The conversion and control of electrical energy using power semiconductor devices is one of the most classical and challenging research areas in electrical engineering. The increasing application of power electronic systems, the development of new power semiconductors devices, the creation of new converter topologies, and specifically the development of more powerful microprocessors, with unprecedented calculation power, offers the possibility to design and implement new highly sophisticated and intelligent digital control and modulation algorithms for power converters. This special section is aimed to research academics and practicing engineers of the industrial electronics and industrial informatics communities to present their most recent findings related to digital control systems in power electronics. This special section presents to the power electronics community the most recent advances with topics such as the following:

- Modern digital control strategies and algorithms: dead beat control, model predictive control, fuzzy logic, neural networks, sliding mode control, etc.
- Modulation methods: pulse width modulation, space vector modulation, harmonic control based methods, etc.
- Advances in hardware implementation: FPGA, DSP, microcontrollers, etc.
- Application to all type of topologies in power electronics: voltage and current source inverters, DC-DC converters, multilevel converters, matrix converters, resonant converters, PWM rectifiers, etc.
- Application to all type of AC drives: synchronous machines, permanent magnets synchronous machines (PMSM), induction machines, etc. Special attention should be given to high performance control strategies and algorithms like field oriented control (FOC), direct torque control (DTC), and predictive torque control (PTC).
- Other applications like renewable energies and smart grids, transportation, mining, pulp and paper, etc.

It is our pleasure to present this Special Section on Digital Control Systems in Power Electronics and Electrical Drives. Due to the high number of good papers submitted, this Special Section has been divided in three parts. The papers of this first part are detailed in the next sections.

I. MODERN DIGITAL MODULATION AND CONTROL STRATEGIES

- A Family of Predictive Digital-Controlled PFC under Boundary Current Mode Control.
- Robust Model Predictive Current Control of Three-Phase Voltage Source PWM Rectifier with Online Disturbance Observation.
- A Digital Dual-state-variable Predictive Controller for High Switching Buck Converter with Improved \( \Sigma-\Delta \) DPWM.
- Instantaneous Reactive Power Minimization and Current Control for an Indirect Matrix Converter under a Distorted AC-supply.

II. ADVANCES IN HARDWARE IMPLEMENTATION

- A Comparison of Simulation and Hardware-in-the-loop Alternatives for Digital Control of Power Converters.
- FPGA Realization of Trapezoidal PWM for Generalized Frequency Converter.
- Multi-DSP and -FPGA Based Fully-Digital Control System for Cascaded Multilevel Converters used in FACTS Applications.

III. DIGITAL CONTROL IN DIFFERENT TOPOLOGIES AND AC DRIVES

- Digital Current Sharing Method for Parallel Interleaved DC-DC Converters using Input Ripple Voltage.
- Short-Circuit Fault Protection Strategy for High Power Three-Phase Three-Wire Inverter.
- Simulink Modeling and Design of an Efficient Hardware-constrained FPGA-PMSM Speed Controller.
IV. APPLICATIONS IN RENEWABLE ENERGY AND ELECTRIC VEHICLES

- Digital Control of Actual Grid-Connected Converters for Ground Leakage Current Reduction in PV Transformless Systems.
- Efficiency Optimization of a DSP-Based Standalone PV System using Fuzzy Logic and Dual-MPPT Control.
- A High Efficiency 5kW Inductive Charger for EVs using Dual Side Control.
- A Nonlinear Optimal Control Approach Based on the Control-Lyapunov Function for an AC/DC Converter Used in Electric Vehicles.

We hope that this Special Section will increase the interest of the scientific community in this very dynamic area and will motivate the generation of new ideas for future research applications. The Guest Editors express their gratitude to the authors for sending their contributions and to the reviewers for their expertise and dedication to the review process. Finally, our special acknowledgement is dedicated to the EiC of the IEEE Transactions on the Industrial Informatics, Bogdan Wilamowski for his enthusiastic support. Finally, we acknowledge the outstanding work of Dr. Marco Rivera in the organization of this Special Section.

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