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A new algorithm to solve the symmetric iterative Marketer problem

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ABSTRACT

The traveling salesman is one of the NP-Complete problems that many researchers have worked on so that they can either solve this problem in general or take it a few steps further. In this article, we also present a new solution. In order to be able to solve this problem close to a complete solution, and in our new solution, it identifies and solves the three main problems facing the traveling salesman route, namely deadlock, intersection and critical routes, and finally the route for The vendor offers a path that is free of the above three problems, and the simulation results of the new solution also show that our solution has been able to be superior to previous solutions, all of which are the advantages of our new solution.

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1. Introduction

The period seller is one of the most interesting problems of researchers because this problem is one of the problems and so far no one has been able to provide a solution that guarantees all the optimality and acceptable time of the NP Complete itinerant seller and that is why there are many researchers who Their effort is to provide a new solution that guarantees all the characteristics of this problem, such as the most optimal route at a very acceptable time for each entry, to register this superiority in their name. This problem was first proposed in 1571 by Ulero called "Knight's Path Problem", which was such that its nodes were 46 squares of the chess board, each of which was adjacent to two other vertices, and the knight could only go to For the first time in the 1191s by (TSP) to move a square adjacent to it. But the problem of the traveling salesman by mathematicians named Karl Menger and Hasler Whitney was raised as a mathematical problem. The description of the problem is that a salesman wants a number of ninety (city) and its goal is to find the shortest path, such that it passes through all the nodes and visits each node only once and thus returns to the starting point. The size and complexity of optimization problems such as the traveling salesman problem and problems The real world has led to the development of methods whose efficiency can be measured by finding reasonable results in an acceptable time, for example, approaches based on biological and social sciences, such as evolutionary algorithms, neural networks and other cases, have shown to be very practical and have provided suitable solutions for various optimization problems. It is among the researchers. One of the important reasons for this issue is its simplicity in terms of understanding and relating, its difficulty in solving and finally its proximity to real world issues. Researches to solve the problem of the traveling salesman and the transmission of particles and the energy governing the pipes and the equations governing the particles have been reviewed by various scientific researchers [7-18]. researches for a new algorithm with dead ends, intersections, critical paths and the equations and energies governing the particles have been presented by various researchers [19-31].

The problem of the traveling salesman plays an important role in the evolution of a major part of scientific and even applied research (G. Gutin, 2001). This problem has played a very sensitive and key role in the evolution of the theory (Holger H. Hoos). , computational complexity and has played a role in the development of new computational tools. There are two types of algorithms to solve the traveling salesman problem, which are 1- Algorithm. Thomas St. Many management problems such as the problem.

2- Approximate algorithms (2009) are TSP search, facility location, activity planning and network design, etc., can be modeled as Denote di,j with j and i in the traveling salesman problem if the distance between two nodes (F.P.García Márquez, 2012) is symmetric if di,j != dj,i and if at least one value of di,j=dj ,i, if it has a value in all cases, it is called asymmetric. Symmetric and asymmetric traveling salesman problem are different in two main ways, First, the computer memory for the symmetric traveling salesman problem is half of the computer memory needed for the asymmetric one, and secondly (Jill Cirasella, David) that in asymmetric problems, optimization and approximation are more difficult than in symmetric problems.

- With other problems, you can: 1- press printing schedule 2 TSP applications and communications (s. johnson)
- Scheduling crews 9- School bus routing problem 6- Scheduling interviews 7- Planning missions 4 chronology of warm alloys 5- design of navigation network of global mapping systems 8- ... mentioned. (Tolga Bektas, 2006).

2. *Theoretical*

2. A new algorithm for solving the traveling salesman problem

1.2.2 Select node for route

In our new algorithm for selecting the next nodes, we give priority to the nodes that have the smallest distance from the last node in the list of nodes without checking the visited nodes.

