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A Novel Hybrid Optimization Algorithm Based On Genetic And Metaheuristic Algorithms (NHyAMeRiA)

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Abstract:
Through this paper we forth put an idea of an unconventional hybrid optimization technique named BBO-PSO. The algorithm is basically a fusion of an evolutionary algorithm i.e. biogeography-based optimization (BBO) and the other one is population-based optimization technique called the particle swarm optimization (PSO). E-commerce websites provides us with various solutions, the result obtained from the idea proposed will be exactly one which will be the most optimized and perfect solution. This will finally result in making it possible to select the offer that best suits to the consumer's requirements.

Keywords: Hybrid optimization algorithm, E-commerce, Biogeography-based optimization, Particle swarm optimization.

I. INTRODUCTION:

The field of research and analysis is improving exponentially day by day. Analysis of any data increases the knowledge and helps to have a profound thinking of it. Apart from developing and applying different algorithms and ways to extract the perfect result, optimizing such algorithms have a significant impact on the end product. Researchers have utilised various methods of powerful algorithms on several data sets of different fields of science and engineering. 21st century has seen progress in technology and engineering in leaps and bounds. E-commerce is one of the fastest growing field in world. Virtual markets have taken over physical markets and billions of request data are generated every day. Similarly the concept of M-commerce has been growing in recent years[2]. About optimizing algorithms many optimization algorithms has been proposed till date among which the Evolutionary Algorithms (EA) are growing in numbers. EA are basically based on human perception and understanding about their surroundings to natural habitation. The way in which humans adapt to natural systems is the key to evolutionary algorithms as they are based on similar functional abilities. The parameters like reliability and robustness of evolutionary algorithms are way better for non-deterministic polynomial (NP) problems as compared to other orthodox optimization techniques. Down the centuries we have many examples of researches that shows that hybrid EAs outperform their constituent algorithms. Biogeography-based optimization (BBO) is a neoteric technique and studies have found out that it provides an above average efficiency compared to other population-based methods. In the paper we design a new hybridization procedure to blend BBO with PSO which will basically combine the advantages of both algorithms and improve the efficiency and precision of the result.

Optimization vaguely includes both local search and global search. In the proposed evolutionary algorithm BBO is implemented first so as to perform local search on the data while PSO is performed on the result obtained from BBO for global search. As a result through this algorithm we get resuktsregarding local and global searches for better optimization performance. Also by using BBO we reduce the work for PSO thus increasing the efficiency of the algorithm all together.

II. BRIEF REVIEW OF ALGORITHMS

A. Biogeography-based optimization

Biogeography-based optimization (BBO) is an algorithm inspired through nature. Dan Simon through his perception developed this technique in 2008. As the name suggests it is infulenced by the learning of biogeography.Habitat suitability index (HSI) is used to represent an independent individual, BBO is no different. The HSI scoring method was originally proposed by the US Fish and Wildlife Service so as to evaluate the habitat's quality and quantity. The range of HSI is between 0-1. It possess a variable called the suitability index variables (SIVs) which is sometimes referred as the decision variable. A high HSI score means the high population similarly a low score means low population. In order to fulfil their needs migration takes place from high HSI to low HSI since if there is no

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migration then a large number of population will be dependent on fixed amount of resources, which may cause problems in near future. Very rarely we see species migrating from a lower HSI to higherHSI.

Algorithm1: Biogeography-based optimization

1. Until ceasing condition is not found
   Set emigration proportion mk and immigration proportion $mk$of each key pk
2. q ← j
3. for (every candidate solution qk)
4. for (every decision variable index a)
5. Depending on mk appropriate qk is selected
6. if (incomer=true)

then

   Exercise mj and fix an emigrating candidate result yi
7. q(a) ← ψq k(a) + (1 − ψ)ji(a)
8. stop 6.
9. Take decision regarding mutation of qk(a)
10. if it is mutating then,

assign a random value that is generated to qk(a).

