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A NOVEL LOGISTIC TRANSFER USING OPTIMIZATION ALGORITHMS IN NATURAL DISASTERS AND HUMANITARIAN SERVICES

Suha Abdullah Ahmed AHMED

Master's Thesis

Supervisor

Asst. Prof. Dr. Abdullahi Abdu IBRAHIM

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The thesis titled A NOVEL LOGISTIC TRANSFER USING OPTIMIZATION ALGORITHMS IN NATURAL DISASTERS AND HUMANITARIAN SERVICES prepared by “SUHA ABDULLAH AHMED AHMED” and submitted on 13/12/2022 has been **accepted unanimously** for the degree of Master of Science in Electrical and Computer Engineering.

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Suha Abdullah Ahmed AHMED

Signature

DEDICATION

For those who taught me that the world is a struggle, and its weapon is knowledge, my dear father. To the most wonderful woman in existence, my dear mother to my companion, my beloved husband, my wonderful brothers and children, and everyone who has supported me in my academic career.

I dedicate this success.

ABSTRACT

A NOVEL LOGISTIC TRANSFER USING OPTIMIZATION ALGORITHMS IN NATURAL DISASTERS AND HUMANITARIAN SERVICES

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Today, there are thousands of organizations involved in the activities of transporting goods, services or people from one point to another. Due to the dynamic conditions of our era, the goals and limitations of organizations are highly variable. In this context, one of the most common problems faced by organizations is the impossibility of carrying out activities such as the distribution of vehicles to service points, transportation, and logistics.

In this study, efficient Logistic transfer algorithm presented to find minimum path by using PSO based Ant Conny optimization method. The main contribution in this study is combining PSO with Ant Conny optimization method to find the best path with minimum execution time. Several scenarios are executed to validate the presented method. Finally, the obtained results compared with several studies presented to solve the same problem.

Keywords: Logistic Transfer, Optimization Algorithms, Natural Disasters Humanitarian Services.

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ABBREVIATIONS

SVM	:	Support Vector Machine
NN	:	Neural Network
RBF	:	Radial Basis Function
ANN	:	Artificial-Neural-Network
PSO	:	Particle Swarm Optimization Algorithm
ACO	:	Ant Colony Optimization Algorithm
GA	:	Genetic Algorithm
SN	:	Signal/Noise
VRP	:	Vehicle Routing Problem
CCR	:	Cell-cycle Risk
ABP	:	Vehicle Routing Problem
MDARP	:	Multi-Depot Vehicle Routing Problem
KARP	:	Capacity Constrained Vehicle Routing Problem
SARP	:	Static and Dynamic Vehicle Routing Problems

1. INTRODUCTION

Today, the concept of optimization has acquired a structure that can be applied to any subject, according to the needs of any organization. The notion of disaster, one of the most debated topics in recent times, is another issue that has a major impact on social services. In order to minimize social disasters in the concept of disaster, the concept of optimization has become an unavoidable necessity, the structure of which can meet the needs of any organization. When the optimization concept is evaluated in terms of disaster logistics, which is an indispensable concept after a disaster, the correct alignment and sequence of vehicles is questioned. Vehicle management and sequence are evaluated according to the vehicle management concept [1][2][3]. The vehicle routing and vehicle routing problems, which benefit many players in the public sector service industry, from logistics to transport, from emergency services to transport, consist of equations that can provide objective functions appropriate, and depending on the type, this problem is destined to be solved. Of these, emergency services are the most notable [4]. More efficient and accurate vehicle guidance is paramount because the delays at the heart of the problem are unacceptable to emergency services. For this reason, it is closely related to the concept of disaster logistics. It is very important to ensure that the vehicle handling problem is also used in the emergency services and it has been argued that this importance stems from the nature of this transport problem. Issues requiring urgency here; It is believed to be characterized by minimizing loss of life and property after natural or man-made disasters, maximizing pain relief for people, and ensuring social order. According to the International Disaster Database, the concept of natural disaster is also divided into two parts: natural disasters and man-made disasters, and it can be seen that there are subclasses in the main inflection . Considering the concept of natural disaster, an important question is what to do before and after a natural disaster.