2.2.2 Identifying the dead end in the seller's path and fixing it

One of the major problems that exist between the seller's path is the node that creates a deadlock. The deadlock occurs when we have met a number of nodes on a transit route and now we want to migrate to another node. Let's re-cross the node or nodes we have already passed. We have shown an example of a dead-end path in Figure 1.

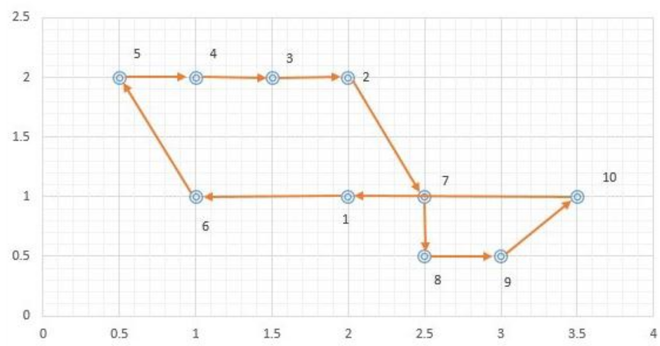


Figure (1): An example of a path with a dead end

To detect the deadlock node, we first obtain the state of the two nodes of origin and destination in relation to each other, which can be in four states in relation to each other, which are:

- All the X's are constant and Y's are different.

All the points whose x is equal to x of one of the two points of origin and destination and whose y is two points higher than the lowest y and two points lower than the highest y are introduced as points between these two nodes.

- Both nodes Y should be constant and X should be different.

All points whose y is equal to y of one of the two points of origin and destination and whose x is two points more than the lowest x and two points less than the highest x are introduced as points between these two nodes.

- X and Y of the first node should be greater than X and Y of the second node and vice versa.

In this case, we first add the x distance and the y distance together, then calculate their difference and act based on it.

X = x (larger) - x (smaller)
Y = y (larger) - y (smaller)

When we calculated the x distance with the y distance. They may have three states in relation to each other, which are:

- The distance of y's is greater than x's.

In this case, it is enough that we act like the following formula to recognize the point between them.

Y1 = Y / X
X1 = x - x (smaller)
M = (X1 * Y1) + y (smaller)

If y is equal to M, then it is between two points, and if it is not equal, then it is not between two points of origin and destination.

The distance between y and x should be less.
We act based on the following formula:

X1 = X / Y
Y1 = y - y (smaller)
M = (x (larger) - (Y1* X1)

The distance between y and x should be equal.
We will act according to the first or second formula.
When we recognized the deadlock, now it's time to remove the deadlock. To remove the deadlock, it is enough to reverse the node that caused the deadlock in the list of nodes to be met. Like Figure 2, which is the solution to the deadlock in Figure 1.

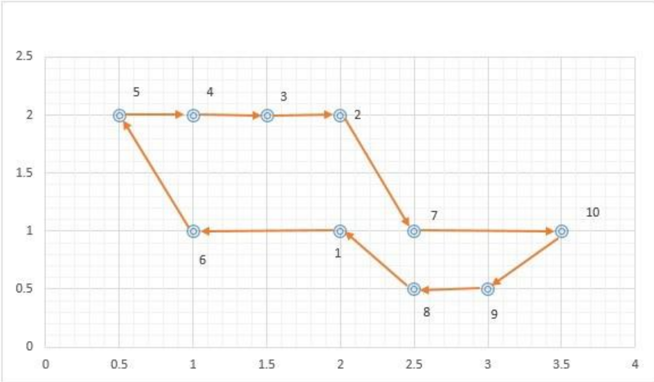


Figure (2): Fixing the impasse of Figure 1

***M* = 1 6 5 4 3 2 7 8 9 10**
***M* = 1 6 5 4 3 2 7 10 9 8**

In Figure 2, considering the detection of node 5, which caused the deadlock, in the list of nodes to be met, we have reversed from 5 onwards, which caused the deadlock to be resolved.

