# Study on Criticality Minimizing Cost in Power System with Optimal Design of Stochastic Wind Power Generators using Moth Flow Optimization


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## Abstract


The power grid, one of the most crucial components of smart cities, faces significant challenges in operating efficiently, dependably, and economically. One of these challenges is forecasting the demand for electricity. Grid managers can balance supply and demand properly while also minimizing operating expenses for generating and transmitting power. Thanks to accurate forecasts, while maintaining respectable system performance in terms of the limitations on the actual and reactive power output of the generator, bus voltages, shunt capacitors and reactors, transformer tap setting, and transmission line power flow. For a sustainable future and to meet the higher carbon emission standards that are being put in place, it is expected that the renewable energy sector will experience enormous development. The placement of wind turbines in a wind farm requires the use of evolutionary algorithms and power system optimization issues because the wake effect caused by upstream turbines impacts the output of downstream turbines, consequently diminishing the total power output from the wind farm. The current study using MFO determines a cost of $ 3160.0824 $/h for minimizing the cost of multiple fuels, which turns out to be the best price when compared to the legitimate results obtained by other algorithms. It results in a cost savings of 1.45% per hour when compared to the worst alternatives given by the comparison algorithm. According to simulation results on the IEEE 30-bus network with six generators, this approach might offer the best solution right away. A further study found that this method works best for medium-scale power installations.


## 1 Introduction

Conventional optimization techniques have frequently been used to resolve the Optimal Power Flow (OPF) problem. The optimal efficiency of electricity flow is hindered by (i) the enormous complexity of power systems and (ii) a lack of domain-dependent power system engineers' competence. The first obstacle is overcome by sequential linearization-based numerical optimization methods that leverage the first and second derivations of objective functions as search axes, as well as by linear programming methods for grey models [1]. The benefits of such techniques are based on their mathematical foundations; nevertheless, drawbacks include issue formulation susceptibility, algorithm selection, and a propensity to converge to local minima [2]. In circumstances when rule completeness is not achievable, the second barrier, insufficient domain knowledge, prohibits expert systems from being deployed reliably. Traditional methodologies for planning, running, and regulating contemporary electrical power networks encounter growing obstacles as they become increasingly sophisticated. Intelligent technologies have been developed and implemented to address issues in such complex power networks. However, it has become vital for energy suppliers to include this limitation as one of the primary goals that must be addressed alongside the cost problem. As a result, we are struggling to accomplish several objectives. Reference [3] addresses the issue of economic load dispatch within the constraints of the environment over a multi-hour time horizon by first reducing SO2 and NOx fuel consumption costs and then reducing emission rates. In reference [4], a cost-cutting problem is solved by using quadratic programming to model environmental constraints as linear inequalities. The passive constraints that have an indirect impact on this function are only retained in their soft limits only after the Genetic Algorithm or evolutionary programming has converged [5]. While bearing in mind that power losses account for 2% of overall power usage, the best parameter configuration is sought. During the load flow