Artificial intelligence applications for microgrids integration and management of hybrid renewable energy sources

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Abstract

The integration of renewable energy sources (RESs) has become more attractive to provide electricity to rural and remote areas, which increases the reliability and sustainability of the electrical system, particularly for areas where electricity extension is difficult. Despite this, the integration of hybrid RESs is accompanied by many problems as a result of the intermittent and unstable nature of RESs. The extant literature has discussed the integration of RESs, but it is not comprehensive enough to clarify all the factors that affect the integration of RESs. In this paper, a comprehensive review is made of the integration of RESs. This review includes various combinations of integrated systems, integration schemes, integration requirements, microgrid communication challenges, as well as artificial intelligence used in the integration. In addition, the review comprehensively presents the potential challenges arising from integrating renewable resources with the grid and the control strategies used. The classifications developed in this review facilitate the integration improvement process. This paper also discusses the various optimization techniques used to reduce the total cost of integrated energy sources. In addition, it examines the use of up-to-date methods to improve the performance of the electrical grid. A case study is conducted to analyze the impact of using artificial intelligence when integrating RESs. The results of the case study prove that the use of artificial intelligence helps to improve the accuracy of operation to provide effective and accurate prediction control of the integrated system. Various optimization techniques are combined with ANN to select the best hybrid model. PSO has the fast convergence rate for reaching to the minimum errors as the Normalized Mean Square Error (NMSE) percentage reaches 1.10% in 3367.50 s.

Keywords Renewable energy integration · Energy management · Microgrids · Artificial intelligence · Optimization techniques

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