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Optimal power generation for wind-hydro-thermal system using meta-heuristic algorithms

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ABSTRACT

In this paper, cuckoo search algorithm (CSA) is suggested for determining optimal operation parameters of the combined wind turbine and hydrothermal system (CWHTS) in order to minimize total fuel cost of all operating thermal power plants while all constraints of plants and system are exactly satisfied. In addition to CSA, Particle swarm optimization (PSO), PSO with constriction factor and inertia weight factor (FCIW-PSO) and social ski-driver (SSD) are also implemented for comparisons. The CWHTS is optimally scheduled over twenty-four one-hour interval and total cost of producing power energy is employed for comparison. Via numerical results and graphical results, it indicates CSA can reach much better results than other ones in terms of lower total cost, higher success rate and faster search process. Consequently, the conclusion is confirmed that CSA is a very efficient method for the problem of determining optimal operation parameters of CWHTS.

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NOMENCLATURE

N_{tp}	Number of thermal units
N_{in}	Number of scheduled intervals
k_i, m_i, n_i	Coefficient of fuel cost function
$PT_{i,j}$, $PH_{k,j}$, $PW_{w,j}$	Generation of the *ith* thermal unit, the *kth* hydro unit and the *wth* wind turbine at the jth interval
N_{tp}, N_{hp}, N_{wt}, N_{in}	Number of thermal units, hydro units, wind turbines and intervals.
$P_{load,j}$, $P_{loss,j}$	Power of load and loss at the *jth* interval
PW_w, $PW_{w,rate}$	Generation and rated generation of the *wth* wind turbine
WV, WV_{rate}, $WV_{cut\text{-}in}$, $WV_{cut\text{-}out}$	Wind speed, rated wind speed, cut-in speed and cut-out speed
$PW_{w,min}$, $PW_{w,max}$	Minimum and maximum generation of the *wth* wind turbine
X_k, Y_k, Z_k	coefficients of the *kth* hydro unit's generation
$Q_{k,min}$, $Q_{k,max}$	Minimum and maximum discharge of the *kth* hydro unit
$Q_{k,j}$	Discharge of the *kth* hydro unit at the jth interval
$W_{avai,k}$	available water for power generation over the scheduled intervals