While examining the awareness raising activities and stage rules about the disasters before the disaster, if the disaster exchanges are to be made, reduce or remove the decision. Responders are quickly tamed for post-disaster negatives. For this fast and effective way of getting help, it can be reached by a way of choosing the optimum routes from the help, the use of these places and the use of these places that come together with the communication infrastructure. Post-disaster relief services have found a place in the literature under different names. These Names are Kovács and Spens [5] This concept is Associated with the Concept of Humanitarian Logistics, Humanitarian Aid Supply Chain, Disaster Relief, Disaster Relief Supply Chain, Disaster Recovery, Disaster Relief Supply Chain, Disaster Relief Logistics (Routing, Location Selection, Right) With Mathematical Problem-Solving Techniques (such as Infrastructure Service at Points). After the disaster, the issue of vehicle routing should be looked at in more detail, since it states that the mathematical barracks are still alive. Литература Developed Under the Concept of "Пробetroor гезина сатичи" And Found Itself As A Subject Of Study Today. It is also described in Youd, Who Tells the Shooter to Pass Through the City Only Once. Oakmini Literature Flood [6] continued as a daily truck exhibition with the introduction of Hadith and Literature. From the general point of view of this Problem of logistics and supply companies, this problem begins in daily life once it is called by a customer. A study continues to enlarge this.

In all of the above cases, vehicles providing services (trailers, trucks, buses, ambulances, fire engines, planes, etc.) have been known to pull over at any time and drive away from that location to complete the job. shift. At the end of the day or at the end of the service time, these vehicles return to their places, prepare a new route and begin their next journey. This level of treatment unknowingly increases costs, but can also be poorly planned, undesirable in the case of paramedics, or cause events such as increased or decreased absenteeism. Image. Advantage. An important concept is that plans on such important matters are sensitive and precise, the adequacy and success of the goal is returned to the organization or enterprise, with positive results affecting human life in the region. of the activity. Disaster. Logistics. The objective of the study was to optimize car journeys based on the theme of emergency logistics developed in the context of emergency services and street vendors. Therefore, mathematical work is taken care of to provide the fastest and most efficient after-sales service for successful vehicle tracking.

Vehicle routing is the process of ordering, prioritizing and routing these requests, for example B. Transport, Transport and Delivery, determined by the number of vehicles or vehicles requested. In the context of this issue, which has an important place in many sectors such as supply chain, logistics, health services, security services and transportation services, it is important to create the most sensitive and optimized route to meet the needs. . The route also takes into account constraints such as the minimum cost of transportation, and if such a route is viable, deciding which vehicles will respond to which requests and in what order.

These limitations and variables in the system to carry out a successful routing work today are some real-life examples. Considering the supply processes, shipping time and money spent on it, a successful vehicle driving system is of great importance. The minimum time allotted for the purchase of a product or service will bring satisfaction. In today's competitive environment, this satisfaction is the key to success in both the public and private sectors. Minimum service time effort is a cost factor and reaches high levels in large systems. The cost elements mentioned are material costs or social costs. Therefore, as mentioned, the success of the vehicle route plays a very important and sensitive role in all long-term systems. one sample of

Figure 1.1: Disaster logistics.

1.1 THE IMPORTANCE OF DISASTER LOGISTICS

It is not necessary to go far to emphasize the importance of disaster logistics, known as the disaster concept. The Marmara Sea earthquake that struck our country in 1999 is a very apt example of this theme. A study conducted to understand the effects of the 1999 Marmara earthquake stated that the earthquake killed 18,000 people, injured 50,000 people, destroyed 5,000 buildings, and damaged 340,000 buildings. On the other hand, it was also reported that 14,513 jobs were lost, 150,000 people were made unemployed, and 129,338 people were forced to live in prefabricated houses. Furthermore, after the earthquake, 39,928 out of 129,338 people were forced to live in prefabricated houses for some time [7]. Furthermore, another study showed that about 500 natural disasters occur in the world every year, and these natural disasters cause about 70,000 deaths and more than two hundred million people are affected by these disasters [8].Looking at the numbers, it is impossible not to realize the importance of the situation. Data shows that in a world where natural disasters are unavoidable, postmenstrual services are essential. With a disaster relief transportation service, the death toll can be kept to a minimum and the injured and those indirectly affected can be offered a service that can ease their suffering. For these reasons, disaster logistics is a subject of study and development, and its importance cannot be denied based on the figures given.

