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ORIGINAL ARTICLE

Developing a strategy based on weighted mean of vectors (INFO) optimizer for optimal power flow considering uncertainty of renewable energy generation

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Abstract

In recent years, more efforts have been exerted to increase the level of renewable energy sources (RESs) in the energy mix in many countries to mitigate the dangerous effects of greenhouse gases emissions. However, because of their stochastic nature, most RESs pose some operational and planning challenges to power systems. One of these challenges is the complexity of solving the optimal power flow (OPF) problem in existing RESs. This study proposes an OPF model that has three different sources of renewable energy: wind, solar, and combined solar and small-hydro sources in addition to the conventional thermal power. Three probability density functions (PDF), namely lognormal, Weibull, and Gumbel, are employed to determine available solar, wind, and small-hydro output powers, respectively. Many meta-heuristic optimization algorithms have been applied for solving OPF problem in the presence of RESs. In this work, a new meta-heuristic algorithm, weighted mean of vectors (INFO), is employed for solving the OPF problem in two adjusted standard IEEE power systems (30 and 57 buses). It is simulated by MATLAB software in different theoretical and practical cases to test its validity in solving the OPF problem of the adjusted power systems. The results of the applied simulation cases in this work show that INFO has better performance results in minimizing total generation cost and reducing convergence time among other algorithms.

Keywords Optimal power flow · Renewable energy sources · Uncertainty modeling · INFO algorithm

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List of symbols

C_{FF}	The cost of fossil fuel
a_i, b_i, and c_i	ith TPG's cost coefficients
$P_{TG,i}$	ith TPG's output power
N_{TG}	Number of TPGs
d_i and e_i	Valve-point loading coefficients
$P_{TG,i}^{min}$	ith TPG's minimum power
C_{wd}	The direct cost of wind power
P_{ws}	WPG's scheduled output power
g_w	WPG's direct cost coefficient
C_{sd}	SPG's direct cost
P_{ss}	SPG's scheduled output power
h_s	SPG's direct cost coefficient
C_{shd}	SHPG's direct cost
$P_{ssh,s}$	Scheduled output power from the SPG in the combined SHPG
$P_{ssh,h}$	Scheduled output power from the small-hydro unit in the combined SHPG
m_h	Direct cost coefficient from small-hydro unit