2.3- Identifying the intersection and fixing it

Intersection is another problem faced by the traveling salesman, which makes the journey of the traveling salesman longer. Intersection occurs when if we draw a virtual line between the first two nodes that passes through the two nodes and the other two nodes that are compared are on both sides of the line and the same for the other two nodes. We have shown an example of intersection in figure 3.

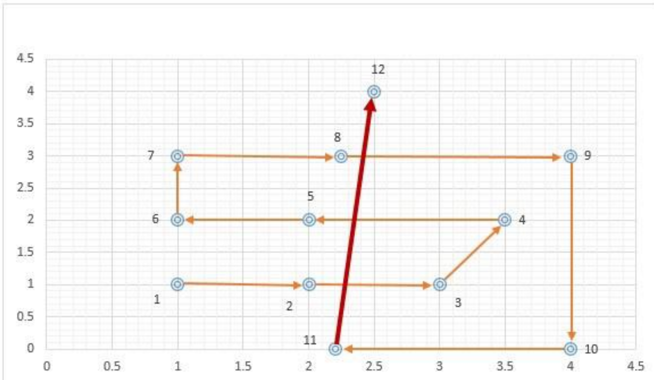
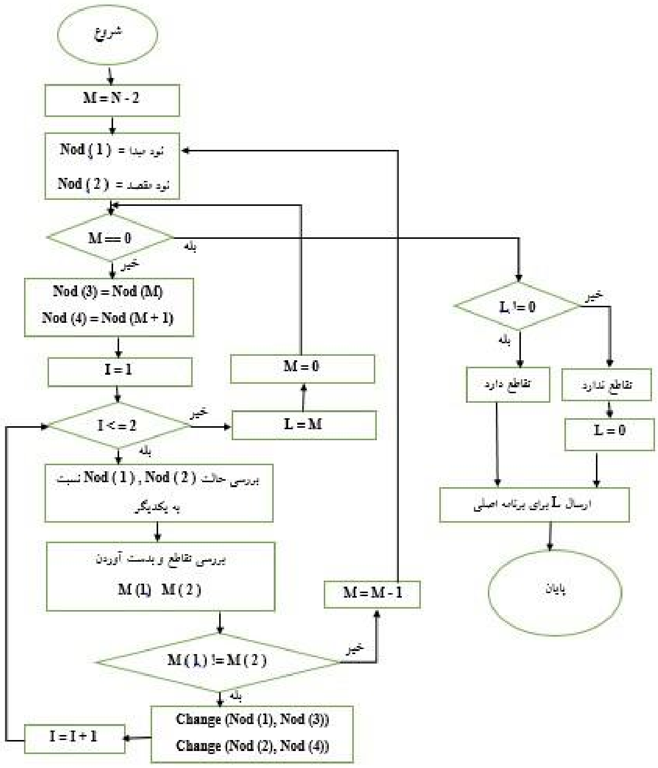


Figure (3): An example of a route with an intersection

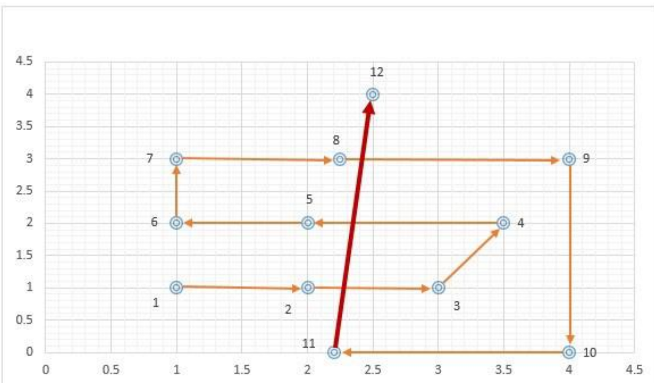
To detect the intersection, we again obtain the state of the two nodes relative to each other, which also have the above four states, then draw an infinite line between these two points that passes through the two points and the other two nodes that are to be checked. Let's compare the intersection with this line and if they are on both sides of the line, then draw the infinite line of the next two points and this time compare the previous two points, and if these two points are on both sides of the line again, declare the intersection and in Otherwise, there will be no intersection. In Algorithm 1, we have shown the overview of the intersection detection flowchart.

