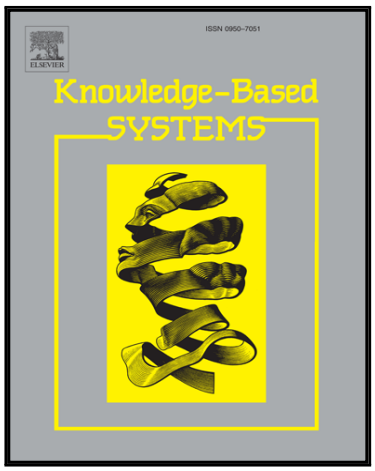

A Robust Memory Based Hybrid Differential Evolution for Continuous Optimization Problem

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A Robust Memory Based Hybrid Differential Evolution for Continuous Optimization Problem

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Abstract: A number of efficient variants of Differential Evolution (DE) and its hybrid have been suggested in recent years to deal with continuous optimization problems. However, recent past studies have indicated that the performance of such algorithms is largely affected by the choice of parameters e.g. mutation factor, crossover rate, mutation strategy and the type of crossover. A combination of these parameters may work out to be the best for a problem while resulting in poor performance for others. In general practice, during simulation DE does not employ any strategy of memorizing the so-far-best results obtained in the initial part of the previous generation. In this paper, a hybrid DE based on use of memory concept under the particle swarm optimization (PSO), called memory based DE (MBDE), is presented for the continuous optimization problems. The algorithm employs two newly operators namely *swarm mutation* and *swarm crossover*. These operators are properly balance exploration and exploitation and improving the convergence rate of the proposed algorithm. Experiments are conducted on a comprehensive set of benchmark functions and real life problems. The results of proposed MBDE are compared with state-of-the-art algorithms. Numerical, statistical and graphical analysis reveals the competency of the proposed MBDE.

Keywords: Differential Evolution, Mutation, Crossover, Elitism, Continuous optimization problem.

1. Introduction

Optimization plays an important role in our day-to-day life. It has wide range of applications such as economic load dispatch [1], model order reduction problem [2], nuclear reactor core design [3] multiproduct economic production quantity [4], network anomaly detection [5] and many others [6]. Over the years, various Evolutionary Algorithms (EAs) like DE [7], PSO [8], IFFO [9] and UCEA/D [10] have been developed to solve a variety of optimization problems.

Among all EAs, DE (Differential Evolution) attracted much attention as an effective approach for global optimization problems. The DE has many advantages like easy implementation, reasonably faster, robust and exhibits effective global search ability [6]. However, DE also has drawback as other intelligent algorithms, such as slower convergence rate and easy to drop into regional optimum [6]. Although DE has gotten success in diverse fields, but there is very limited theoretical understanding of how it works and why it performs well. In order to improve the performance of DE, a number of attempts are made in the literature. A detailed survey on the variants of DE can be found in [11, 12]. Moreover, to improve the robustness of DE, a number of mutation strategies of DE have been proposed in [13, 14, 15, 16]. Similarly, researchers mainly used two types of crossover in DE namely binomial and exponential crossover [7]. In [17], Price recommended the use of binomial crossover is better. But later, it is observed that there are no significant differences between these crossovers [18].

Unfortunately, according to 'No Free Lunch Theorem [19]', no single optimization method exist which is able to solve consistently to all global optimization problems. In spite of quite a good number of DE variants exist in the literature; DE further yields improved results while hybridizing with PSO (Particle Swarm Optimization) [8]. In recent past, many hybrid methods of DE and PSO have been proposed [20-31] and