Responses to the comments of reviewers for the Parallel DE

# Reviewer 1

## 1. Comment

Equation (1) must be ended with point.

## RESPONSE

Done

## 2. COMMENT

The Abstract should contain answers to the following questions: What problem was studied and why is it important? What methods were used? What are the important results? What conclusions can be drawn from the results? What is the novelty of the work and where does it go beyond previous efforts in the literature?

## RESPONSE

The abstract have been modified to the following:

“*Global optimization is a widely used technique that finds application in many sciences such as physics, economics, medicine, etc. and with many extensions, as for example, in the area of machine learning. However, in many cases, global minimization techniques require high computational time and, for this reason, parallel computational approaches should be used. In this paper, a new parallel global optimization technique based on the differential evolutionary method is proposed. This new technique uses a series of independent parallel computing units that periodically exchange the best solutions they have found. Additionally, a new termination rule is proposed here that exploits parallelism to accelerate process termination in a timely and valid manner. The new method was applied to a number of problems in the established literature and the results were quite promising.*”

## 3. COMMENT

Equation (2) must be ended with comma.

## RESPONSE

Done.

## 4. COMMENT

The authors are requested to add more details regarding their original contributions in this manuscript.

## RESPONSE

The following paragraph has been added in the Introduction section:

“*The proposed technique is a modified version of the parallel island methodology for the different evolutionary techniques [*[*de\_island1*](#LyXCite-de_island1)*,* [*de\_island2*](#LyXCite-de_island2)*]. Therefore, in the proposed technique the initial population of agents (candidate solutions) is divided into a series of independent populations and each individual population evolves independently in a parallel computing unit, such as a thread. Populations periodically exchange information with each other, such as the lowest functional value to which they have been driven. The proposed technique uses a new differential weight calculation scheme, can use a number of different information exchange methods between the parallel computing units, and furthermore proposes a new termination method of the optimization process that can take advantage of the parallelism so that the optimization terminates in time and valid.*”

## 5. COMMENT

Papers cited in references section must be rewritten according to journal style before further process.

## RESPONSE

The paper has altered using the MDPI style.

## 6. COMMENT

This paper should be polished in grammatical frame.

## RESPONSE

The paper has been checked and corrected using the free grammar check https://www.grammarcheck.net/editor/.

## 7. COMMENT

Equation (4) must be ended with comma.

## RESPONSE

Done.

# Reviewer 2

## 1. COMMENT

How does the proposed parallel algorithm differ from the classical island model of the evolutionary algorithm known for many years?

## RESPONSE

The following paragraph has been added in the Introduction section:

“*The proposed technique is a modified version of the parallel island methodology for the different evolutionary techniques [*[*de\_island1*](#LyXCite-de_island1)*,* [*de\_island2*](#LyXCite-de_island2)*]. Therefore, in the proposed technique the initial population of agents (candidate solutions) is divided into a series of independent populations and each individual population evolves independently in a parallel computing unit, such as a thread. Populations periodically exchange information with each other, such as the lowest functional value to which they have been driven. The proposed technique uses a new differential weight calculation scheme, can use a number of different information exchange methods between the parallel computing units, and furthermore proposes a new termination method of the optimization process that can take advantage of the parallelism so that the optimization terminates in time and valid.*”

## 2. COMMENT

Why are there no comparisons with other versions of the parallel Differential Evolution algorithm in the results of the experiments? Maybe then you would see some of its advantages compared to other algorithms because currently it is not clear what its advantages and disadvantages are.

## RESPONSE

The proposed method has been compared against the original DE method and two variants from the relevant literature and the results are shown in the Table 4 of the revised manuscript. The added text reads:

“Furthermore, the proposed method was compared against the original Differential Evolution method and two variants from the relevant literature mentioned as DERL and DELB[[de\_kaelo](#LyXCite-de_kaelo)]. The results from this comparison are shown in the Table [tab:deVariants](#tab_deVariants). As is evident, the proposed technique significantly outperforms the other modifications of the different evolutionary method. This is largely due to the different differential weight calculation technique but also to the proposed termination method. The used differential weight calculation technique largely succeeds in making a better search of the search space, while the new termination method terminates the optimization method in time. Also, this new termination technique has been modified to perform well in parallel computing environments as well.”

