IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Special Issue-16, May 2019 E-ISSN: 2347-2693

Effective Loading of Goods into the Container using Garden Optimization Algorithm

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DOI: https://doi.org/10.26438/ijcse/v7si16.811 | Available online at: www.ijcseonline.org

***Abstract* -** The aim of this work is to load the goods into the container using the Garden Optimization Algorithm (GOA) to secure goods delivery. Using BR datasets, the effectiveness of the proposed approach was demonstrated and compared with various Bio inspired optimization algorithms. It is observed from the experiment that the proposed GOA is being implemented and fulfills the goal of optimally loading the goods into the container. It is also observed that the order in which the goods are placed in the container is optimal than other competitive optimization algorithms.

Keywords: Container loading, Garden Optimization algorithm, secure delivery, Optimization algorithm.

I. INTRODUCTION

Traditional Goods Carrying (TGC) framework carries products utilizing lorries that have the chances of dropping the products as the vehicle moves due to dishonorable courses of action. Advance interferences of normal calamities like rain, wind make the conventional TGC as a risky and unsecured transportation. The improper arrangement of goods in a lorry is shown in Figure 1.

Figure 1. Improper arrangements goods in Lorries

This work centers on giving an arrangement to such challenging errand by utilizing container for the transportation of products. The Container could be a kind of lorry like vehicle but it incorporates a closed metal scope that produces the merchandise free from the defilement of rain and other hazardous variables. This container mode of transportation will decrease the labor and fuel required for transportation and will provide more secure scope for things than lorries. Research papers related to container loading using different optimization algorithm are available in the literature.

Xueping Li *et al.* (2015) proposed a Differential Evolution (DE) algorithm hybridized with a novel pressing heuristic technique, the best-coordinate first, which produced a minimized pressing arrangement in view of a given box pressing succession and a compartment stacking group. The adequacy of the proposed algorithm is assessed on an arrangement of mechanical occasions with haphazardly produced examples. The outcomes demonstrate that the proposed algorithm outflanks existing arrangement approaches regarding arrangement quality.

Tansel Dokeroglu *et al.* (2014) proposed an arrangement of hearty and adaptable crossover parallel algorithms that exploited parallel algorithm procedures, transformative gathering hereditary metaheuristics, for huge scale one-dimensional Bin Pressing Problem (BPP) occurrences. An aggregate number of 1318 benchmark issues is inspected with the proposed algorithms and it is demonstrated that ideal answers for 88.5% of these examples can be acquired with functional streamlining times while taking care of whatever the remains of the issues with one additional receptacle. At the point, when the outcomes are contrasted the current best in class heuristics in the parallel cross breed gathering hereditary algorithms can be considered as outstanding amongst other one-dimensional BPP algorithms as far as algorithm time and arrangement quality is considered.

Kyungdaw Kang *et al.* (2012) created a packing system to limit the number of cuboid spaces produced amid the packing procedure by coordinating the container height, length and width with the measurements of the pressing space. A half-breed hereditary algorithm was utilized to tackle the three-dimensional container packing issue with this developed system. The outcomes under the proposed algorithm were contrasted with different arrangements of computational outcomes found in scholastic papers identified with this subject.

D.S.LiuK.C.Tan *et al.* (2008) built up a Multi-Objective two-dimensional scientific model for Bin Packing Problem (MOBPP-2D). A multiobjective transformative molecule swarm improvement algorithm (MOEPSO) is proposed. Without the need of joining the two destinations into a composite scalar weighing capacity, MOEPSO consolidates the idea of Pareto's optimality to advance a group of arrangements along with the exchange of surface. Broad numerical examinations are performed on different test cases, and their exhibitions are contrasted both quantitatively and factually and other improvement strategies to show the adequacy and proficiency of MOEPSO in taking care of the multiobjective receptacle bin packing issue.

The objective of this work is to organize the goods into a1. container in an ideal way so that the space of the container is successfully connected. The way of surrounding this issue2. endeavors to get the optimized arrangement within the form3. of giving the leading arrange of arrangement and4. accomplishing the greatest volume of containers.

The rest of the paper is organized as follows. In section 2, a Garden optimization algorithm is discussed. In section 3, Pseudo code for a garden optimization algorithm for container loading are discussed. Simulation result is given in section 4. Finally concluding remarks are discussed in section 6.