1.2 THE AIM OF THE STUDY

The proposed section shows that natural disasters have a serious impact on human life. In order to minimize the destruction, the occurrence of natural disasters, the concept of disaster logistics was formed. Mathematical characteristics play an important role in the development of this disease. The success of observed logistics is measured by the achievement of optimal results. These results are optimistic in several respects, in some cases they receive extended services and in some cases they obtain the highest score. In other cases also in the form of risk minimization. In the field of disaster logistics in particular, success will be decisive for the occurrence of natural disasters. The objective is to offer services at the service points most suited to the routes. At these times, the routes that the vehicles must follow must be real, the shortest and the most efficient. Therefore, the optimization of fast media routes becomes an effective concept in disaster logistics. Indeed, it supports the optimization of vehicle routes and logistics in the event of natural disasters.

Many optimization techniques are currently being used to decide how to get the correct driving result. In parallel, many resolution methods have been developed. To get the most accurate result, vehicle routing problems are divided into different classifications to apply these methods and techniques. It is extremely important to make this classification because theoretical methods are complex and time-consuming to solve in relation to real problems. In addition to classification, methods of solving these problems were also differentiated to solve various models by dividing them into certain divisions. Driving a vehicle, which has been studied by many scientists and academics for more than 50 years, has become more controlled in recent years due to the aforementioned elements. It can be seen that the new vehicle routing problems, solution models, mathematical and heuristic methods introduced over half a century have systematically multiplied. Over the years interest in road routes has grown and attempts have been made to contribute to the literature. This is a fact when we look at the studies done all over the world using various databases.

1.3 METHODOLOGY

The study will try to make a contribution to transport systems by identifying an application area to be chosen in the framework of disaster logistics with the theme of vehicle routing as a methodology and developing an optimization procedure for this area of application. Optimization displays the network. This network also presents risks due to several factors. Therefore, part of the risk analysis is also included in the study. The optimization performed in this study works on the assumption that it will reduce travel times for congestion and other causes, but this assumption is considered hypothetical to allow the study to begin, rather than an assumption who may be checking. In other words, it shed light on the investigation and made the first step easier. In order to reduce the time indicated in this direction, it is necessary to find the shortest routes and create routes, optimizing the risk present on these routes. Therefore, a two-step optimization takes place during routing. In the first step, the objective function is used to generate the shortest distance. After that, you can minimize the risk value of the created path. The results of the study are revealed by calculating the travel time for the shortest and least risky routes. As part of this study, we have tried in the first part to give an overview of the reasons for which the study on this subject was carried out and the link between the route of vehicles and the logistics of disasters with a general introduction. The second part proposes a classification of vehicle routing problems and an evaluation of research on this subject. The following sections discuss the Vehicle Routing Problem (VRP) and its underdiffraction, and the concept of disaster logistics. Next, the relationship between disaster logistics and vehicle handling is discussed in detail. The following section explains how to perform a risk analysis and how to optimize the risks. Of the existing methods to solve the vehicle trajectory problem and the chosen method, the chosen reason was PSO, and information about CCR is given in the section following the analysis method risks. The following sections provide information about the Applications and Results sections. The studio will seek to take advantage of this when deciding which vehicle route to take for disaster logistics with PSO and “vehicle route activities will find the shortest travel distances and minimize travel times and provide disaster logistics services as quickly as possible after a natural disaster and less risky roads We are trying to test the hypothesis "this will be a worthwhile business"

2. OVERVIEW

2.1 VEHICLE ROUTING OVERVIEW

As stated in the introduction, vehicle routing has been the subject of many studies. There has been a significant increase, especially in recent years. Looking at the research, there are different definitions when it comes to finding the definition of the trajectory of vehicles. Although these definitions are expressed and conveyed differently, they are basically similar. In Thoth and Vigo's book, transportation demand is defined as the determination to implement these road routes as much as possible by deciding which demand will be met and in what order by a group that includes all or some of the requests. at the lowest cost available (2014). Looking at another definition, vehicle routing problem is the delivery of goods and products from one or more warehouses to customers in different locations with existing vehicles [9]. Analog Vehicle Routing: It is an efficient product allocation in which fleet routes and times are determined by minimizing all distribution costs by providing various constraints or needs such as vehicle capacity, vehicle load and/or delivery time intervals and availability of vehicles. [10] It can be thought of as providing common features, constraints and meeting requirements in an appropriate way at various times in extended definitions. And while providing these, providing the most accurate route with the lowest cost has been the subject of the vehicle routing problem.