## 3. COMMENT

What results are shown in tables 2 and 3? This should be described in the titles of the tables.

## RESPONSE

The title of Table 2 has been changed to:

“*Comparison of experimental results with “1 to 1” propagation scheme. The first column represents the name of the objective function and the remaining columns are the average function calls using 1 to 10 processing threads for the proposed method*”

The title of Table 3 has been altered to:

“*Experiments for the proposed method using different options for the propagation method. The number of processing threads was set to 10. Numbers in cells represent average function calls for every test function.*”

## 4. COMMENT

Are these average results from multiple runs of the algorithm? There is also no statistical analysis of the results obtained.

## RESPONSE

Two additional figures are included in the revised version of the manuscript. In the first figure, statistical comparison is performed for the proposed method and different numbers of execution threads (Table 2 of the Results). The second figure shows statistical comparison for the experimental results of the proposed method against different variations of the DE method (Experimental Table 4).

# Reviewer 3

## 1. COMMENT

The original DE method. What are the input and output variables of this algorithm? INPUT: … OUTPUT.

## RESPONSE

We have rewrite the algorithm of the original DE method according to this comment.

## 2. COMMENT

Same descriptions for the algorithm, presented in section “2.2 Proposed modifications”.

## RESPONSE

Done.

## 3. COMMENT

Description of Equation (4). What is this “R” something like correction factor. You have to describe it. Na matter that you show literature sources [58].

## RESPONSE

The following text has been added:

“*This random scheme for the calculation of the parameter F was used successfully to better explore the search space of the objective function.*”

## 4. COMMENT

Table 1. Are these values dimensionless?

## RESPONSE

We have added the corresponding information for each parameter in the table.

## 5. COMMENT

Figure 1. You have to add X and Y axis titles.

## RESPONSE

Done.

## 6. COMMENT

Page 8. Sinusoidal function. If “z” has a name, it will be good to write it.

## RESPONSE

The following text and an appropriate reference have been added:

*“**The parameter z is used to shift the location of the global minimum [*[*Sinu*](#LyXCite-Sinu)*].”*

## 7. COMMENT

Discussion part is missing. You have to compare your results with those from minimum 3 other papers.

## RESPONSE

The proposed method has been compared against the original DE method and two variants from the relevant literature and the results are shown in the Table 4 of the revised manuscript. The added text reads:

“Furthermore, the proposed method was compared against the original Differential Evolution method and two variants from the relevant literature mentioned as DERL and DELB[[de\_kaelo](#LyXCite-de_kaelo)]. The results from this comparison are shown in the Table [tab:deVariants](#tab_deVariants). As is evident, the proposed technique significantly outperforms the other modifications of the different evolutionary method. This is largely due to the different differential weight calculation technique but also to the proposed termination method. The used differential weight calculation technique largely succeeds in making a better search of the search space, while the new termination method terminates the optimization method in time. Also, this new termination technique has been modified to perform well in parallel computing environments as well.”

## 8. COMMENT

Conclusion part. It is not clear how your work improves the known solutions in this study area.

## RESPONSE

The following text has been added at the beginning of the Conclusion section:

“*A new global optimization technique was presented in this manuscript, which can be performed in parallel computing environments. This method is based on the well-known differential evolutionary technique and partitions the initial population of agents, so as to create independent populations that are executed on parallel computing units. The parallel units periodically exchange the best values for the objective function with each other, and from the experiments carried out it was found that the most robust information exchange technique is the so-called "1 to 1", where a randomly selected subpopulation exchanges information with another randomly selected subpopulation. Furthermore, a new termination method was proposed here which can take full advantage of the parallel computing environment. With this termination rule, the decision to terminate the method can be efficiently made even by a small portion of the independent computing units.*”