

# 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 Programming (EP) [7], Differential Evolution (DE) [8] and other natural-inspired algorithms [9]. DE was introduced by Storn and Price [8], also is considered 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 through 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 Controlled Random Search (CRS) [11]. In spite of the popularity and effectiveness of DE, there exists several weakness that had been partially solved through 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 reside in the reproduction process, since that are based in vector differences it depends on the content of the population and the search process is affected, therefore a limited number of solutions can be produced. In fact, this transformation of a continuous to discrete problem can lead to converge to 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 occurs with small population size. However, large populations are not prone to stagnate it involves more evaluation functions.

The last one drawback is highly related with the diversity issues. The search process of all the EAs involves the following two process: the exploration and intensification. A desirable behavior of an algorithm is to obtain a balance between these process. Thus, at first stages is induced a exploration process in the search space and at the last stages is applied an explotation of the knowledge gathered during the search process [17].

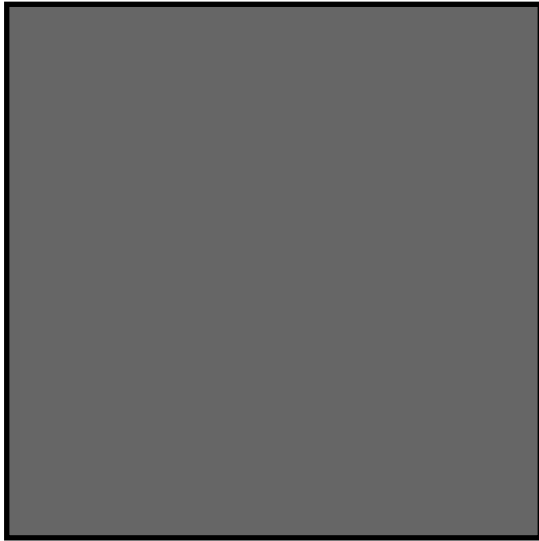
The rest of the paper is organized as follows. In section .. is described a the classic DE. A brief revision of the last EAs is showed in section ... Our proposal based in diversity is described in the section ... In the section .. are showed the experimental results including some of the most popular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

\*\*Techniques to deal with this hybridization with annealing 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. \* \*

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



**Fig. 1** Please write your figure caption here

**Table 1** Please write your table caption here

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### 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.

$$a^2 + b^2 = c^2 \quad (1)$$

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**Fig. 2** Please write your figure caption here

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