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Editorial

Special Issue on Power Converters: Modelling, Control, and Applications

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1. Introduction

It is very important to utilize the available sources of energy efficiently using power electronics devices and to increase the share of renewable energy sources. Power converters are a very broad and important family of power electronic devices. DC/AC inverters are one of the largest groups among them. Problems with their efficient work on-grid and maximum power point tracking when supplying from the photovoltaic modules are crucial for the implementation of renewable energy sources. The DC/DC switching mode power supplies are the dominant group among DC power-supplying systems. Inverters can operate in many applications, including uninterruptible power supplies and motor drives. The other group of inverters can operate as serial or shunt active power filters for which the power theory of circuits with the non-sinusoidal current is unavoidable. Each of these groups has separate requirements and control systems. Single- or three-phase inverters for UPSs should meet the requirements of the low output voltage distortions. The harmonics causing parasitic torques should be cancelled in motor drives. The models of inverter, which are discrete based on the solution of their state space equations or digitalised from the continuous models, are necessary for most of the control systems of inverters. There is a wide range of problems with the modelling, control and applications of power converters. This Special Issue provided a platform for publishing the results of the research work on the latest advancements in AC/DC and DC/DC power converters. In the first edition of this Special Issue, 9 research papers were published from 13 submitted, and in the second edition of the Special Issue, 5 research papers were published from 8 submitted.

2. A Brief Description of the Papers Published in the First Edition of the Special Issue

Lasek et al. [1] presented very important aspects of driving the modern SiC MOSFET transistors in the inverters. The authors discussed an active gate driver for the SiC MOSFET module. Nourani Esfetanaj et al. [2] presented the problem of electromagnetic compatibility when using power factor correction which is almost always obligatory now for power loads. The paper presents the study of a differential mode EMI filter design for the interleaved boost power factor corrector to minimize the component size. The work in [3,4] was in the range of the implementation of renewable energy sources. Wang et al. [3] proposed an isolated buck-boost topology and control strategy for the photovoltaic medium-voltage DC converter with a low-voltage ride-through capability. Miao et al. [4] presented a very interesting algorithm of maximum power point tracking for the thermoelectric generator considering its internal resistances, which was not as common as in the case of photovoltaic or wind turbines energy sources. It is important research because the thermoelectric generator is perfectly designed for energy harvesting. Saralegui et al. [5] presented the model of the half-bridge that can be used in hardware-in-loop simulations

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with the implementation of the dead-time events to increase the accuracy of the model. Zhang et al. [6] presented sensorless PI passivity-based control for a DC/DC boost converter to avoid the need for the current sensor. Golsorkhi et al. [7] presented a novel sensorless control method of the single-phase inverter as the induction motor drive that can lead to huge energy savings. Górecki and Górski [8] proposed a new form of a compact electrothermal model of impulse transformers taking into account electrical, thermal, and magnetic phenomena occurring in the considered device. Resutík and Kaščák [9] discussed a new approach for building a compact all-in-one matrix converter module based on SiC semiconductors arranged in a common source connection suitable for use in matrix converter applications.

Summarizing the first Special Issue edition, papers [1,5,7,9] referred to the design and modelling of the inverters including motor drives, papers [3,4] concerned the implementation of renewable energy sources, papers [2,3,6] described DC/DC converters and their control, and [2] was devoted to the electromagnetic compatibility of the power factor corrector, and paper [8] presented electrothermal model of the components of the power converters. All the expected key areas were presented in the first Special Issue.

3. A Brief Description of the Papers Published in the Second Edition of the Special Issue

The publishing success of the first Special Issue resulted in the publication of the second edition of the Special Issue with the same topic, "Power Converters: Modelling, Control, and Applications", and the same expectations from the prospective authors. Beshir et al. [10] presented the interesting problem of the choice of PWM modulation in the switching mode power converters that minimizes conducted emissions and reduces the influence on the power line communication. Gholami-Khesht et al. [11] proposed a probabilistic framework that could be used for the sensitivity assessment of grid-connected voltage source converters, where uncertainties in the grid short circuit ratio and operating point conditions, as well as control–loop interactions, were considered. The on-grid connection is a very important topic for many renewable power sources. Górecki and Górecki [12] presented a method involving fast computations of waveforms of the junction temperature of power SiC-MOSFETs operating in switched networks at the steady state. It is an important topic for modelling power converters. Pichon et al. [13] developed power converter inductor loss models based on the experimental characterization of off-the-shelf components to outline the methodology to select the optimal inductor value. Al-Baidhani and Kazimierczuk [14] presented a simplified double-integral sliding-mode control method for pulse-width modulated DC-AC buck conversion.

Finally, all five papers from the second edition of the Special Issue covered the expected range of topics. Paper [11] concerned on-grid inverters, papers [12,13] showed the problems of power converter's component modelling, paper [14] presented control in DC/DC converters, and paper [10] presented an interesting PWM idea for the reduction in conducted emissions.

In conclusion, it can be said that the problem of designing and modelling devices for switching-mode power conversion, as well as DC/AC and DC/DC, is currently very hot in the case of the growing importance of renewable energy sources, requirements of the high efficiency of the power conversion, and the expectation of satisfactory electromagnetic compatibility of these converters, which has resulted in a lot of researchers all over the world working on this problem.

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