



Applicability of MMKE alongside statistical assessment in RESs and SVC-based power networks to solve the ORPD problem in load-varying scenarios

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Abstract

This paper attempts to solve the optimal reactive power dispatch (ORPD) problem on an IEEE 30-bus and IEEE 118 bus experimental networks. The traditional network is first countered, and then renewable energy sources including solar photovoltaic (PV) sources, wind power (WP), and tidal power (TP) are integrated with the traditional network. Both single and multiple type objective functions are investigated in this work. Lessening active power loss (APL), reducing the voltage stability index, lowering aggregated voltage deviation (AVD), and concurrently lowering AVD and APL are among the objectives. There are twenty two cases altogether between the three test modules. In conjunction with the test setup, SVC is being used in Cases 5–8, Cases 13–16 and Cases 20–22. The objectives have been accomplished by the application of the MMKE method, whose performance has been compared to that of other optimization algorithms documented in recent ORPD studies. The study includes situations with both constant load demand and uncertainly fluctuating load demand. The unknown WP, PV power, TP, and load demand are all estimated using the appropriate probability density functions. Monte Carlo simulations are used to develop uncertain scenarios with variable load demand, wind speed, solar irradiance, and tidal discharge rate. The number of scenarios is then whittled down to a reasonable quantity that does, in fact, reflect real-world circumstances using the backward reduction algorithm. The experiment results demonstrate that the MMKE can solve ORPD difficulties far more effectively than the optimization techniques found in the most recent ORPD literature, based on a variety of analysed instances. The Friedman test has been employed to statistically validate the effective performance of MMKE. A noteworthy result in the ORPD problem is that the application of SVC enhances power network performance.

Keywords Friedman test · Multi-trial vector based monkey king evolution (MMKE) · Optimal reactive power dispatch (ORPD) · Renewable energy sources (RESs) · Static VAR compensator (SVC)

Abbreviations

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ORPD	Optimal reactive power dispatch
MMKE	Multi-trial vector based monkey king evolution
BRA	Backward reduction algorithm
PV	Photo voltaic
TP	Tidal power
OFs	Objective functions
PDF	Probability density functions
WS	Wind speed
ι	Scale factor for wind speed PDF
χ	Shape factor for wind speed PDF
v_{in}	Turbine's cut-in speed
v_r	Turbine's rated speed
v_{out}	Turbine's cut-out speed
P_{wr}	Rated output of the wind turbine

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