II. Garden Optimization Algorithm

In this section, the steps involved in the execution of Garden Optimization Algorithm are discussed. This GOA is new evolutionary algorithm suitable for continuous nonlinear optimization problems. It is inspired by the growing and seeding procedure of the plants in the garden. This GOA involves three main stages namely 1.Local seeding of plants 2. Population restrictive, 3.Global seeding of plants. Like another evolutionary algorithm, GOA starts with an initial population of plants, so that each plant represents a potential solution to the problem. Age is the numerical variable that is attached to each plants so that this variable defines the age of the particular plant and in the initial stage age of the plant is set to Zero.

After the initialization of the plants, the local seeding operator will generate the new plants from the plant with the age=0. The age of the plant is increased by 1 except newly generated plants. In population restrictive stage, plants that exceed the area limit in the garden are collected and form candidate population for global seeding stage. In global seeding stage, a certain percentage of the candidate population is selected. From the selected population, it adds a new potential solution to get the local optimum solution. Now the plants in the garden are ranked according to their fitness values and the plants with the biggest fitness value is selected as the best plant and finally, the age of the best plant is set to 0. These stages of operation will continue until the termination criterion is met. The detailed explanation of the proposed algorithm is discussed under subsections below.

III. PSEUDO CODE OF GOA FOR CONTAINER LOADING

In this section, pseudo code for the proposed GOA for container loading is discussed.
Input: lifetime, LSC, GSC, transfer rate, area limit.
Output: The best plant with its order of arrangement of variables is displayed.
Initialize the garden with random plants
Each plant is represented as a dimensional vector X, then X= (age, v1, v2, v3…., vn) for N dimensional problem.
“Age” of each plant is initialized by “0”.
While stop condition is not satisfied do
Perform local seeding on plants with age 0

```
For i=1 “LSC”
    Randomly choose a variable from the selected plant.
    Change the selected variable of the tree randomly
from “A” used for execution.
    Here A= {1, 2, 3}.
Increase the age of all the plants by 1 except newly
generated plants.
```

Population restrictive stage

- The plants are removed with the age greater than lifetime parameter and add them to the candidate population.
- The plants are sorted according to their fitness value
- Remove extra plants that exceed area limit parameter from the end of the garden and add them to the candidate population.

Global Seeding stage

- Transfer rate percent of the candidate population is selected
- For each selected plant

- Choose "GSC" variable to the selected plant randomly
- Change the value of each variable with another randomly generated variable from "A" and add a new plant to the garden with age=0.

Updation of the best plant so far
Based on the fitness value sort plant in the garden
Reset the age of the best plant to 0
Return the best plant and display the order of arrangement of variables as the result

IV. SIMULATION RESULT

This section presents the subtle elements of the reenactment carried out on BR datasets. Recreations are conducted to look at the rate of container volume utilization by the proposed GOA. The proposed GOA methodology is implemented in Java SE 6 and implemented in a PC with Intel Core i3 processor, 2.4 GHz speed and 4 GB of Ram.

4.1 Setting of Control Parameter

The GOA was run with different number of plants and GOA control parameters. Computational experiments allowed the selection of parameters using BR datasets with the following settings are presented in Table 1.

Table 1 Garden Optimization algorithm parameter used in computational experiments

S.No	Parameter	Value
1	Initial population plants in garden	30
2	Area limit	10
3	Local seeding changes	1
4	Global seeding changes	1
5	Transfer rate	4%
6	Lifetime	2

4.2 Performance Computation using GOA

The arrangement of items and their container utilization are two execution measurements considered for execution of the proposed GOA algorithm. Table 2 reports the value for those measurements exclusively for the data set BR1 to BR16.