Figure 2.1 visualizes the vehicle routing problem in a way that simply illustrates the above mentioned mathematical expressions. In the figure, three different routes from a warehouse to various demands and their structure designed in accordance with the desired purpose function are represented

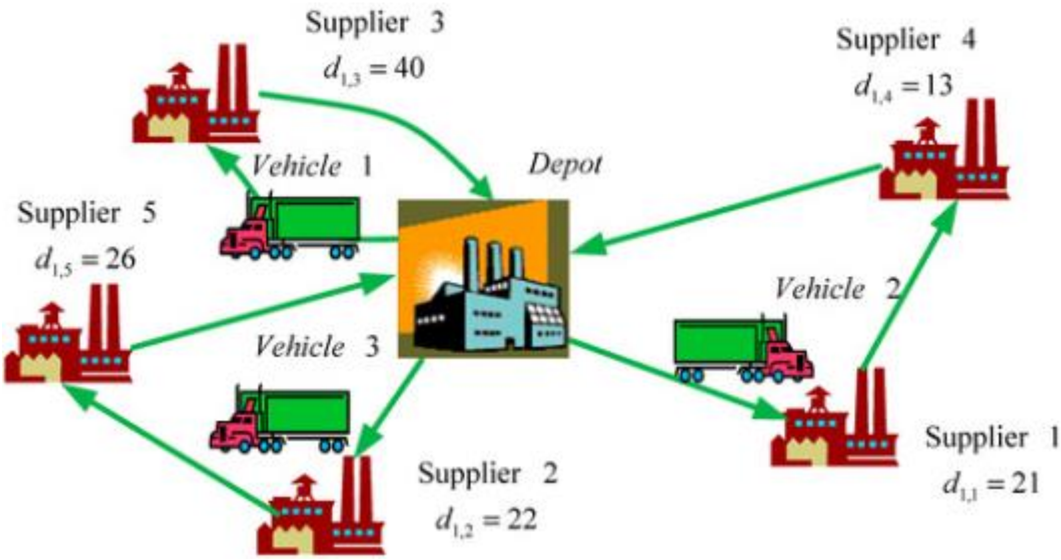

Figure 2.1: Graphical representation of the vehicle routing problem.

2.2 VEHICLE ROUTING PROBLEM (ARP) CLASSIFICATIONS

As mentioned in the previous sections, classifications have been made in order to conclude the solutions in a more practical and easy way in vehicle routing problems. The purpose of classification is to visualize the problem type and to determine the actions to be taken more accurately. In addition, thanks to the classifications, it is revealed how detailed the subject has been studied throughout history and how deep the subject has been.

Constraints are also an important issue in optimization studies, such as objective function, variable definitions, variable signs. Considering that vehicle routing problems are also optimization studies, it is necessary to mention the classification and studies made according to the constraints that are of high importance in their solutions

2.2.1 Capacity Constrained Vehicle Routing Problems

It is the situation where each vehicle in the fleet has a certain capacity and customer demands are known. It is the most common type of problem. It usually has a deterministic structure. Vehicles start the transport process and return to the warehouse again. The distinctive feature of this type of problem is that while minimizing the total travel distance of the vehicles, it evaluates it with a certain fixed cost and limited capacity of the vehicles.
The capacity constrained vehicle routing (KARP) problem is classified as arc routing problem, which expresses meeting the demands of each customer as a result of associating

each customer with an edge or arc in graphical representation [11]. Although integer programming is suitable for solving this type of problem, it is stated that integer programming is time consuming for large-scale problems.
The important thing in the solution methods established for this type of problem is to express the capacity constraint correctly and to prevent the vehicles from going to the requesters more than once during their tours [12].