11. stop 10
12. stop 4
13. stop 3
14. assign the value of q to p.
15. substitute the independent with elites
16. stop

Migration and Mutation are considered as the two main steps of this unorthodox algorithm. Of the two migration rate is taken under considerations to decide the amount of decision variables that will be moved between various outputs. Apparently, the candidate solutions should provide with statistics with each other in such a way that outputs with high fitness must give a high amount of decision variables and similarly low fitness must give a low amount of decision variables.

For every decision variable of a given candidate output pk, we probabilistically decide the action to be taken i.e. immigrate or not as per the rate mk. Generalized operator can be shown as:

$p(a) \leftarrow \psi p k(a) + (1 - \psi) ji(a)$

where ψ is a real number between 0 and 1 and a is the decision variable index in original BBO.

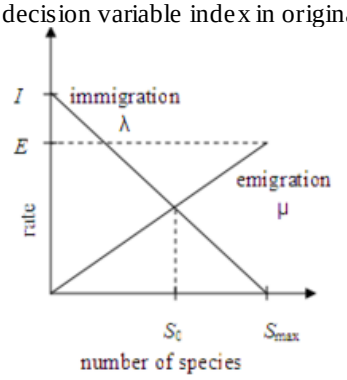

Fig.2.1 BBO Species distribution.

B. Particle Swarm Optimization

This algorithm is yet again another population based technique. It is influenced or rather inspired by the notion of flocking of birds in search of food. We can think about this technique as in the best fit bird is always leading the charge of the group and the instant another bird is more eligible it is replaced with him. The technical analogy can be thought of as the population has many particles representing a candidate solution the optimal solution at the particular instance will be found. This technique considers the position and velocity which is fixed for every particle. The instant position of the particle is taken as the solution. The particle that is selected at the current time should see to the path of the previous best and the global best location.

Algorithm2: particle swarm optimization

1. Start
2. Animate the particles
3. set the following parameters
   3.1 global best location.
   3.2 best location
4. Until ceasing condition is not found
5. for (every particle (i))
6. compute the speed along with directions.
7. review the fitness of (i).
8. end 5
9. re-equip the best position
10. improve the global best position.
11. stop

PSO is a computational method which tries to optimize a task by reviewing iteratively which is the best fit candidate solution. In a nutshell it is meta-heuristic. It makes very few number of assumptions for searching a large set of knowledge. PSO is trivial as it performs by maintaining a swarm of particles. As the optimization is the trend we have seen different variants of this unorthodox model with some of them improving the performance and precision. PSO can be hybridized with many other algorithms or optimizers.

The pseudo ccode is explained in Algorithm 2.

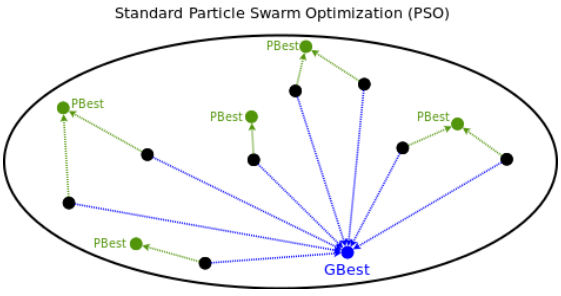

Fig.2.2 Standard PSO Working

III. PROPOSED HYBRID ALGORITHM.

In this paper we try to implement an intricate design that will be used for the e-commerce websites. E-commerce websites have their own way of promoting and recommending items while we browse through them. We try to optimize this procedure as the items recommended by the websites are not always correct, moreover if they are correct they tend to be irrelevant at times which doesn't help the customer. Many optimization techniques have been hybridized or cross-over to exploit the advantages of the so called parent algorithms. Similarly we are combining the benefits of the above mentioned two algorithms because of their powerful searching ability. As observed in many EAs the entire population may reside at a local optimum during optimization.