After identifying the intersection, now it's time to fix the intersection. To fix the intersection, we find the node that is sent by the intersection detection algorithm in the list of nodes to be met and reverse it from then on.

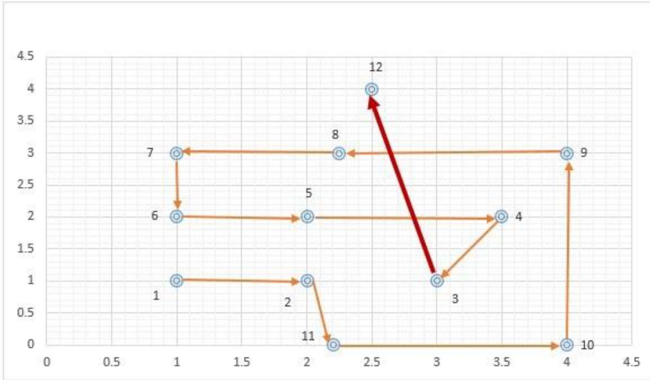
Note: At the time of detecting the intersection and to fix the intersection, we consider the node that created the intersection as the origin and the previous origin as the destination, and if the intersection does not occur, we will reverse the node from that point onward, and if detected At the intersection, we consider that node as the origin and do this until there is no intersection between the origin and the destination, and we reverse from the last node that is known as the intersection. In figure 6, we have shown the visual view of fixing the intersection in figure 9.



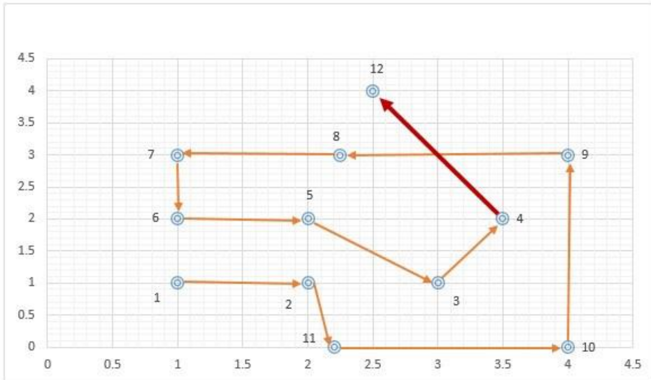
Algorithm (1): *overview of intersection detection flowchart*



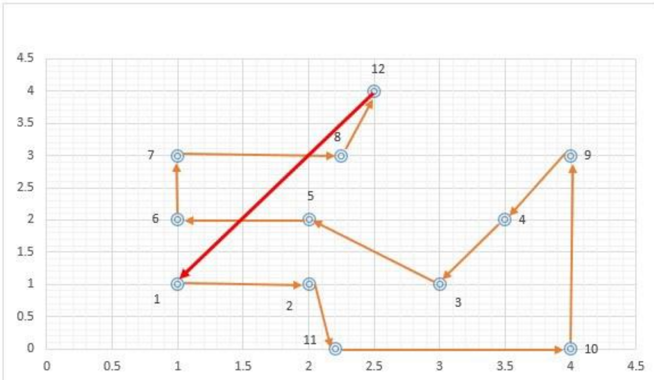
D = 1-2-3-4-5-6-7-8-9-10-11
D = 1-2-11-10-9-8-7-6-5-4-3



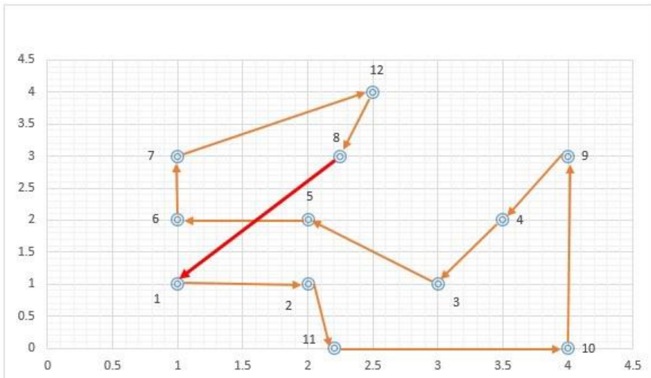
D = 1-2-11-10-9-8-7-6-5-4-3
D = 1-2-11-10-9-8-7-6-5-3-4