2.2.2 Distance Restricted Vehicle Routing Problems

Each vehicle in the fleet has a certain distance constraint. This restriction finds its place in the problem as maximum distance or time. Laporte et al. [13] studied this constraint. The main reason underlying this type of problem is that some demands are located far from the warehouse in terms of distance, and meeting the distance causes fluctuations in the objective function. In addition, such demands in problem solving give very inefficient results, especially when heuristic algorithms are used. For this reason, Li et al. [14] created a structure in the form of providing services according to the constraint they developed in order to meet the long-distance demands.

2.2.3 Divisible Demand Constrained Vehicle Routing Problem

Bolduc et al. [15] defined it as a situation in which customers' demand is met by more than one vehicle. Dror et al. [16] changed the problem from heuristic methods to integer programming. In the literature, it has been shown by the studies that the demands cannot be met from a vehicle in divisible demand-constrained vehicle routing, which is affected by the type of problem referred to as the Rural Postman Problem. The study by Ho and Haugland (2004) on six problem sets combined divisible demand-constrained vehicle routing with time-constrained vehicle routing.

2.2.4 Multi-Depot Vehicle Routing Problem (MDARP)

It is the type where the number of warehouses in the system is more than one. In this case, it is a compelling situation because of the assignments of which warehouses the vehicles will use. The most widely used case study on this subject in the literature is Cordeau et al. [17] developed a new solution method. The development of multi-depot vehicle routing problems is due to the fact that there are few institutions providing services with a single depot in today's conditions and there are transfers between depots. In this type of problem, there are situations where the vehicle leaving each warehouse returns to its own warehouse and also it may occur on the routes between the warehouses. Ho et al. [18] provided a hierarchical solution to this problem type in three steps in their study, and this hierarchical structure is as follows; first, the assignment of the requesters to the warehouses, that is, the clustering, then providing service to the assigned customers by creating routes in accordance with the purpose 17 function, and finally, ordering each route according to the warehouses. Considering that the solution becomes more difficult in parallel with the increase in the number of warehouses, the solution becomes easier and less time-consuming with heuristic algorithms.

2.2.5 Periodic Vehicle Routing Problem

It is the type of problem in which route plans are made periodically. Vidal et al. [19] studied this type of problem with the method they developed based on the Genetic Algorithm. In addition, Angelelli and Speranza [20] approaching the issue of periodic vehicle routing from another point of view, made a reverse change in the problem by taking delivery of products or services from the customers to the warehouse instead of taking products or services from the warehouse to the customers. They have made a significant contribution to the subject of reverse logistics by handling this study with the waste collection service. On the other hand, another of the studies on periodic vehicle routing is Alonso et al. [21] stated that the results they reached by using a heuristic algorithm in a system with 1000 customers were more successful than the results of other problem types with the same number of customers.

2.2.6 Stochastic Vehicle Routing Problem

It is the type where randomness is in question in the variables in the problem. In this type of problem, problems are tried to be solved by establishing models with historical data sets. It is a type of problem that is the subject of quite frequent study since many variables can be stochastic. In the literature, Schilde et al. (2011), Laporte et al. (1992), Gendraeu et al. (1995) and Novoa and Storer (2009) studies, it is seen that the factors that enable stochastic vehicle routing to have a stochastic structure are as follows; -Stochastic demands -Stochastic customers -Stochastic vehicle travel time Due to the aforementioned reasons, vehicle routing takes on a stochastic structure and optimization is made in accordance with the objective function by extracting probability diagrams that can be formed from previous probability data. The concept of stochastic can be seen on different parameters and variables. It is noteworthy that three different general characteristics are studied in the optimization made with historical data sets and stochastic model methods. Customer demands, the duration of the service and the time spent on the road can be stochastic (Lahyani et al, 2015). In stochastic models, the study begins by assigning random variables. The reason for assigning this random variable is that there is no exact data available for solving the problem. In the continuation of the problem, the past data is handled and the study is carried out by analogy with certain probability density functions. Bent and Hentenryck (2003) made their study by comparing customers' requests within the system, that is, their involvement in the system, to the Poisson probability distribution [22]. As a result of this assignment, the problem is tried to be concluded with intuitive and mathematical models and solution methods. The most widely used method in the literature for mathematical models is the Markow Chain Decision Making Process. In the literature, Laporte et al. (1992) used the branch and cut method for the stochasticity of travel time for normal size problem sizes. The stochastic nature of the demands Laporte et al. (2002) solved it with the full 19 numbered L-shaped algorithm in their study. In addition, Secomandi (2001) also discussed the stochastic nature of demands with "rollout algorithms" in his study. As it is said in this subject, there is a situation where there is inaccurate information in the parameters [23]. If this information is not certain, studies are carried out by adapting the data of the past to a certain distribution, so that the data obtained to make the needed plan can be used in vehicle routing problems.

