Using quasi-oppositional butterfly optimization algorithm, a probabilistic optimal power flow for a combined tidal and electric vehicle renewable energy system

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Abstract

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Abstract:
Aiming to reduce operating expenses and emissions while satisfying system restrictions, optimal power flow, or OPF, is essential for effective and sustainable power system management. Quasi-Oppositional Based Learning (QOBL) is added to the butterfly optimization algorithm in this research to improve convergence and solution accuracy when solving the OPF issue. When tested on the IEEE 57-bus system, the suggested QOBOA outperforms current optimization methods in terms of transmission loss and voltage profile improvement. Combining renewable energy sources is crucial for efficient electricity generation because fossil fuel sources are becoming more and more improved every day. The suggested solutions integrate renewable energy sources, such as tidal and electric vehicles, to reduce the demand for fossil fuels in the generation of electricity. Furthermore, the suggested approach has a great deal of promise for improving the adaptability and resilience of contemporary power grids, particularly in light of the growing integration of decentralized energy resources (DERs) and renewable energy sources. This strategy can help future smart grid systems operate more effectively, sustainably, and dependably by facilitating quicker decision-making and enhancing the coordination of dispersed assets.

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***Abstract*—Aiming to reduce operating expenses and emissions while satisfying system restrictions, optimal power flow, or OPF, is essential for effective and sustainable power system management. Quasi-Oppositional Based Learning (QOBL) is added to the butterfly optimization algorithm in this research to improve convergence and solution accuracy when solving the OPF issue. When tested on the IEEE 57-bus system, the suggested QOBOA outperforms current optimization methods in terms of transmission loss and voltage profile improvement. Combining renewable energy sources is crucial for efficient electricity generation because fossil fuel sources are becoming more and more improved every day. The suggested solutions integrate renewable energy sources, such as tidal and electric vehicles, to reduce the demand for fossil fuels in the generation of electricity. Furthermore, the suggested approach has a great deal of promise for improving the adaptability and resilience of contemporary power grids, particularly in light of the growing integration of decentralized energy resources (DERs) and renewable energy sources. This strategy can help future smart grid systems operate more effectively, sustainably, and dependably by facilitating quicker decision-making and enhancing the coordination of dispersed assets.**

***Index Terms*—Probabilistic optimal power flow (POPF), transmission system, butterfly optimization algorithm (BOA), quasi oppositional based learning (QOBL).**

I. Introduction

A network that transfers energy from generators to loads is called a power system. The power system network allows the transfer of energy from generators to loads.Modern power system networks are becoming more complex to plan and operate due to factors such as significant power transfers over a greater distance, intricate coordination, challenging interactions between different system controllers, and reduced power reserves. Power system operators have always put a high premium on the safe and dependable operation of the system.When a power system can endure abrupt disruptions with little loss of quality of service—that is, when a disturbance happens, the system endures the resulting transient and transitions into an appropriate stable state where all operating limitations are within acceptable bounds—it is considered secure.To satisfy the specific load demand with the lowest fuel costs in an integrated power system, the generators' true and reactive powers must fluctuate within operational bounds.

II. Literature Survey

An essential instrument for power system management, control, and planning is optimal power flow (OPF).It was initially presented by Dommel et al. [1].The goal of this non-linear programming problem is to find the best steady-state behaviour of a power system in order to minimise a specified objective function while still meeting the system's inequality constraints and power balancing equations. Insufficient reactive power exacerbates voltage instability brought on by growing power demand, transmission expansion, and generation, which results in significant transmission losses. OPF should so take voltage