Optimal Wind Resources Assessment in Costal Area of Lome Based on Genetic Algorithm

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Abstract

Implementing a wind power project at a coastal site, such as Lome located in Togo, requires a thorough study of the wind speed distribution to select the most suitable wind turbines for local conditions. Although the region has significant wind potential, the multimodal distribution of power density, characterized by a high frequency of calm winds, complicates resource assessment. The traditional Weibull distribution, commonly used to model wind speeds, proves inadequate and results in significant discrepancies with observed data. To address these limitations, a metaheuristic approach based on a genetic algorithm is proposed, which estimates distribution parameters while minimizing quadratic error. Data collected from January 1, 2010, to December 31, 2023, validated the robustness of this approach through χ^2 goodness-of-fit tests and comparison with numerical methods, yielding best RMSE, MAPE, and R^2 values. This method allows for a more accurate selection of wind turbines to optimize energy production based on local wind conditions.

Keywords

Weibull Distribution, Wind Speed, Genetic Algorithm, Optimization