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Editorial: Advanced intelligent control strategies for solar and wind farms

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Editorial on the Research Topic
Advanced intelligent control strategies for solar and wind farms

This research topic addressed new and advanced techniques in controlling, operating and augmenting solar photovoltaics (PVs) and wind turbines low voltage or fault ride through scenarios. This is necessary for the effective operation of solar and wind farms based on the stipulated grid codes (requirements).

The first paper on this research topic (Okedu) investigated three types of Fault Current Limiters (FCLs) that were tied to the network side of a Permanent Magnet Synchronous Generator (PMSG) wind turbine. These three FCLs are; Series Dynamic Braking Resistor (SDBR), traditional Bridge Fault Current Limiter (BFCL), and Capacitive Bridge Fault Current Limiter (CBFCL). The modeling of the PMSG wind turbine (Okedu and Barghash 2021), and those of the FCLs were done and analyzed in the wind generator considering severe three-phase to ground fault, in order to test the robustness of the various control strategies. The results show improved performance of the PMSG wind turbine variables when the same conditions of operation were employed, for fair comparison of the three FCL schemes.

The second paper presented wind power system operational state assessment considering Particle Swarm Optimization (PSO), Analytic Hierarchy Process (AHP) and Fuzzy Comprehensive Evaluation (FCE) models (Zhang et al.). In this paper, the hybrid approach of AHP and PSO models were used in optimizing the weights in the comprehensive evaluation of the operational status of wind power system. This strategy would help in addressing the challenges of the AHP weights determination process based on the judgment matrix (Li et al., 2021), where the values of the weights and their consistencies are of paramount interest. The earlier solutions in the literature were not able to enhance these challenges, however, this study employed a comparison chart of the consistency indexes that were computed at different degrees. Furthermore, for several judgment indexes scenarios, in a sub-project layer having serious deviation, a degradation index was introduced and fuzzy comprehensive judgment strategy was applied accordingly. This would improve the effective establishment of wind power system operational status assessment models.

In the third paper, a comprehensive comparison and evaluation of the tracking performance of modern heuristic optimization considering Global Maximum Power Point Tracking (GMPPT) scheme (Wang et al.), was presented. This is necessary because under partial shading conditions, the generation system of the solar PVs experience multiple local and single GMPPT. Therefore, the effective control of the GMPPT would definitely enhance the solar PV performance during partial shading conditions (Deboucha et al., 2021). In this study, the Monte Carlo technique was employed to statistically analyze the different scenarios considered. The presented results reflect the issues in striking a balance between explorative and exploitative search behavioral patterns in the various algorithms used. Consequently, a variable vortex search having the ability of enhancing the performance of the GMPPT based on variable step size and deterministic starting points was proposed, in this study. This would help in comprehending the use of modern heuristic algorithms and guidance of solar PV system maximum power and performance under partial shading conditions.

The fourth paper presents a short-term frequency regulation technique for Doubly Fed Induction Generator (DFIG) based wind turbine (Zhang et al.). The concept of short-term frequency regulation in wind generation units is imperative due to safety and efficiency of the power system. Some of the hindrances of effective frequency regulation are the uncertain nature, and non-modeled dynamics of wind speed. Based on this, an additive controller that is data-driven could help in the stochastic framework, with survival information potential of random variables. The concept of the survival information potential control has merit over information potential based controllers because it can evaluate droop and inertial controls (Yang et al., 2022). In this study, a hybrid strategy of a particle swarm optimization scheme and arithmetic mean filter approach were used for the additive control coefficient. The presented simulation results in the study show considerable improvements of the frequency regulation of the DFIG using the proposed scheme, compared to the conventional scheme of frequency regulation.

The fifth paper presents an improved sag control scheme considering adaptive virtual impedance (Zhang et al.).This study is necessary to solve line impedance difference between the distributed power sources, and lack of reactive power dissipation according to droop gain, in a micro grid that is operating in Island operation mode. The concept of this study is based on the capacity of the inverters in the system and total load capacity of the line. This computed signals are sent to each inverter, which then evaluates the value range of the virtual impedance based on the available reactive power (Wu and Wang, 2020). More so, the voltage drop difference due to the line impedance difference is compensated using a voltage link in the control strategy, for stability of the output power and control of the micro grid. Simulations were performed in MATLAB/Simulink environment where the results show that when the inverters having the same capacity were tied in parallel, a more stable active power was realized, while the reactive power was maintained constant.

Finally, the contents of this research topic were able to promote some of the new studies required to evaluate the behavior of solar and wind farms. These research topic would serve as a tool to improve the design of solar PVs and wind turbines in an efficient and cost-effective way, for power grids operators, engineers, and stakeholders of solar and wind farms.

Author contributions

KEO did the conceptualization and writing of the editorial.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Deboucha, H., Kermadi, M., Mekhilef, S., and Lalouni, S. L. (2021). Voltage track optimizer based maximum power point tracker under challenging partially shaded photovoltaic systems. *IEEE Trans. Power Electron.* 36, 13817–13825. doi:10.1109/tpel.2021.3089658

Li, S., Bai, Y. H., Li, X. B., and Wang, Z. L. (2021). Quality evaluation of commercial concrete production process based on AHP-FCE method. *Sci. Technol. Innov.* 14 (15), 30–38. doi:10.15913/j.cnki.kjycx.2021.15.014

Okedu, K. E., and Barghash, H. (2021). Enhancing the transient state performance of permanent Magnet synchronous generator based variable speed wind turbines using power converters excitation parameters. *Front. Energy Res.* 9, 109–120. doi:10.3389/fenrg.2021.655051

Wu, H., and Wang, X. (2020). A mode-adaptive power-angle control method for transient stability enhancement of virtual synchronous generators. *IEEE J. Emerg. Sel. Top. Power Electron.* 8, 1034–1049. doi:10.1109/JESTPE.2020.2976791

Yang, D., Jin, Z., Zheng, T., and Jin, E. (2022). An adaptive droop control strategy with smooth rotor speed recovery capability for type III wind turbine generators. *Int. J. Electr. Power & Energy Syst.* 135, 107532. doi:10.1016/j.ijepes.2021.107532