Table 2. Performance computation using GOA algorithm

S.No	Number of boxes	Container utilization (%)
1	BR1	94.89
2	BR2	94.12
3	BR3	95.34
4	BR4	95.64
5	BR5	95.12
6	BR6	96.78
7	BR7	96.05
8	BR8	94.89
9	BR9	95.65
10	BR10	95.32
11	BR11	94.76
12	BR12	96.10
13	B13	95.37
14	BR14	96.25
15	BR15	94.22
16	BR16	95.19

The above table shows the container volume utilization for different BR data sets. The fitness of the obtained solution is evaluated through the fitness function namely $f(x) =$ *l*b*h of the box / l*b*h of the container *100*. From the above table it is observed that the proposed GOA algorithm obtain the best order of arrangement and their container utilization for the data set BR1 to BR16. For simplicity, the best order of arrangement using BR-4 data set is 3, 2, 1, 1, 3, 2, 1, 2, 1, 3, 3, 1, 2, 1, 2, 3, 1, 2, 1, 3, 1, 2, 1, 2, 1, 3, 1, 3, 1, 2, 3, 3, 1, 2, 1, 2,1, 2, 1, 2, 3,3, 1, 2, 3, 2, 2, 1, 3, 3, 2, 1, 1, 3, 2, 1, 3, 2, 3, 2, 1, 3, 1, 3, 1, 2, 1, 3, 3, 1, 2, 3, 3, 1, 1, 3, 1, 3, 3, 1, 2, 1, 2, 1, 1, 3,3,1,2,1,2,3,1,3,3,1,2,1,3,1,3,2,3,1, 3, 2,1,3,2,1,2,3. In the first step, counting the number of occurrences of the boxes and multiplying with their corresponding length, width and height. In the second step, the solution obtained by step 1 is divided by the length, width, height of the container. In step 1, the solution obtained by step 3 is multiplied by 100 and finally, the volume utilization is achieved for each number of data from BR1 to BR16.

4.3 Performance Comparisons

To compare the performances of the proposed GOA, three different approaches are developed and the comparison is given in Table 3. The first one is Particle swarm optimization (PSO) based on the ideas of animal flocking behaviour. The second one is Bees Algorithm (BA) based on the foraging behaviour of honey bees. Third one is Ant Colony Optimization (ACO) Based on the ideas of ant foraging by pheromone communication to form paths. Fourth one is Fish Optimization (FO) this algorithm is inspired by the collective movement of the fish and their various social behaviors.

Table 3 Comparison of different optimization algorithms for container loading

		Container volume Utilization in %				
S.No	Number of Datasets	PSO	BA	ACO	FO	GOA
1	BR1	94.02	91.51	93.12	92.34	94.89
3	BR2	93.19	93.45	93.93	93.55	94.12
1	BR3	94.21	94.45	94.88	95.06	95.34
4	BR4	94.33	94.57	95.22	95.62	95.64
5	BR5	94.55	94.29	94.78	94.99	95.12
6	BR6	95.27	95.54	95.12	95.98	96.78

7	BR7	95.67	95.88	95.33	95.76	96.05
8	BR8	94.11	94.33	94.56	94.22	94.89
9	BR9	94.78	94.81	95.36	95.61	95.65
10	BR10	94.66	94.89	94.91	95.26	95.32
11	BR11	94.22	94.12	94.44	94.74	94.76
12	BR12	95.34	95.78	95.89	96.2	96.10
13	BR13	95.11	95.22	95.24	95.37	95.37
14	BR14	95.78	95.33	95.89	96.11	96.25
15	BR15	94.06	94.06	94.00	94.07	94.22
16	BR16	94.98	94.92	94.89	94.98	95.19

From this Table.3, it is found that the proposed GOA has higher volume utilization than other approaches of all BR datasets. The objective of this work is to meetout and arrange the goods into the container in an optimized way by utilizing the maximum container volume for loading goods.

V. CONCLUSION

A Garden Optimization algorithm is implemented for arranging goods into the container for secure delivery of goods. The effectiveness of the proposed approach has been demonstrated using BR data sets and compared with a different optimization algorithm. This kind of computational arrangement of goods into the goods carrying container is more secure for transportation.

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Authors Profile

Sathish Kumar Ravichandran received his B.Tech, M.E, and Ph.D in Information Technology, Computer Science Engineering and Information and Communication Engineering from Anna University Coimbatore and Anna University Chennai, Anna University Chennai in 2011, 2013, and 2019 respectively. He is currently working as Assistant Professor in Computer Science and Engineering department at Presidency University Bangalore in Karnataka. He received best paper award in IEEE sponsored International Conference on Advanced Computing & Communication System, India. His research area includes IoT, Big Data Analytics, and Bio Inspired Optimization Algorithm.

