A Harris hawks optimization based single- and multi objective optimal power flow considering environmental emission

ABSTRACT

The electric sector is majorly concerned about the greenhouse and non-greenhouse gas emissions generated from both conventional and renewable energy sources, as this is becoming a major issue globally. Thus, the utilities must adhere to certain environmental guidelines for sustainable power generation. Therefore, this paper presents a novel nature-inspired and population-based Harris Hawks Optimization (HHO) methodology for controlling the emissions from thermal generating sources by solving single and multi-objective Optimal Power Flow (OPF) problems. The OPF is a non-linear, non-convex, constrained optimization problem that primarily aims to minimize the fitness function by satisfying the equality and inequality constraints of the system. The cooperative behavior and dynamic chasing patterns of hawks to pounce on escaping prey is modeled mathematically to minimize the objective function. In this paper, fuel cost, real power loss and environment emissions are regarded as single and multi-objective functions for optimal adjustments of power system control variables. The different conflicting framed multi-objective functions have been solved using weighted sums using a no-preference method. The presented method is coded using MATLAB software and an IEEE (Institute of Electrical and Electronics Engineers) 30-bus. The system was used to demonstrate the effectiveness of selective objectives. The obtained results are compared with the other Artificial Intelligence (AI) techniques such as the Whale Optimization Algorithm (WOA), the Salp Swarm Algorithm (SSA), Moth Flame (MF) and Glow Warm Optimization (GWO). Additionally, the study on placement of Distributed Generation (DG) reveals that the system losses and emissions are reduced by an amount of 9.8355% and 26.2%, respectively.

Keyword: Harris hawk optimization (HHO); Optimal power flow (OPF); Salp swarm algorithm (SSA); Whale optimization algorithm (WOA)