



Editorial Grid-Connected Renewable Energy Sources

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Abstract: The use of renewable energy sources (RESs) is a need of global society. This editorial, and its associated Special Issue "Grid-Connected Renewable Energy Sources", offer a compilation of some of the recent advances in the analysis of current power systems composed after the high penetration of distributed generation (DG) with different RESs. The focus is on both new control configurations and novel methodologies for the optimal placement and sizing of DG. The eleven accepted papers certainly provide a good contribution to control deployments and methodologies for the allocation and sizing of DG.

Keywords: renewable energy conversion; power conditioning devices; renewable energy policies; power quality; computations methods; control strategies; electric vehicle charging; energy management systems; ancillary services; monitoring; prognostic and diagnostic

1. Introduction

A significant share of the electricity presently produced worldwide is generated by centralized systems based on conventional fossil fuel plants or nuclear power. Nonetheless, energy systems across the globe are undergoing a significant transformation as society transitions towards the widespread use of clean and sustainable energy sources. Thus, renewable distributed generation (DG) can play a major role in the future world's energy generation. As a result, the architecture of energy generation is rapidly shifting from centralized to decentralized power plants. Instead of depending on only one energy source, a wide range of types can be used. This will eventually lead to the extensive inclusion of power electronics based on non-synchronous or renewable DG. The grid-interactive power converters involved will significantly improve the flexibility, controllability, and efficiency of conventional power systems. Smart control strategies can thus enable energy management capabilities as well as the provision of ancillary services to the grid from renewable DG. Nevertheless, maintaining a reliable and safe power system poses significant challenges. The optimization of the allocation and sizing of renewable DG is also an important task in this context.

2. A Short Review of the Contributions in This Issue

To cover the above-mentioned promising areas of research and development, this Special Issue collects the latest research on relevant topics, and more importantly, addresses current issues related to more sustainable, safer, and more resilient power systems. This Special Issue received fifteen submissions, of which eleven were accepted for publication. Various topics are addressed in these manuscripts, mainly on energy storage and photovoltaic and wind power technologies. The contents of these papers are summarized hereafter.

In the paper "Intermittent Renewable Energy Sources: The Role of Energy Storage in the European Power System of 2040" [1], the authors address the challenges of variable renewable energy integration in Europe in terms of the power capacity and energy capacity of stationary storage technologies.

Two papers discuss the issues related to the time framework. In article [2], the enhanced time delay compensator approach manages varying time delays inherent to



Citation: Hernández, J.C. Grid-Connected Renewable Energy Sources. *Electronics* **2021**, *10*, 588. https://doi.org/10.3390/electronics 10050588

Received: 8 February 2021 Accepted: 1 March 2021 Published: 3 March 2021

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Copyright: © 2021 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). communications schemes in power systems. This introduces the perspective of network latency instead of dead time. The potential provision of advanced energy services from the small grid-connected renewable DG is described in article [3]. This work shows that the smart meter roll-out in household-prosumers offers an easy access to granular meter measurements for future advanced energy applications. The development and calibration of a smart meter prototype is adjusted as required in the provision of advanced energy services.

The grid integration of renewable DG is increasingly pursued all over the world due to several technical, economical, and environmental benefits. Consequently, three articles work on the optimal placement and sizing of DG in distribution networks. The work done by S. Katyara et al. [4] exploits genetic algorithms for the proper placement of a new DG; meanwhile, the energy management is designed using a fuzzy inference system. A hybrid master–slave optimization procedure is proposed in article [5]. In the master stage, the discrete version of the sine–cosine algorithm determines the optimal location of the DG. In the slave stage, the problem of the optimal sizing of the DG is solved through the implementation of the second-order cone programming equivalent model to obtain solutions for the resulting optimal power flow problem. Still on the topic of DG, the comparison between AC and DC distribution networks to provide electricity to rural and urban areas from the point of view of grid energy losses and greenhouse gas emissions impact is analyzed in [6]. Results confirm that power distribution with DC technology is more efficient than its AC counterpart.

Electrical system performance can be enhanced to maximize economic benefits by incorporating an appropriate electric energy control scheme. Accordingly, this Special Issues includes four papers focused on converter control. The research in [7] introduces an LC impedance source bi-directional DC–DC converter by redesigning after rearranging the reduced number of components of a switched boost bi-directional DC–DC converter. This novel design decreases the stress on the capacitor voltage compared to existing topologies in literature. The second paper, [8], proposes a proportional-integral passivity-based controller to regulate the amplitude and frequency of the three-phase output voltage in a DC–AC converter with an LC filter. The third paper, [9], authored by Md.R. Hazari et al., presents a novel control scheme for a battery-based energy storage system (ESS) in coordination with an SCIG-based wind turbine generator (WTG), which improves the low voltage ride through capability. A closely related work of [9] is [10], which automatically identifies the frequency stabilization by WTG and ESS. The work models a control scheme that shares their releasable and absorbable energies between both sources.

Another range of topics is addressed in this Special Issue. Thus, a microcontrollerbased PV source emulator is presented in [11]. This modeling and design is based on a completely new technique, which consists in subtracting an adequate amount of current from a fixed direct current source so as to reproduce the desired I–V characteristic.

3. Future

While the potential of grid-connected renewable DG has been extensively recognized by the research community, several significant obstacles still remain, and therefore, research and technology are essentials tools for attaining a new energy paradigm, which is going towards the responsible and careful use of the environment's resources. In the future, it can be expected that more friendly and pollution-free energy sources will be required in large amounts for sustainable societies. In this circumstance, for the optimal planning of DG in electrical distribution networks, appropriate converter control strategies and approaches should be ready.

Acknowledgments: First of all, the Guest Editor would like to thank all the authors for their great contributions in this Special Issue. We are grateful to all the peer reviewers who helped evaluate the submitted manuscripts and made beneficial suggestions for their improvement. We would also like to acknowledge the editorial board of *Electronics*, who graciously invited me to guest edit this Special

Issue. Finally, we are grateful to the *Electronics* Editorial Office staff; they worked tirelessly to ensure the peer-review schedule and timely publication.

Conflicts of Interest: The author declares no conflict of interest.

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