Improved opposition-based particle swarm optimization algorithm for global optimization

ABSTRACT

Particle Swarm Optimization (PSO) has been widely used to solve various types of optimization problems. An efficient algorithm must have symmetry of information between participating entities. Enhancing algorithm efficiency relative to the symmetric concept is a critical challenge in the field of information security. PSO also becomes trapped into local optima similarly to other nature-inspired algorithms. The literature depicts that in order to solve pre-mature convergence for PSO algorithms, researchers have adopted various parameters such as population initialization and inertia weight that can provide excellent results with respect to real world problems. This study proposed two newly improved variants of PSO termed Threefry with opposition-based PSO ranked inertia weight (ORIW-PSO-TF) and Philox with opposition-based PSO ranked inertia weight (ORIW-PSO-P) (ORIW-PSO-P). In the proposed variants, we incorporated three novel modifications: (1) pseudo-random sequence Threefry and Philox utilization for the initialization of population; (2) increased population diversity opposition-based learning is used; and (3) a novel introduction of opposition-based rank-based inertia weight to amplify the execution of standard PSO for the acceleration of the convergence speed. The proposed variants are examined on sixteen bench mark test functions and compared with conventional approaches. Similarly, statistical tests are also applied on the simulation results in order to obtain an accurate level of significance. Both proposed variants show highest performance on the stated benchmark functions over the standard approaches. In addition to this, the proposed variants ORIW-PSO-P and ORIW-PSO-P have been examined with respect to training of the artificial neural network (ANN). We have performed experiments using fifteen benchmark datasets obtained and applied from the repository of UCI. Simulation results have shown that the training of an ANN with ORIW-PSO-P and ORIW-PSO-P algorithms provides the best results than compared to traditional methodologies. All the observations from our simulations conclude that the proposed ASOA is superior to conventional optimizers. In addition, the results of our study predict how the proposed opposition-based method profoundly impacts diversity and convergence.