Improving particle swarm optimization via adaptive switching asynchronous – synchronous update

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ABSTRACT

Particle swarm optimization (PSO) is a population-based metaheuristic optimization algorithm that solves a problem through iterative operations. Traditional PSO iteration strategies can be categorized into two groups: synchronous (S-PSO) or asynchronous (A-PSO) update. In S-PSO, the performance of the entire swarm is evaluated before the particles' velocities and positions are updated, whereas in A-PSO, each particle's velocity and position are updated immediately after an individual's performance is evaluated. Previous research claimed that S-PSO is better in exploitation and has fast convergence, whereas A-PSO converges at a slower rate and is stronger at exploration. Exploration and exploitation are important in ensuring good performance for any population-based metaheuristic. In this paper, an adaptive switching PSO (Switch-PSO) algorithm that uses a hybrid update sequence is proposed. The iteration strategy in Switch-PSO is adaptively switched between the two traditional iteration strategies according to the performance of the swarm's best member. The performance of Switch-PSO is compared with existing S-PSO, A-PSO and three state-of-the-art PSO algorithms using CEC2014's benchmark functions. The results show that Switch-PSO achieves superior performance in comparison to the other algorithms. Switch-PSO is then applied for infinite impulse response model identification, where Switch-PSO is found to rank the best among all the algorithms applied.

KEYWORDS:

Asynchronous; Diversity; Iteration strategy; Particle swarm optimization; Synchronous