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A Novel Searching Strategy - Shuffled Frog Leaping Algorithm

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ABSTRACT

Shuffled frog leaping algorithm is a memetic meta-heuristic and population based intelligent inquiry metaphor impacted by normal memetics. Predominantly SFLA has been utilized for arrangement of combinative streamlining issues. In SFL algorithm there are two basic things one is population which is divided into several memeplexes and another is information between these memeplexes has been exchanged. In Shuffled frog leaping algorithm various issue are available like slow convergence, stuck at local minima etc. To resolve these problems various technologies are used.

Keywords: *Shuffled Frog Leaping Algorithm, Memetic, Memeplex.*

INTRODUCTION

Nature-inspired algorithms (NIAs) are algorithms, which takes acutation from nature. These type of algorithms are used to resolve divergent complex real world problems, whose definite clarification doesn't exist. Swarm intelligence based algorithms are basically based on swarms e.g. particle swarm optimization (PSO), artificial bee colony algorithm (ABC), shuffled frog leaping algorithm (SFLA) and bacterial foraging algorithm (BFO) etc. Shuffled Frog Leaping Algorithm is a swarm intelligence based algorithm. In SFLA frogs are divided into meme that inspired from the foraging behaviour of frogs. In SFLA, population (frogs) is divided into several memeplexes. In SFLA frogs exchange their memes with other frogs by using memetic evolution procedure. That memetic evolution procedure helps to improve the performance of individual frog towards its global optimum solution. Basic SFLA coincide slowly at the last stage and easily falls into local minima. So for improvement in basic SFLA, various modifications and technologies are used.

BASIC SHUFFLED FROG LEAPING ALGORITHM

Shuffled Frog Leaping Algorithm is right off the bat created by Eusuff and Lansey in 2003. Shuffled Frog Leaping Algorithm is mainly used for solving combinatorial optimization problems. SFLA is a population based cooperative search metaphor which is inspired as a result of foraging behaviour of frogs. In SFLA worst solution is updated by local best solution, global best solution or frogs are randomly initialize in search space. A shuffling is a good approach which is used for exchanging thoughts among local searchers with the purpose of leads them toward a global optimum. A pseudo code of shuffled Frog Leaping Algorithm is described in algorithm is as follows:

1) Firstly, we set initial values such as size of the population (frogs) N, the number of memeplexes M, the number frogs in each memeplexes F and maximum number of iterations;
2) For each individual frog, calculate objective value and sort the population N in the descending order of their objective value;
3) After this, we divide N population into M memeplexes;

4) for each memeplex: do
5) Calculate triangular probability distribution using Eq.(1);

Prob(j)=2(n + 1 − j)/(n(n+1)) (1)

where j = 1, ..., n, represents rank of frogs within the memeplex, n is the total population of the swarm.

6) Sort the frogs in the descending order of their probability and elect the best and worst frogs;
7) After this, improve the worst frog position using Eq.(2) with respect local best frog;

Unew = PW + R(0, 1) × (PLB − PW) (2)
if Unew < Pw then;
Pnew = Unew
else

If worst frog position is not improved by local best frog then we update worst frog position by using Eq.(3)with respect global best frog;
Unew = PW + R(0, 1) × (PGB − PW) (3)
if Unew < Pw then
Pw = Unew
else
censorship = true
end if
end if
Repeat for a specific number of iteration;
end for
Combine the evolved memeplexes and sort the population N according to their objective value
Check if termination condition is true then stop, otherwise partition the frogs into the memeplexes;

REVIEWS ON SHUFFLED FROG LEAPING ALGORITHM-

An Efficient Shuffled Frog Leaping Algorithm for Clustering of Gene Expression Data-Shuffled frog-leaping algorithm is an evolutionary algorithm, which uses a stochastic search method that mimics natural biological evolution and the social deeds of species. These evolutionary algorithms are developed to find a new optimum solution for optimization problems that cannot be solved by gradient based mathematical methods. The generation of frog leaping algorithm is drawn from two other search techniques: the local search of the particle swarm optimization and the competitiveness mixing of information of the shuffled complex evolution technique. Then introduces a new parameter for acceleration of searching into the formulation of the original shuffled frog leaping algorithm to create a modified form of the algorithm for effective clustering of gene expression data.

