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Differential Evolution – A diversity approach

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Abstract Insert your abstract here. Include keywords, PACS and mathematical subject classification numbers as needed.

Keywords Diversity · Differential Evolution · Evolutionary

1 Introduction

Evolutionary Algorithms (EAs) are built to deal with optimization problems, which are designed from many scientific and application fields, such as science, economic and engineering [1,2]. Principally, EAs can be classified into following categories, such as Genetic Algorithms (GAs) [3, 4] , Evolutionary Strategies (ESs) [5], Genetic Programming (GP) [6], Evolutionary Programing (EP) [7], Differential Evolution (DE) [8] and other natural-inspired algorithms [9]. DE was introduced by Storn and Price [8], also is cosidered as one of the most effective EAs used to deal with real-world optimization problems, mainly for its convergency properties. Similarly than with other EAs, DE follows the natural evolution process which involves mutation, recombination and selection to evolve a population throuth an iterative progress until the criteria stop is reached. However, the peculiarity of DE is that employs the difference of vectors parameters to explore the search space, being very similar than its precursor algorithms namely the Nelder-Mead [10] and the Controled Random Search (CRS) [11]. In spite of the popularity and effectiveness of DE, there exists several weakness that had been partially solved througth learning techniques. One of the first weakness and possibly the most important is that

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the performance of DE is very sensitive to choice of the strategy parameters depending in the objective function [12]. Several strategies as adaptive and self adaptive have been proposed to alliviate this drawback [13, 14]. However, none of these strategies has shown superior results than the rest.

A second weakness of DE algorithms resides in the reproduction phase. In DE this phase is involves the vector differences, therefore it depends on the content of the population affecting the search process, as result a limited number of solutions are produced. In fact, this issue can lead to converge into a local optima or lost of diverse solutions better known as premature convergence [15]. On the other hand, there exist situations where the search process could not progress and the population remains diverse, this phenomena is known as stagnation [16]. Its well known that stagnation ocurrs with small populations size. Although that large populations are not prone to stagnate, it involves more evaluation functions and in certain situations is not available a large population e.g. expensive optimization problems ref CEC.

The last one drawback is highly related with the diversity of the population. Generally speaking, the search process of all the EAs involves two process: exploration and intensification. A desirable behavior of an algorithm is to produce a proper balance between these two process. So that first it induces an exploration in the search space and after that an exploitation of the knowledge gathered during the search process [17]. Both exploration as exploitation are equally important, since that with a excessive exploitation, the population loses its diversity and the populations members can be located in a reduced sub-optimal region of the search space. On the other hand, if the exploration is dominant, the algorithm focus resources on uninteresting regions, resulting in too slow convergence and in poor quality-solutions. Principally, DE algorithms are ver likely to prematurely converge, since that introduce a high selection pressure [15].

To deal with the Once known the previous drawbacks, in this paper is proposed a novel DE algorithm, which is based in the classical DE scheme.

In our proposal is introduced a similar paradigm showed segura2016novel

The rest of the paper is organized as follows. In section .. is described a the classic DE. A brief revision of the last EAs is showed in section ... Our proposal based in diversity is described in the section ... In the section .. are showed the experimental results including some of the most popular EAs. Finally, out conclusions and some lines of future work are given in section ...

**Techniques to deal with this hybridization with anneling procedures to reduce the selection pressure ref37 **Generational replacement ref3. **Incrementing the population size ref19. **Organization of the paper.ss

2 Differential Evolution

*Fundamentals. - Fully description of Differential Evolution. —— Description of differential evolution. *Decription of the single-objective problem. *Explain each stage in DE. * *

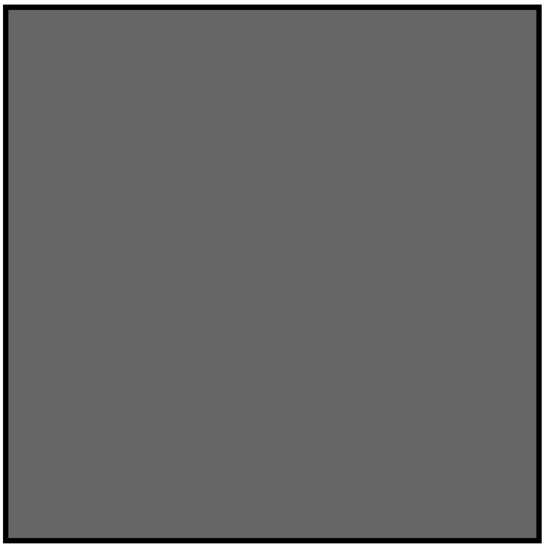

Fig. 1 Please write your figure caption here

——Diversity Revision *Explain the influence of the paramters. *Show the implication of these operators with the population diversity. *Talk about hybrid and adaptive strategies.

3 Differential Evolution Trends

4 Proposal

5 Experimental Study

6 Conclusion

6.1 Subsection title

as required. Don't forget to give each section and subsection a unique label (see Sect. **??**).

Paragraph headings Use paragraph headings as needed.

$$a^2 + b^2 = c^2 \tag{1}$$

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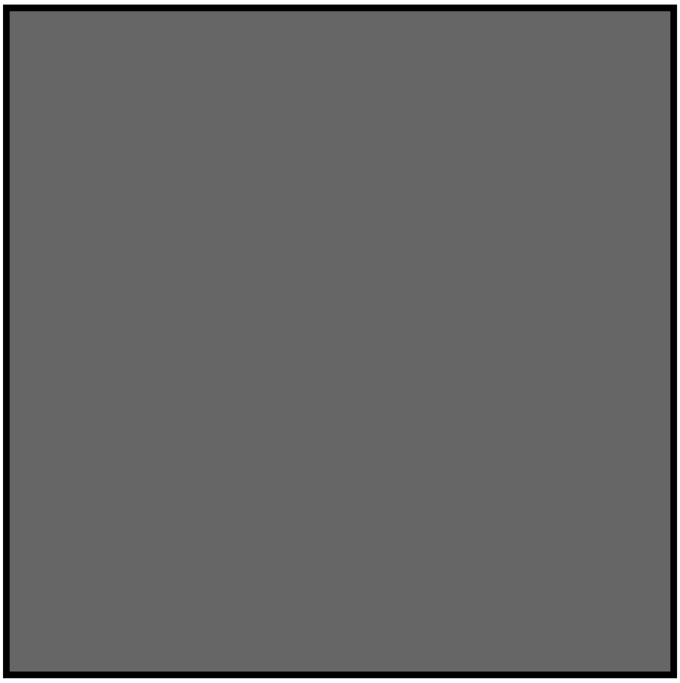

Fig. 2 Please write your figure caption here

Table 1 Please write your table caption here

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