University of Zabol
Faculty of Engineering
Electrical and Computer Department

The Thesis Submitted for the Degree of M.Sc (in the field of Electric power)

Optimal design of wind-solar-battery-off-grid hybrid system using meta-heuristic algorithm for Mile Nader region

Supervisors:
Dr. A. Hosseinpour

Advisors:
Dr. M.R. Rakhshani

By:
H. Arbabi

February ۲۰۲۱

Abstract

In this thesis, the optimal design and energy management of renewable photovoltaic-wind hybrid systems with battery storage system is presented in order to minimize the total energy costs for Mile Nader region by considering the equipment exit rate. The design of the hybrid system is performed based on total energy cost by taking into account the reliability constraint as a load loss probability (LPP) index. The decision variables are the number of photovoltaic panels, wind turbines, batteries, the inverter transfered power to the load and the photovoltaic panel angle, which is determined based on Combination of the Gray Wolf Optimization (GWO) Algorithm and the Genetic Algorithm (GA). The performance of the proposed method i.e. HGWOGA has been compared with the GWO and GA. In this study, the simulation results of the optimal system design for different combinations with considering the equipment exit rate and without it have been presented. Moreover, the effect of changes in reliability constraints on the design of hybrid systems has been evaluated. The simulation results confirm the superiority of HGWOGA than GWO and GA in different system combinations with lower cost and higher reliability.

The implementation of wind-based hybrid systems is not cost-effective due to high costs, so the photovoltaic-wind combination is an optimal combination based on cost and reliability for the Mill Nader area. In addition, the results showed that considering the output rate of hybrid energy systems equipment gives a more accurate and realistic view to designers of such systems. Considering the exit rate of equipment increasing the cost and weakening reliability.

Keywords: Photovoltaic-Wind-Battery Hybrid System, Cost Evaluation, Reliability, Gray Wolf Algorithm, Genetic Algorithm.