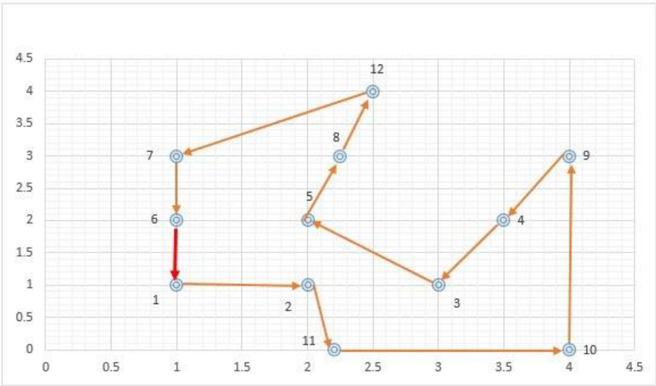
D = 1-2-11-10-9-8-7-6-5-3-4
D = 1-2-11-10-9-4-3-5-6-7-8



D = 1- 2 -11- 10- 9- 4- 3- 5- 6- 7- 12- 8
D = 1- 2 -11- 10- 9- 4- 3-5- 8 -12- 7- 6



D = 1-2-11-10-9-4-3-5-6-7-12-8
D = 1-2-11-10-9-4-3-5-6-7-12-8



D = 1-2-11-10-9-4-3-5-6-7-12-8
D = 1-2-11-10-9-4-3-5-8-12-7-6

Figure (4): visual views of the stages of fixing the intersection

2. The critical path and its solution

Another problem with the traveling salesman path is the critical path. A critical path occurs when there is a path that has neither intersections nor dead ends that we could have done better. In Figure 7 and Figure 4, we have shown a visual view of a non-crisis path and a critical path, respectively.

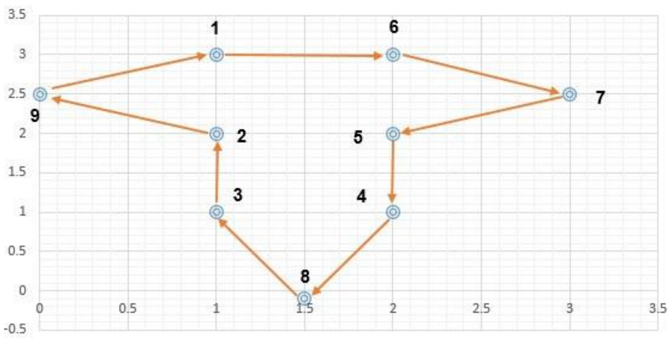


Figure (5): *Visual view of a path without crisis*

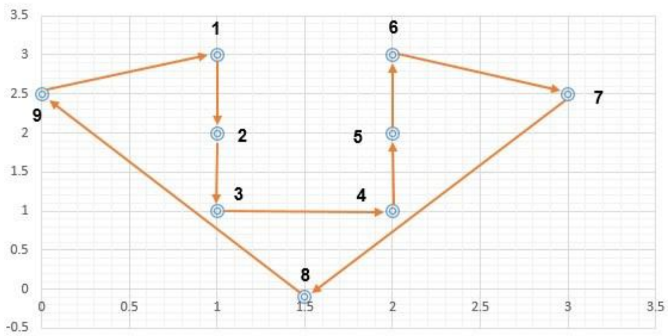


Figure (6): *Visual view of a critical path*

In order to recognize the critical path, we have thought that: we calculate the distance matrix for the origin node and if the destination node is not in the matrix except for the two smallest distances, and this is also the case for the destination, then we recognize it as a critical path.