For this problem we separate the whole population into different clusters or subgroups. Then after dividing into subgroups we first implement BBO to perform local search in every subgroups independently. Thus we will have several local optimums rather than a single large set of local optima. BBO is implemented first so as to reduce the task of PSO and not only reduce but provide PSO with already optimized data. Since many a times there are data whose knowledge is irrelevant and by implementing PSO on it reduces the accuracy and increases the time complexity. Further PSO is performed to global search on the result obtained by the BBO. For robustness we implement PSO five times and make a decision about the most optimized result which will be the best result. Following flowchart can be used for a rough understanding.

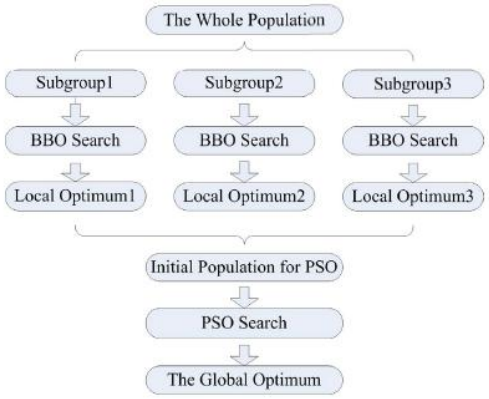

Fig.3.1 Algorithm structure of BBO-PSO

Step1: Initialize the candidates.
Step2: Define and declare parameters in the algorithm.
Step3: Sectioning the candidates into several subsections.
Step4: Apply BBO for local search.
Step5: Obtain the different sets of local optimums.
Step6: Over this apply PSO for global best search (n times).
Step7: Select the best result.

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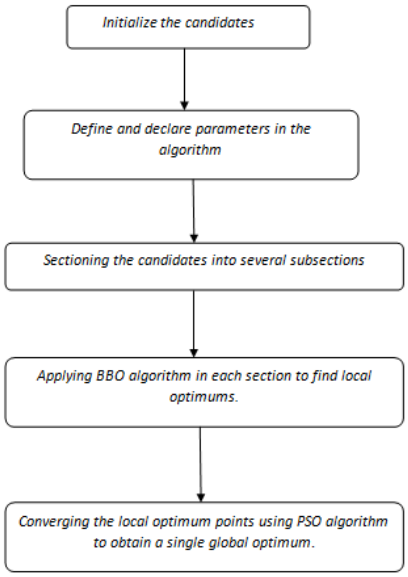


HYBRID BBO-PSO

IV. STATISTICS AND ANALYSIS

The algorithm was initially tested using standardized benchmarks and the resultants of the fitness tests are displayed in the table 2. Clearly we can see that the performance of BBO and PSO combined yields much better results as compared to using those algorithms individually. Combining the algorithm, results in better efficiency and accuracy.

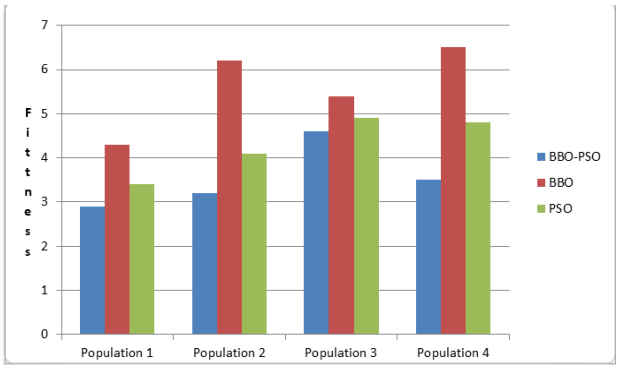
$F_1(x) = -20\exp\{-0.2\,\mathrm{sqrt}(1/n\ \Sigma^{N}_{j=1}x^2_j)\}-\exp[1/n\ \Sigma^{N}_{j=1}\cos(2\pi x_j)]+20+e$
$F_2(x) = 1/4000\,\Sigma^{N}_{j=1}x^2_j - \Pi^{N}_{j=1}\cos(x_j/\mathrm{sqrt}(j)) + 1$

