International Journal of Swarm Intelligence Research
Volume 14 • Issue 1

Learning Sparrow Algorithm With Non-Uniform Search for Global Optimization

Yifu Chen, School of Information Engineering, Jiangxi University of Science and Technology, Ganzhou, China
Jun Li, School of Artificial Intelligence, Jiangxi University of Applied Science, Nanchang, China
Lin Zhang, School of Software Engineering, Jiangxi University of Science and Technology, Nanchang, China*

ABSTRACT

Sparrow Algorithm as a New Swarm Intelligence Search Algorithm, the sparrow algorithm has good optimization ability, but in complex environments, it still has certain limitations, such as weak learning ability. Therefore, this paper proposes a learning sparrow search algorithm for non-uniform search(Sparrow search algorithm with non-uniform search, NSSSA). A learning behavior selection strategy is proposed, and saltation learning and a random walk learning are introduced respectively. To a certain extent, the algorithm avoided alling into the local optimum, and a non-uniform variable spiral search is proposed to balance the development and search capabilities of the algorithm. In the experimental simulation, the effectiveness of the NSSSA algorithm is verified by using the benchmark function, and it is tested on the CEC 2013 test set. Compared with the algorithms with better performance in recent years, the results show that the NSSSA algorithm has better universality . Finally, the NSSSA algorithm is applied to the WSN coverage optimization problem. The results show that NSSSA achieves more than 90% and 96% coverage on the two models of 50×50 and 100×100, respectively, which verifies the practicability of the algorithm.

KEYWORDS

CEC 2013, Non-Uniform Spiral Search, Random Walk Learning, Saltation Learning, Sparrow Search Algorithm, WSN

1. INTRODUCTION

In nature, all kinds of organisms have their behavior strategie0d ways in the process of evolution. Inspired by these phenomena, people put forward many new methods and concepts to solve practical problems. The swarm intelligence optimization algorithm is an evolutionary algorithm of random search. The main idea is to simulate the foraging behavior of group creatures, such as fish schools, bird groups, and wolves. They will search for food in a cooperative way and constantly exchange food in the process. information to get more quality food as quickly as possible. Swarm intelligence has strong robustness, and the interacting individuals in the group are distributed, have no direct

DOI: 10.4018/IJSIR.315636
*Corresponding Author

control center, and will not affect the solution of the problem due to the failure of a small number of individuals. The structure is simple and easy to implement, each individual can only perceive local information, and the rules that individuals follow are simple.Many classical algorithms such as particle swarm optimization (PSO) (Kennedy, James, and Russell C. Eberhart, 1997), Grey wolf optimization algorithm (GWO) (Mirjalili et al., 2014), ant colony algorithm (ACO)(Dorigo M et al., 2006), whale optimization algorithm (WOA) (Mirjalili S et al., 2016), and beetle antennae search algorithm(BAS)(Jiang X and Li S, 2017). They have been successfully applied in path planning (Wu Q et al., 2019), nonlinear control (Khan A H., 2019), image processing (Maitra M and Chatterjee A, 2008), and other fields.

The Sparrow Search Algorithm (SSA) is a new swarm intelligence optimization algorithm proposed in 2020 (Xue J and Shen B, 2020), Its principle is simple, the parameters are few, and the convergence speed is fast. It is more efficient than PSO, GWO, CO, and other algorithms in function optimization. Advantage. At present, SSA is also widely used in many practical engineering problems, such as vibration classification of rheostat transformers (Wu Y, 2021;Wang H and Xianyu J, 2021), flexible traction power supply systems (FTPSS) (Chen M et al., 2021), maximum power problems in the photovoltaic system(Zafar M H et al., 2021), the multi-objective problem of heater(Sukpancharoen S, 2021), prediction of water quality parameters in rivers (Song C et al., 2021), prediction of carbon price (Zhou J and Chen D, 2021;Zhou J and Wang S, 2021), Noise removal of measurement signals for concrete face rock fill dams (Xu L et al.2021), strength prediction of reinforced concrete(Li G et al.2021) bearing fault diagnosis (Xing Z et al., 2021), diabetes prediction (Wang Y and Tuo J, 2020).

However, it also has its shortcomings. For example, in the face of high-dimensional and complex problems, the optimization process always relies on a certain role, which reduces the learning ability of the algorithm and falls into a local optimum; on the other hand, there are more random parameters in the algorithm, resulting in the results being contingent.

In order to improve the above-mentioned defects of SSA, scholars have also proposed some schemes to improve the optimization effect of SSA. Liu et al. (2021) used the chaotic mapping strategy to initialize the population to make the population distribution more uniform, and then introduced and reintroduced the development and search capabilities of the adaptive thought balancing algorithm, and finally introduced Gaussian mutation to prevent the algorithm from stagnant.It is applied to three-dimensional UAV path planning, and good results are obtained.Liang et al. (2021)used the homogeneous chaotic system to provide adequate preparation for the algorithm optimization, also used the adaptive idea to improve the algorithm optimization ability, and finally proposed an improved boundary processing method to make the search scope more reasonable and effective. When it is applied to the antenna matrix problem, its optimization effect is more advantageous. Song et al.(2020) proposed chaos initialization population is a skewed tent, promoted the exploration and development of space with non-linear decreasing weight, and finally used mutation strategy and chaos search to update the poor and better individuals simultaneously, balancing the searchability of the algorithm. Wang et al.(2021) used Bernoulli chaos to initialize the population, a dynamic adaptive parameter adjustment algorithm to optimize, Then use the reverse learning strategy and the Cauchy mutation strategy to prevent the algorithm from stagnating. Apply the improved algorithm to the microgrid cluster with good results.Yuan et al.(2021)The population is initialized by using the center of gravity reverse learning, so that the individual distribution in the population is more uniform, and the global vision of the algorithm is opened up. Then the learning factor is proposed to speed up the information exchange between the populations. Finally, the mutation strategy is used to reduce the algorithm from falling into the local optimum. The probability. The improved algorithm is applied to maximum power point tracking (DMPPT), which has a better stability.Lei et al.(2020) uses Levy flight to improve the flexibility of the sparrow search algorithm and to apply it to positioning problems in wireless sensor networks, which has a good effect. In addition, Liu et al.(2021) have applied it to the diagnosis of diseases with good diagnostic results.Zhang et al.(2021)introduced the sine-cosine search algorithm and proposed a cooperative idea, which can be applied to the adaptive enhancement classifier with

Related Content