Special Issue ELECTRIMACS 2019 ENGINEERING Modelling and computational simulation for analysis and optimization in electrical power engineering
Preface

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Preface

Special Issue ELECTRIMACS 2019 ENGINEERING Modelling and computational simulation for analysis and optimization in electrical power engineering

This special issue briefly called "ELECTRIMACS 2019 ENGINEERING" collects peer-reviewed research papers presented at ELECTRIMACS 2019, that is the 13th Conference of the IMACS Technical Committee "ELECTRIMACS". The conference was held in Salerno, Italy, from 21st to 23rd May 2019. The conference has been a meeting point for researchers from 27 countries to share ideas and advances in the broad fields of electric machines and electromagnetic devices, power electronics, transportation systems, smart grids, electric and hybrid vehicles, renewable energy systems, energy storage, batteries, supercapacitors and fuel cells. Within these application fields, the conference was mainly focused on modelling aspects, simulation, analysis, design, optimization, identification and diagnostics in electrical power engineering.

Three tutorial sessions, three plenary sessions with thought leaders from academia and research centres, two industrial forums, four technical tracks, and nine special sessions were included in the conference programme. The conference hosted 133 oral presentations of papers, selected among 169 submissions received. The main institutional sponsor of the conference is the Università degli studi di Salerno — Dipartimento di ingegneria dell'Informazione ed Elettrica e Matematica applicata (DIEM). The conference received also the technical co-sponsorship from two important scientific societies: IMACS and IEEE Industrial Electronics Society (IES), and a financial co-sponsorship from Institut Français — Italia, and the Ambassade de France en Italie, in the framework of Programma CASSINI. Many industries and private companies sponsored the event or took part in the industrial exhibit.

This special issue, together with the companion special issue briefly called "ELECTRIMACS 2019 ENERGY", includes original research papers invited for extended submission after a selection among the conference papers, and then peer-reviewed according to the journal standards. The Guest Editors would like to express their deep appreciation to all Authors and Reviewers who contributed to this MATCOM special issue. Moreover, they are grateful to the Editors in chief Dr. Rosa Maria Spitaleri and Prof. Christina Christara for their great efforts to make this special issue a success. The Guest Editors also thank the Journal manager Mr. Thennarasu Gunasekaran for his constant support.

This issue includes 20 papers with special emphasis on mathematical and numerical computation aspects for electrical end electronic engineering applications. For a straightforward browsing of the special issue content, the articles are grouped into the following three thematic sections:

- *Power converter architectures and control strategies*
- *Analysis and design optimization of electrical machines*
- *Smart grids and renewable sources.*

A short introduction of the published papers is given hereinafter.

The section *Power converter architectures and control strategies* includes seven papers dealing with modelling, control and simulation of power converters. In [1] Xiao et al. present an equivalent model for the d-q impedance of three-phase grid-connected converters, which leads to two scalar impedance ratios instead of the conventional 2-by-2 matrix. Consequently, the system is analysed by using the classic Nyquist stability criterion. A novel converter for a hybrid fuel cell/supercapacitor storage system is discussed by Siangsanoh et al. in [2]. High efficiency

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and maximum use of supercapacitor energy are the main benefits of the proposed architecture. The mathematical model is developed and a closed-loop control by using an indirect-sliding mode technique including a disturbance estimator is provided.

Studies related to the driving strategies of switching converters are also afforded in some papers. In [3], Bhadra et al. propose an analytical approach to eliminate harmonics and thereby improve the total harmonic distortion in switching waveforms of power converters. Chebyshev expansion is used to convert the transcendental equations to power-sum non-linear polynomials. The main contribution of [4], authored by Patin et al. is to evaluate the impact of interleaved pulse width modulation strategies on the current flowing through the dc-link capacitor associated to two back-to-back three-phase full bridge converters. A mathematical proof is presented in [5] by Buccella et al. to demonstrate that, under a particular choice of the switching angles, several harmonics can be eliminated from the output voltage waveform of a single phase cascaded H-bridge inverter with variable dc sources levels. Compared to a conventional selective harmonic elimination procedure, the proposed procedure reduces distortion in a wide range of modulation index.

Multicellular converters use interleaved carriers to reduce filtering elements and potentially improve transient response, in [6] Hillesheim et al. present a behavioural discrete model for analysing the stability criterion, determining the convergence speed and choosing the appropriate parameters of decentralized control techniques. In paper [7], authors Pascal et al. propose a comprehensive analytical model of the magnetism, electrostatics, and loss mechanisms of a simple and economical structure with a printed circuit board-embedded magnetic component for electric power conversion in the range 1–100 W. The model is adapted to predict the electrical characteristics of the device used as a monolithic series-LC tank, with a resonant frequency in the MHz range.

