LSHADE Enhancement Using MTS-LS1

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Abstract— **Differential Evolution (DE) has been considered as an effective approach for solving numerical optimization problems. Due to different characteristics of optimization problems, many proposed algorithms try to perform consistently over a range of problems. The proposed algorithm combines both LSHADE and MTS-LS1 by giving both a participation ratio of the fitness evaluation where each technique works until finishing its participation budget or reaching the optimum solution. Using hybrid model gives an opportunity to achieve better performance for both algorithms. The evaluation of this algorithm has been tested using CEC 2014 benchmark problems.**

Keywords— evolutionary algorithms, differential evolution, single objective optimization.

I. Introduction

High-level relay hybrid (HRH) is introduced by Talbi [2], he tries to classify hybrid metaheuristics from which four basic hybridization strategies can be derived; First; low-level relay hybrid (LRH), one metaheuristic is embedded into another single-solution metaheuristic. Second; high-level relay hybrid (HRH) in which two metaheuristics asynchronously executed. Third; low-level teamwork hybrid (LTH), in this class one metaheuristic is embedded into a population-based metaheuristic. The fourth class is high-level teamwork hybrid (HTH) where two metaheuristics are synchronously executed.[14]

Researchers propose many algorithms and compare it on several benchmarks of functions, with different performance depending on the problems. Therefore, a trial for combining different search strategies is supposed to be desirable to obtain the best performance of each of these techniques. However, there has been many researches in HRH or memetic models, combining different types of metaheuristics and DE is one of the evolutionary algorithms that has been hybridized using HRH.

Antonio LaTorre et al. propose a hybrid technique based on the MOS framework [14]. In this algorithm, the hybridization of local search with Differential Evolution algorithm (DE) helps this type of algorithms to avoid the stagnation problem and the DE let the local search be able to find promising regions with good fitness evaluations.

Another combination of Differential Evolution and the IPOP-CMAES algorithms is proposed by LaTorre et al.[17] where the hybrid algorithm based on the Multiple Offspring Sampling framework in which two meta heuristics algorithms are executed and the participation ratio of each algorithms is adjusted dynamically according to their performance.

An HRH approach is preferred than HTH since it gives the opportunity to each technique to use its amount of number of function evaluation in its own way instead of making all the techniques work on a population based scheme. Also, both algorithms is supposed to work in a better way when they are executed for a longer time and let them compete for a percent of the output population of each [14]. The proposed approach in this research belongs to HRH strategy, in which two combined algorithms are executed in sequence. In the proposed technique, LSHADE is combined with Local search 1 and they are executed in sequence.

This paper is organized as follows; after the introduction, section II is a state of the art in optimization algorithms especially differential evolution family and hybrid techniques. Section III describes the design of the proposed algorithm. The experimental results, and the analysis of those results, are presented in section IV. Finally, conclusions are given in section V.

II. Related Work

The objective of optimizing performance of a system is to find a set of parameter values under some conditions in which case the overall performance will be the best[15]. One approach for handling optimization problems is Differential Evolution (DE) which is simple and effective. Recent researches have been focusing on search efficiency and optimization performance.

Differential Evolution (DE) which is proposed by R. Storn and K. Price is a parallel direct search method that utilizes NP parameter vectors. DE main idea is a scheme for generating trial parameter vectors by adding a vector that represents the difference between two population individuals to a third individual. If the resulting vector has a lower objective function value than a predetermined population individual, the predecessor vector will be replaced in next generation.[1]

Several variants of DE have been proposed to achieve better optimization performance and to develop self-adaptive mechanisms. For example, A. K. Qin et al. present a self-adaptive DE (SaDE) in which the strategies of generating a trial vector and adapting control parameter values by learning from previously generated solutions. Therefore, the generation strategy that is more suitable and adaptation of its parameter settings match different phases of the search process. [7]

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