An improved Shuffled Frog Leaping Algorithm with a fast Search Strategy for Optimization Problems-Several evolutionary algorithms (EAs) are proposed to solve continuous optimisation problems. In this paper we present a new search strategy to improve the efficiency of the Shuffled Frog Leaping Algorithm (SFLA). The shuffled frog leaping algorithm is a population-based approach for a heuristic search in optimization problems. The algorithm consists of a set of virtual frogs partitioned into several groups called “memeplexes”. However, after some optimization runs frogs position's become closer in each memeplex. Indeed, this problem leads to a premature convergence. For getting better efficiency we propose a novel search strategy by infecting not only the worst individual but also the best individual ideas. To further improve the speed of convergence of the algorithm, we have introduced two acceleration factors in the search strategy formulation. The proposed algorithm has been evaluated on five mathematical benchmark functions. Compared with the original SFLA and the particle swarm optimization algorithm, the experimental results in terms of optimization performance and the speed of convergence shows that the proposed algorithm can be an effective tool for solving combinatorial optimization problems.

A fast Shuffled Frog Leaping Algorithm: Because of the weaknesses of the shuffled frog leaping algorithm (SFLA) for optimizing some functions such as a low optimization precision, a slow speed, and trapping into the local optimum easily, etc., a fast shuffled frog leaping algorithm (FSFLA) is proposed. At first, each individual of subgroups learns from the group extreme and the subgroup extreme when it is updated by the update strategy. Its boundaries are controlled by the “hit-wall” method. Secondly, the speed of this algorithm is improved by means of sorting and grouping all individuals at a regular interval. Then, in order to keep most individuals and take full advantages of the useful information in the population, a small number of individuals are randomly generated. By comparing and analyzing the experimental results of several standard test functions, the high convergence precision and fast speed of the FSFLA are validated.

Directional Shuffled Frog Leaping Algorithm: Shuffled frog leaping algorithm is one of the popular used optimization algorithms. This algorithm includes the local search and global search two solving modes, but in this method only the worst frog from divided group is considered for improving location. In this paper, we propose a directional shuffled frog leaping algorithm (DSFLA) by introducing the directional updating and real-time interacting concepts. A direction flag is set for a frog before moving, if the frog goes better in a certain direction, it will get better in a big probability by moving a little further along that direction. The movement counter is set for preventing the frog move forward infinite. Real-time interacting works by sharing the currently optimal positions from the other groups. There should have some similarities among the best ones, and the worst individual could be improved by using those similarities. The experimental results show that the proposed approach is a very effective method for solving test functions.

Chaotic Shuffled Frog Leaping Algorithms for Parameter Identification of Fractional-Order Chaotic Systems: An accurate mathematical model has a vital role in controlling and synchronisation of chaotic dynamic systems. In this technique a shuffled frog leaping (SFL) algorithm and two chaotic versions of it to detect the unknown parameters and orders of chaotic models. The SFL by a grouping search strategy can provide a good exploration of search space. Also an independent local search for each group in this algorithm provides a proper exploitation ability. In the current research, to help the SFL to jump out of the likely local optima and to provide a better stochastic property to increase its convergence rate and resulting precision, the chaotic mapping is incorporated with the SFL. The superiority of the proposed algorithms is investigated on parameter identification of several typical fractional-order chaotic systems. Numerical simulation, comparisons with some typical existing algorithms and non-parametric analysis of obtained results show that the proposed methods have effective and robust performance. A considerably better performance of proposed algorithms based on average of objective functions demonstrates that the proposed idea can evolve robustness and consistence of SFL.

Improved Shuffled Frog Leaping Algorithm by using Orthogonal Experimental Design-In Shuffled Frog Leaping Algorithm (SFLA), the worst frog' position is improved based on the experiences of the best local or global frog, in two steps separately. In this Algorithm, discovering more useful information of previous search experience through designing learning strategies is a challenging research. While each of these experiences may has better value on some dimensions, the other one may has better value due on some others. Hence, an orthogonal learning (OL) strategy as a learning strategy is proposed that combines good dimensions of them by orthogonal experimental design (OED). Combined dimensions' values form a more efficient guidance vector to guide the worst frogs leaping to global best area. This modified SFLA is introduced as Orthogonal Learning Shuffled Frog Leaping Algorithm (OLSFLA). The proposed strategy is evaluated on a set of 13 benchmark functions including unimodal and multimodal. Results confirm that this strategy in most of the time improves the performance of SFLA, offering faster global convergence, higher solution quality in comparison with some SFLA.

CONCLUSION

This paper described study of various techniques on SFLA, a memetic meta-heuristic to solve combinatorial optimization problems. A memetic algorithm is a population-based approach for heuristic search. The SFLA starts with a sample virtual population of frogs, leaping in a swamp, searching for the optimum location of food. Frogs act as hosts of memes. A meme is considered as a unit of ideas or Cultural Revolution. Each meme consists of memo type(s). During the memetic evolution the memes of the frogs are changed, resulting in a change in their position towards the goal. The change in or evolution of memes occurs when the frogs are infected by other better ideas. The SFLA is quite general but relies strongly on suitable model parameters.

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