The papers included in the section *Analysis and design optimization of electrical machines* deal with mathematical and simulation aspects related to the modelling, simulation and design of electrical machine (EM). In [8], Amara et al. developed a numerical tool, based on the electrical circuits model of the hybrid excitation synchronous machines for the optimization of the hybridization ratio α which is an additional degree of freedom in the design of synchronous EMs. A novel saliency tracking algorithm based on high frequency injection with an iterative search-based technique for pre-commissioned look-up tables is proposed by Scicluna et al. in [9] for estimating the rotor position at low/zero speed for a surface-mounted Permanent Magnet Synchronous Machine (PMSM). The influence of the shift phase angle ψ between phase currents and back-electromotive forces on magnetic radial forces and torque ripple in low power PMSM is discussed by Uygun et al. in [10]. The aim is to establish a good compromise between consumed current, torque and radial force harmonics at the origin of the electromagnetic noise. In [11] the author Vivier presents a new approach for the optimal design of a PMSM. The method is based on the construction and analysis of two-dimensional graphic representations of the isovalue surfaces providing the continuous sets of the domain where the output variables assume values in accordance with the defined specifications.

Demagnetization fault is a common problem in PMSM which deteriorates the machine performance and can lead to serious machine damages. To prevent such an issue, a novel method to effectively detect the demagnetization fault is proposed in [12] by Zhang et al. The technique is based on the measurement of a voltage signal by means of a non-invasive search coil and analysed by using the Hilbert–Huang transform.

In [13] Linshi et al. present a linear parameter-varying observer for an induction machine under sinusoidal dc-supply disturbances. Simulation and experimental results on a laboratory test-bench show the effectiveness of the observer to estimate not only the state variables, but also the disturbances considered as a part of the states.

The third section *Smart grids and renewable sources* collects papers dealing with mathematical and numerical aspects related to modelling and simulation of renewable sources as well as control issues in smart grid. Microgrids with dc-bus are usually preferred for renewable energy distributed systems due to their high efficiency and more suitability to new load appliances. In these architectures the dc-bus voltage regulation is a challenging task. In [14], authored by Jebalibenghorbal et al. two types of control are investigated to ensure a constant dc-bus voltage with good performances when constant power loads are connected to the microgrid or in presence of power flow variations. The mathematical model and the control system of ultra fast charging stations (UFCS) based on dc microgrid concept are presented by Iannuzzi et al. in [15]. The UFCS charges electrical vehicles in less than 10 min. The design procedure and the control strategy are dealt in Matlab–Simulink environment, simulation results provide UFCS performance and the charging station's dynamics. In [16] authors Almaksour et al. propose a simulation model for studying a reversible power substation aimed at improving the energy efficiency of a dc railway electrical network connected to the main ac grid. The model provides a reliable tool for analysing the electrical network during braking mode. A numerical method to simulate a large mismatched photovoltaic array by using a low cost system-on-chip device is shown in [17] by Guarino et al. The method is a key tool for the implementation of monitoring and diagnostic methods as well as of model-based control strategies in modern photovoltaic systems.

The last three papers of this section are focused on the energy management of smart grids. In particular the accurate estimation of load consumptions and energy production forecast of renewable sources are crucial issues to design demand response programmes in the paradigm of smart grids. In [18], Mansoor et al. analyse the feed-forward neural network and the echo state network to predict the electric load of commercial buildings. The results of both models are compared based on the load forecasting accuracy through experimental measurements and suitably defined metrics. A non-linear autoregressive network with exogenous inputs artificial neural network model is investigated for short-term forecasting of the hourly wind speed, solar radiation, and electrical power demand by Di Piazza et al. in [19]. Compared to other models, the proposed approach shows high capability to reconcile good forecasting performance in the short-term time horizon with a very simple network structure, which is potentially implementable on a low-cost processing platform.

Paper [20], authored by Segarratamarit et al. introduces deep learning-based forecasting models for the continuous prediction of the aggregated production generated by concentrated solar power plants. These models use as inputs the expected atmosphere irradiance values and available weather conditions forecasts for the locations where the power plants are installed. The performances of the forecast models are analysed and compared by means of the most extended metrics in the literature for a whole year of energy production.

The readers interested in knowing more about the ELECTRIMACS Technical Committee and its activities are referred to [21], wherein all details of the past conferences and publications are reported.

The next ELECTRIMACS conference will take place in Nancy, France, in May 2021 [22]. We look forward to meeting you there!

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