In order to fix the critical path, the source node is attached to the nearest node except the node before it in the list of nodes to be met, and the two nodes that will be separated due to the movement of the source node to the nearest node are placed in the forbidden list and until a node Do not add to the list of visited nodes, two nodes in the forbidden list are not placed next to each other, and as soon as a node is added to the list of visited nodes, the forbidden list is deleted and a new list is defined.

In Figures 7 and 8, respectively, we have shown the path selection for the Uleysses22 standard, which is one of the traveling salesman's own standard examples, by applying the critical path correction and without applying the critical path correction in the new solution, so that we can understand that How effective is fixing the critical path in our new solution.

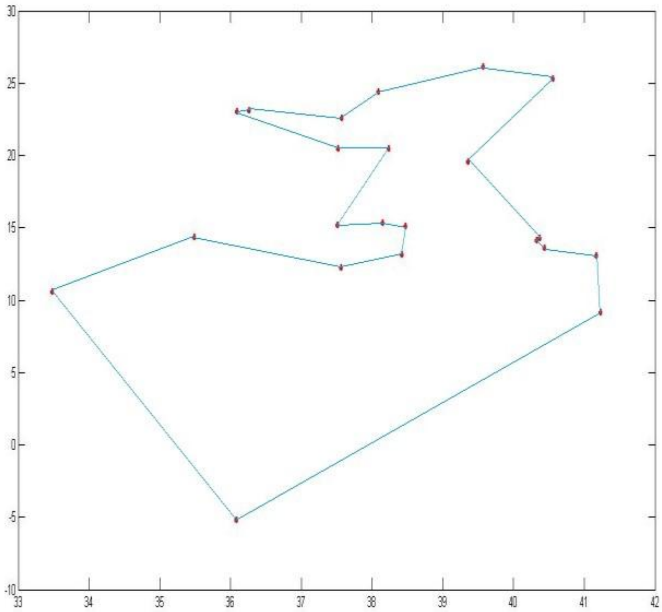


Figure (7): Path selection for the 22 Uleysses standard by applying critical path correction

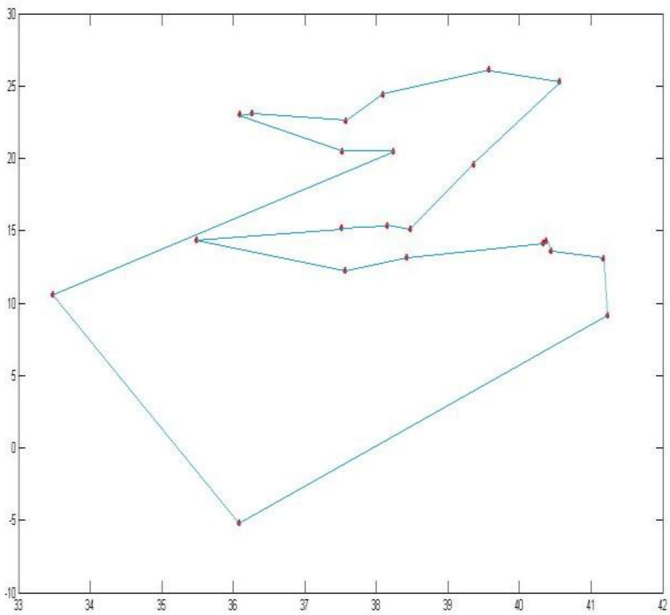
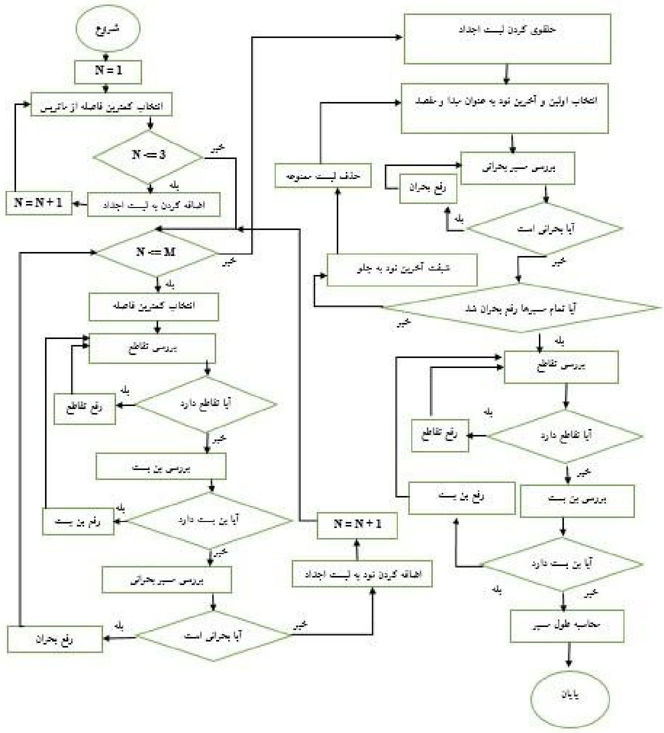