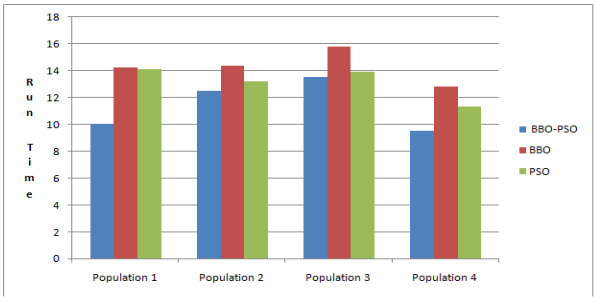
Table 1: Run-time Comparisons

	BBO-PSO	BBO	PSO
F1	10.02s	14.23s	14.12s
F2	10.32s	15.61s	16.01s

Table 2: Average Performance

	BBO-PSO	BBO	PSO
F1	4.53E+02	3.23E-01	2.97E-01
F2	4.21E+02	3.12E-01	2.87E-01





V. IMPLEMENTATION

The actual purpose of combining the aforementioned algorithms is to provide solutions in the feasible region of operation. Bio-geography based optimization algorithm's primary focus is to find the local optima, and exploiting this feature we can apply it to the heritage healthcare sectors and recommendations. Particle swarm optimization concentrates on finding the global optima. Combining these two results in high power searching ability and we have harnessed this particular attribute. In healthcare sector one of the major concern is the historical data of the patients. Our proposed algorithm helps in finding the data much faster. The evidence provided is in table1 wherein the run-time statistics is shown. The second implementation can be done in the recommendation sector relative to e-commerce or m-commerce. The accurate results are optimized in the end by using the proposed algorithm. Initially the required product is searched and using bio-geography based optimization a result is obtained[6]. Then using particle swarm optimization more optimized result is obtained. Aforementioned were the possible implementations of the proposed algorithm.

VI. CONCLUSION:

In this paper, two of the most powerful algorithms have been combined to develop a hybrid algorithm called BBO-PSO. This aforementioned hybrid technique combines the advantages of both the algorithms and coordinates local as well as global search. This new technique has powerful searching abilities.

For the future work we can combine BBO with some other algorithms to produce more efficient optimization algorithms. This technique can be used with search engines and web crawlers to enhance the customers experience on e-commerce market.

REFERENCES

[1] A Novel Hybrid Optimization Algorithm Combined with BBO and PSO. Gang Cheng, Chao Lv, Shi Yan, Li Xu. 2016 28th Chinese Control and Decision Conference (CCDC).

[2] Big Data Analysis: Recommendation System with Hadoop Framework. 2015 IEEE International Conference on Computational Intelligence & Communication Technology.

[3]A hybrid algorithm for global optimization. 2015 11th International Conference on Computational Intelligence and Security

[4] Particle Swarm Optimisation with Genetic Operators for Feature Selection. Hoai Bach Nguyen, Bing Xue, Peter Andreae and Mengjie Zhang

[5] H. P. Ma, D. Simon, M. R. Fei, X. Z. Shu, Z. X. Chen, Hybrid biogeography-based evolutionary algorithms, Engineering Applications of Artificial Intelligence, Vol.30, 213-224, 2014.

[6] R. G. Reynolds, An introduction to cultural algorithm, Proceedings of the 3rd Annual Conference Evolution Programming, Singapore: World Scienctific Publishing, 131-136, 1994.

[7]D. Simon, Biogeography-based optimization, IEEE Trans. on Evolutionary Computing, Vol.12, No.6, 702-713, 2008.

[8]A Novel Parallel Hybrid PSO-GA using MapReduce to Schedule Jobs in Hadoop
Data Grids. 2010 Second World Congress on Nature and Biologically Inspired Computing Dec. 15-17,2010 in Kitakyushu, Fukuoka, Japan