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Editorial

Power Converters in Power Electronics: Current Research Trends

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1. Introduction

In recent years, power converters have played an important role in power electronics technology for different applications, such as renewable energy systems, electric vehicles, pulsed power generation, and biomedical. Power converters in power electronics are becoming essential for generating electrical power energy in various ways. Voltage source and current source inverters are well-known as the conventional topologies to convert a DC source to an AC source. For single-phase current source inverters, DC-side low-frequency power oscillation is an inherent limitation. Various active power decoupling circuits for single-phase current source converters are reviewed in [1]. During the last decade, the multilevel inverter has become very popular in medium and high-power applications, with some advantages, such as the reduced power dissipation of switching elements, low harmonics, and low electromagnetic interferences (EMIs). An overview of the multi-level inverter topologies is presented in [2]. The development of the advanced power converters is necessary for the various applications. This special issue focuses on the development of novel power converter topologies in power electronics.

2. The Current Research Trends

Each of the 28 articles collected in this special issue proposes a solution to a specific problem related to the power converter topologies. The impedance source inverters (ISIs) overcome the limitation of the conventional inverters, because they can operate in single-stage power conversion with buck-boost voltage and shoot-through immunity. In Reference [3], a three-phase cascaded active ISI is proposed to reduce the number of passive elements. A common ground Z-source SEPIC inverter is proposed in [4] to eliminate leakage current. In order to increase the voltage gain, a multiplier cell technique is applied to the quasi-switched boost inverter with low input current ripple [5]. The applications of the ISI for grid connection [6] and photovoltaic [7] are presented.

New concepts of pulse-width modulation (PWM) control techniques and control theories for the inverters are another focus of this issue. A modified model predictive power control for grid-connected T-type inverter with reduced computational complexity is presented in [8]. A robust two-layer model predictive control for three-level inverter is shown in [9]. Current source AC-side clamped inverter for leakage current reduction in grid-connected photovoltaic (PV) system is shown in [10]. A control design of the LCL filter [11] and PWM method [12] for single-phase inverter are carried out. The space vector modulation technique is applied to the quasi-switch boost t-type inverter for common mode voltage elimination [13]. In addition, the PWM techniques for five-level inverter are presented in [14,15], with a minimal number of commutations. The inverter topology for the DC motor is presented in [16].

In addition to the research in the inverter topologies, this issue has collected important research on isolated [17,18] and non-isolated [19–22] DC-DC power converters and rectifiers [23,24]. In Reference [17], a comparative evaluation of some wide-range soft-switching full-bridge modular

multilevel DC–DC converters is discussed. To realize the functions of reduced primary current loss and balanced voltage and current, a DC-DC converter with the series/parallel connection on the high-voltage/low-voltage side is presented in [18]. A bipolar bidirectional DC/DC converter and its interleaved-complementary modulation scheme are introduced in [19]. A multiple three-phase low-voltage and high-current permanent magnet synchronous generation system is proposed in [20] for 5 V/10 kA DC power supply. In Reference [21], a new technique for enlarging the stable range of peak-current-mode-controlled DC-DC converters is presented. In Reference [22], a combination of the one-comparator counter-based PWM control with pulse frequency modulation (PFM) control is presented for buck DC-DC converter. A power-based space vector modulation technique for a matrix rectifier is proposed in [23], where the modulation index and applied phase are calculated, based on the active and reactive power of the rectifier for intuitive power factor control. In Reference [24], a modeling method is introduced to establish a parametric-conducted emission model of a switching model power supply chip through a developed vector fitting algorithm.

Various power converter topologies for different applications, such as wireless power transfer [25,26], battery charging [27,28], static synchronous compensator (STATCOM) [29], and gate driver [30] are presented in this issue. In Reference [24], an inductive power transfer (IPT) system with three-bridge switching compensation topology is proposed, to achieve the load-independent constant current (CC) and load-independent constant voltage (CV) outputs. In Reference [25], a generalized fractional-order wireless power transmission is established for medium and long-range wireless power transmission. A fast-charging balancing circuit for LiFePO4 battery is proposed in [26], to address the voltage imbalanced problem of a lithium battery string. In Reference [27], an add-on type pulse charger is introduced, to shorten the charging time of a lithium ion battery. In Reference [28], an individual phase full-power testing method for high-power STATCOM is presented with reconfiguration the port connection of three-phase STATCOM. In Reference [30], an intelligent control method for suppressing electromagnetic interference (EMI) sources in the fast switching power converters is proposed, with a combination of open-loop and closed-loop methods.

3. Future Trends

The future research in the advanced power converter topologies will continue to find the solutions in applications of current power electronics for different disciplines. New power converters will be investigated to enhance or replace the current converter topologies. A new growing interest is the integration of impedance-source converters for renewable energy system applications.

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