Figure (8): Path selection for the 22 Uleysses standard without apply to fix the critical path

2-5: Overview of the proposed algorithm

In Algorithm 2, we have shown the overview of the flowchart of the proposed algorithm.



Algorithm (2): *Overview of the flowchart of the proposed algorithm*

In figure 9, 10, 11, and 12, we show some examples of the chosen paths of the standards by the new solution.

To understand how the new solution can choose the path.

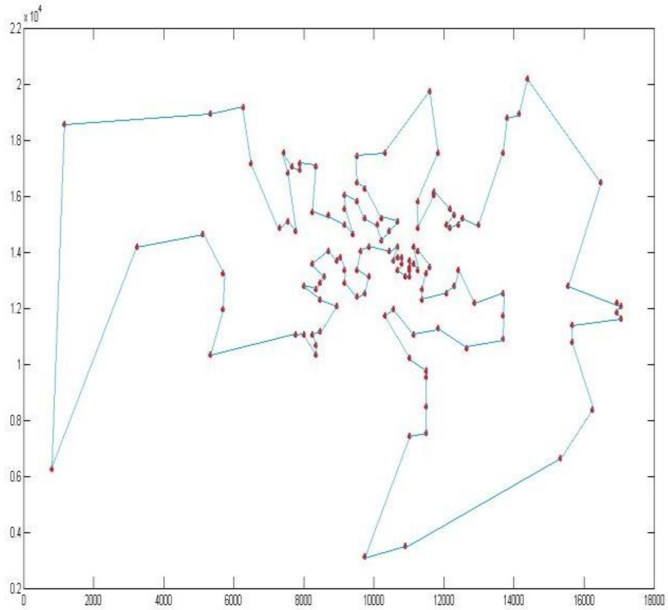


Figure (9): *The chosen path for standard Bier127 by the new solution*

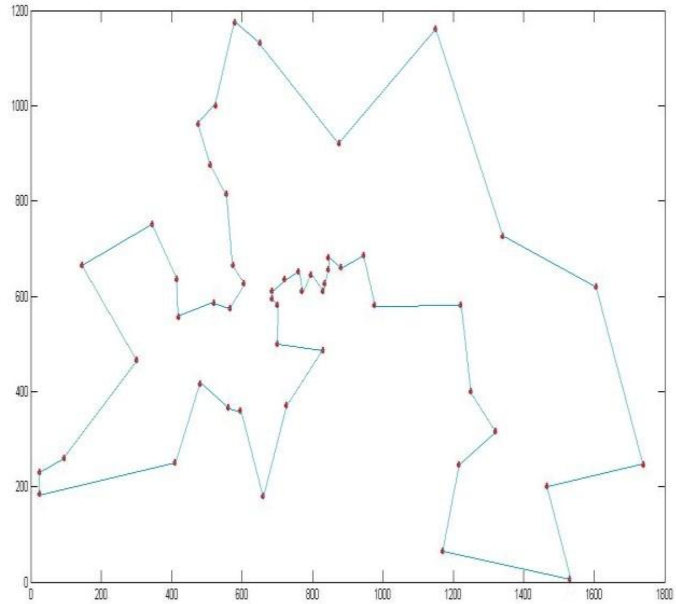


Figure (10): *The chosen path for standard Berlin52 by the new solution*

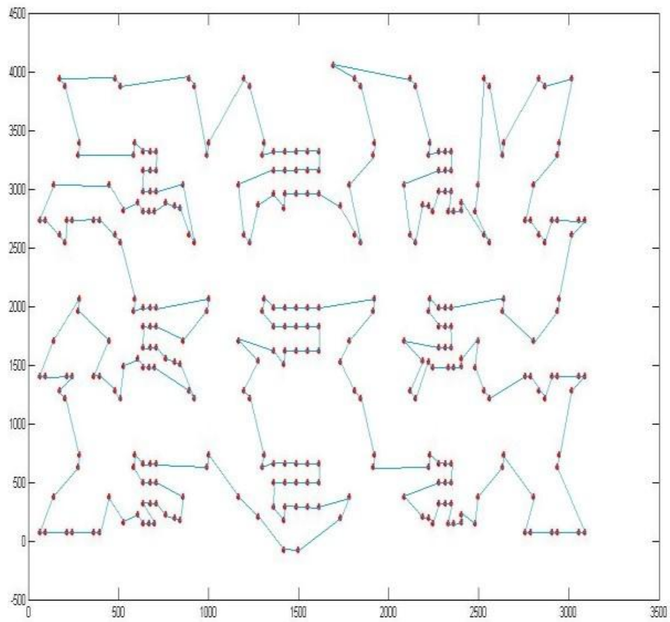


Figure (11): *The chosen path for standard lin318 by the new solution*

3. Result and discussion:

3.1 Conclusion:

