Chapter 4
Ant Colony Optimization Algorithm for Electrical Power Systems Applications:
A Literature Review

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ABSTRACT

Optimization has been an active area of research for several decades. As many real-world optimization problems become increasingly complex, better optimization algorithms are always needed. Recently, meta-heuristic global optimization algorithms have become a popular choice for solving complex and intricate problems, which are otherwise difficult to solve by traditional methods. This chapter reviews the recent applications of ant colony optimization (ACO) algorithm in the field of electrical power systems. Also, the progress of the ACO algorithm and its recent developments are discussed. This chapter covers the aspects like (1) basics of ACO algorithm, (2) progress of ACO algorithm, (3) classification of electrical power system applications, and (4) future of ACO for modern power systems application.

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Box. List of symbols

Symbol	**Definition**
τ_{ij}	pheromone trail deposit ed between city *i* and *j* by ant *k*,
α and β	two parameters which influence the relative weight of pheromone trail and heuristic guide function,
η_{ij}	visibility or sight and equal to the inverse of the distance or (= $1/d_{ij}$).
η_{ij}	transition cost between city *i* and *j*
q	cities that will be visited after city *i*,
N_i^k	a tabu list in the memory of ant that recodes the cities visited to avoid stagnations
$\tau_{ij}(t+1)$	pheromone after one tour or iteration
ρ	pheromone evaporation
ε	elite path weighting constant
$\tau_o = 1/d_{ij}$	incremental value of pheromone of each ant
λ	large positive constant
d_{best}	shortest tour distance.
P_{gj} and Q_{gj}	active/reactive power outputs from the generator bus *j*
P_{dj} and Q_{dj}	active and reactive power demand at bus *j*,
V_i and V_j	voltages at sending end *i* and receiving end *j*,
Y_{ij} and θ_{ij}	admittance magnitude and angle between buses *i* and *j*
δ_i and δ_j	phase angles of voltages at buses *i* and *j*,
P_{DGj} and Q_{DGj}	active and reactive power injections at location *j*,
QCj	the reactive power injection at location *j*.
VSI_j	the voltage stability index of bus *j*,
Vi,	the voltage magnitude of sending end bus *i*
P_j and Q_j	the total active and reactive power load fed through bus *j*,
R_{ij} and X_{ij}	the resistance and reactance of the line connected buses *i* and *j*, respectively.
w_1, w_2 and w_3	weighting factors.
P_{Loss}	the total real power loss
P_i and Q_i	the net active and reactive power at bus *i*,
N_b	the system buses number.
R_{ij}	line resistance between buses *i* and *j*,
VD	total voltage deviation
VSI	voltage stability index
G_{ij} and B_{ij}	mutual conductance and susceptance between bus *i* and *j*,
N_{PQ}	load buses number
P_{L_i} and Q_{L_i}	active and reactive power demand at bus i
Q_{C_i}	capacitive or inductive power of existing VAR source installed at bus *i*.
N_{pv}	total number of voltage-controlled buses;
T_k	tapping change of a transformer
N_t	total number of on-load tap changing transformers.

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