Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 89 (2016) 69 – 77

Energy Procedia

CoE on Sustainable Energy System (Thai-Japan), Faculty of Engineering,
Rajamangala University of Technology Thanyaburi (RMUTT), Thailand

Optimal photovoltaic placement by self-organizing hierarchical binary particle swarm optimization in distribution systems

N. Phuangpornpitak[a,*], S. Tia[b]

[a] *Department of Electrical and Computer Engineering, Faculty of Science and Engineering, Kasetsart University, Chalermphrakiat Sakonnakhon Province Campus, Sakonnakhon 47000 Thailand*

[b] *Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangmod, Bangkok 10140 Thailand*

Abstract

The novel method of BPSO is proposed for solving optimal number and size of photovoltaic (PV) units on a radius distribution system. For the optimal number of PV unit problem, the SHBPSO is used to obtain quick convergence and explore solution space in the new direction. For the problem of the optimal sizes of PV units, the proposed method is used to avoid a local optimum trap. Multiple grid-connected PV units are considered. The SHBPSO can find better locations and sizes than other methods such as the classical BPSO, the BPSO with inertia weight, the BPSO with acceleration coefficients and the BPSO with sigmoid increasing inertia weight on the radial distribution system. The results including the active power of PV supplies injected into the system and total yearly power loss reduction are analyzed.

Peer-review under responsibility of the organizing committee of the 12th EMSES 2015

Keywords: Distributed generation; Optimal PV placement; Optimization; Photovoltaic; Renewable energy; Sustainable development

* Corresponding author. Tel.: +66-42-725-042 ext. 3409; fax: +66-42-725-034.
E-mail address: napaporn.ph@ku.ac.th.

Peer-review under responsibility of the organizing committee of the 12th EMSES 2015
doi:10.1016/j.egypro.2016.05.009

Nomenclature

$C_{g,f}$	Final value of social acceleration coefficient
$C_{g,i}$	Initial value of social acceleration coefficient
$C_{p,f}$	Final value of cognitive acceleration coefficient
$C_{p,i}$	Initial value of cognitive acceleration coefficient
$g_{i,pop}^{k}$	Probability value of the global best particle
gen	Maximum number of generations to run
G_{best}	Global best of the group
k	Iteration
$k_{\max}$	Maximum iteration limit
$Loss_k$	Distribution loss at section k
n	Constant to set partition of sigmoid function
N_{SC}	Total number of sections
$p_{i,pop}^{k}$	Probability value of the best position of particle i
P_{best_i}	Personal best of particle i
$P_{D,i}$	Real power demand (MW)
$P_{PV,i}$	Real power generation of PV (MW)
P_i	Net real power injection (MW)
P_{loss}	Power loss in the system (MW)
Q_i	Net reactive power injection (MVAR)
R	Chosen number between 1 and 10
R_1, R_2, R_3, R_4, R_5	Random numbers between 0 and 1
u	Constant to adjacent sharpness of the function
$v_{i,pop}^{k}$	Probability velocity of particle i
V_i	Voltage at bus i (kV)
w	Weighting function
x_d	Position of particle on the d^{th} dimension
$x_{i,pop}^{k}$	Probability value of the position of particle i
δ_i	Angle at bus i (rad)