The traveling salesman problem is one of the Np-Complete problems that so far no one has been able to provide a solution to give it any data and obtain the most optimal Hamiltonian circuit for that data in a reasonable time, and hence that the researchers are trying to bring this problem closer to the complete solution and we have also tried to bring this problem a few steps closer to the complete solution and according to the simulation results it shows us that this solution It can find an almost optimal route for the traveling salesman and provides a route that is free of dead ends, intersections and tries to choose the closest nodes to each other as much as possible, all of which can be one of the advantages of the new route.

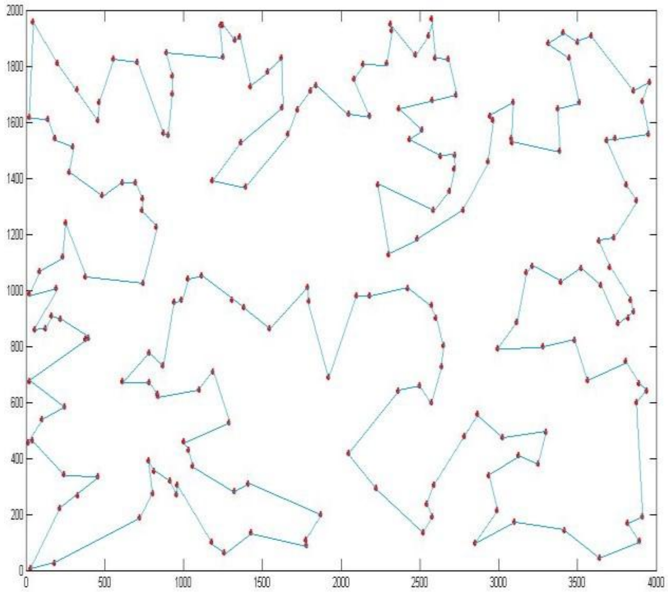


Figure (12): *The chosen path for standard KroA200 by the new solution*

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