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Industry 4.0 - Bibliometric Study for Microgrid Optimization

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Abstract

In recent years, microgrids (MGs) based on renewable energy sources have gained prominence due to their advantages over traditional power grids. The increasing investment in Distributed Energy Resources (DERs), driven by governmental and corporate awareness, requires the development of robust mathematical models to optimize the operation of these networks. This study conducts a bibliometric analysis to identify trends and advances in the application of optimization models to MGs, emphasizing tertiary control and optimal power flow (OPF), integrating the AMPL language to enhance algorithm performance.

Keywords

Microgrids; Bibliometric Research; Tertiary Control; Optimization; AMPL; Power Flow; Industry 4.0.

1. Introduction

The Industry 4.0 revolution has driven the adoption of emerging technologies in energy management, making it essential for the efficient operation of MGs. The growing intermittency of renewable sources demands optimization solutions that ensure the reliability and stability of these networks. This study investigates the most effective mathematical methods applied to MG optimization, based on a bibliometric approach.

2. Methodology

The research employed bibliometric analysis to identify the main approaches applied to tertiary control of microgrids. Indexed publications in the Web of Science, Scopus, and Google Scholar databases were analyzed using the search strings 'Bibliometric Research AND Tertiary Control AND Optimization AND AMPL AND Power Flow'. Data processing was performed using VOSviewer software, enabling the identification of co-authorship networks and research trends in the field.

3. Results and Discussion

The bibliometric analysis results highlighted the relevance of authors such as Josep M. Guerrero and Alessandra Parisio in developing techniques for MG optimization. The study

also identified research gaps regarding MG applications in the industrial sector, indicating the need for tailored solutions for the sensitive loads present in these environments.

4. Conclusion

The research revealed that integrating mathematical models with Industry 4.0 is essential for optimizing MGs. The use of the AMPL language proved to be a robust tool for solving the OPF problem, allowing for greater reliability and stability of the networks. Applying the algorithms to real-world scenarios and exploring new machine learning approaches are recommended as future work to enhance industrial MGs.

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