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Optimal power flow of wind-solar-EV-based combined heat and power for economic power generation and environment sustainability

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ABSTRACT

The primary focus of this paper is the analysis of the optimal power flow (OPF) of the combined heat and power economic dispatch (CHPED) problem integrated with renewable sources and performed using a new practical approach based on the chaotic oppositional sine cosine algorithm (SCA) (COSCA). The main contribution of the proposed work is to determine the OPF for the CHP-based system for economic dispatch. Secondly, renewable energy sources such as wind-solar-EVs are integrated with the system for economic power generation and environmental sustainability. As in proposed SCA approach oscillating property being used which balance the exploration and exploitation ability to improve performance. Furthermore, as in the higher version of SCA (COSCA) incorporating chaotic-oppositional-based learning, the shortcomings were overcome and provide a global optimal solution. The use of renewable energy sources is crucial to generate economical electricity and mitigating the greenhouse effect in the current environment where fuel is evolving daily. The primary goal of the proposed OPF-based CHPED is to maximize power flow in transmission lines while addressing the requirement of less emissions and more affordable power generation. Thus, for IEEE 30 and IEEE 57-bus systems, the CHPED-based OPF is integrated with renewable energy sources including solar, wind, and electric vehicles. Furthermore, a novel approach called COSCA is applied to the proposed work in order to address the nonlinearity resulting from the valve point loading of thermal units from the uncertainties related to address the power of wind, solar and electric vehicles, and to provide optimal solutions regarding cost and emission at a rapid rate of convergence. Subsequently, the proposed COSCA technique is assessed on multi-objective functions in an effort to concurrently minimize cost and emission. Statistical analysis has been used to evaluate the robustness of the proposed technique. This data is thoroughly examined using an analysis of variance (ANOVA) test which allows for a more accurate evaluation of COSCA's robustness. The superiority of the suggested COSCA algorithm has been addressed by a comparative study between it and well-established optimization techniques.

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