric models that have been properly identified beforehand.

Objectives: Study and implement an optimization-based control design methodology for power converters based on non-parametric models and H-infinity loop shaping theory. Leverage previous work from Prof. A. Karimi at EPFL, Lausanne, Switzerland. Throughout the project, identify the specificities of power electronic applications that can be leveraged to simplify the formulation of the desired open-loop transfer function, as well as the stability constraints. Demonstrate the superiority of the achievable results against conventional model-based design approaches.

Skills: Very solid prior knowledge in automated control is mandatory. A good background in numerical analysis (convex optimization, linear programming) is also recommended.

SENSORLESS CONTROL FOR HIGH-SPEED MOTORS

Motivations: High-speed motors pose various challenges to their control. Notably, as the mechanical frequency becomes closer to the switching frequency, the modulation must be adapted to avoid undesirable sub-harmonics. On the other hand, a proportionally larger back-EMF facilitates the implementation of sensorless control, except at low speed or when facing non-negligible measurement delays.

Objectives: Conduct an extensive review of the control and modulation techniques for high-speed motors, with a particular focus on sensorless techniques. Design and validate a suitable control implementation example. Experiment on a low-power prototype in the laboratory.

Skills: Sound theoretical knowledge of motor control is required.

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. Such machine types are currently not addressed in our existing base of online examples.

Objectives: Review and evaluate the conventional control techniques for SynRM and SRM machines. Review and evaluate the conventional modeling approaches for these motors as well. Develop a complete PHIL test bench implementing an emulated motor (using a power amplifier) connected to a real inverter (hosting the digital control).

Skills: A strong interest in electrical machine modeling and control is required.

REINFORCEMENT LEARNING-BASED CONTROL FOR MOTOR DRIVES

Motivations: Traditional PI controllers for motor drives struggle with non-linearities and parameter variations (e.g. due to temperature variations or aging). Reinforcement Learning offers an alternative that is expected to eliminate manual tuning and improve dynamic response under such conditions.

Objectives: Develop and train an agent to replace traditional control loops in a motor drive (e.g., PMSM), validating its dynamic performance against standard Field-Oriented Control (FOC).

Skills: Some previous experience in power electronics is recommended.

AUTOMATED PI CONTROLLER TUNING WITH META-HEURISTIC OPTIMIZATION

Motivations: The manual tuning of PI/PID controllers is often a time-consuming task, which may also yield sub-optimal performance. Auto-tuning techniques can accelerate this process while improving overall performance and stability.

Objectives: Review and evaluate eligible meta-heuristic auto-tuning techniques, e.g. including methods like Particle Swarm Optimization or Genetic Algorithms. Implement performance metrics (objectives) and compare their effectiveness in various real-world scenarios and conditions.

Skills: An excellent background in automated control is recommended. Experience in power electronics and/or machine learning is a plus.

YOUR PROFILE

An internship with us will suit you if:

- You are a PhD, MSc, or BSc student.
- You are looking for a 3-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. Email correspondence should be addressed to jobs@imperix.ch. We reserve the right to maintain correspondence only with profiles that reasonably match the position requirements.

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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.