2.2.7 Time-Dependent Vehicle Routing Problem

It is the type of problem that indicates that the time the vehicle will spend along the road and reach the customers must be within a period of time. Explanations have been made because it is important to understand the type of problem in the model to be established in the classification determined according to the constraints. In addition to these, there are open-ended route and closed-ended route types, respectively, according to the situations when the vehicle leaving the warehouse does not come to the warehouse or arrives, and symmetrical and asymmetrical problem types, respectively, according to the situation where the distance between customers or requesters along the route is equal or not. The fleet structure, which can have a homogeneous or heterogeneous structure, constitutes another type. If all vehicles in a fleet have the same equipment in terms of physical features such as cost, size, speed, it is a homogeneous fleet. Conversely, if there are differences in these physical properties, it is said to be a heterogeneous fleet [24].

2.2.8 Static and Dynamic Vehicle Routing Problems

One of the most common classifications in the literature is the distinction between dynamic and static vehicle routing problems (DARP and SARP), which is determined according to the variability of the information included in the system. If precise and complete information is provided to the person who will make the plan about the information entered into the system, this is a static vehicle routing problem. On the other hand, if this information changes over time (such as cancellation, new order, new customer)[25], a dynamic vehicle routing problem arises. In the light of researches, two factors that are important within the scope of dynamic and static vehicle routing issues and that enable a clearer understanding of this distinction are the development of knowledge and the quality of knowledge. The development of knowledge is divided into deterministic and stochastic in terms of whether the requests are known beforehand in routing, and the quality of the information, that is, the accuracy of the data used as input if it is necessary to tabulate his work, since it would be easier to focus on 20 study subjects, the following table was created based on this basic distinction [26].

2.3 VRP CORE COMPONENTS

Some components are essential for ARP. These components are the concepts included in the definitions when the definition of ARP is made. Route and road maps come first among the components and are the plans of the distribution points that the vehicles will visit sequentially. The key issue in this component is routing and timing issues. The route solution, which specifies the path to be followed by the vehicles, is formed to meet the purpose of the function to be provided. Customers and requesters in the system are the main nodes in the distribution network. These requests can be goods or products to be purchased from the customer or services to be provided to the customer. Logistics distribution includes both receiving and delivering goods from the customer. In emergency services, there is a service delivery to the customer. Warehouses or stops are the starting and ending points of the routes of the vehicles in the system. In services such as buses and taxis, they can also be called stopping points. Vehicles, which are the last component, are important in terms of their capacity, the condition of the load they can carry, the maximum weight they can carry, and the principle of not traveling empty. The structure formed by the vehicles in the routing problems is called the fleet in the problem and it has been stated in the previous section that it can have a homogeneous or heterogeneous structure. In order to reach a solution in vehicle routing problems, firstly the steps and the ways to be followed are specified in the literature. To state these step-by-step, the first thing to do is to create clusters of vehicles with requesting customers. This is followed by creating the first route. Optimization is made by applying one of the solution methods that will be mentioned in the following sections with this first route created later. After the optimization, the measurement of the vehicle routing problem can be made, the results are evaluated and compared with the solutions in the literature [26]. After the basic components listed and how to reach the solution, the issue that needs to be done is how to make a solution for vehicle routing. ARP is a very rich subject in terms of solution method diversity. After bringing together the essential components of ARP, the final stage is to find the appropriate solution method. Precise methods or heuristic methods have different advantages and disadvantages [27].

2.3.1 Vehicle Routing Problem Solution Methods

Vehicle routing is a type of problem that has been trying to solve the problem by using many methods since its emergence. It is stated that it emerged in the 1950s. As of this date, systems that initially consisted of a small number of customers were dissolved. Subsequently, the use of heuristics began by increasing the number of customers. In the future, the methods that gave full results, consisting of mathematical models, continued to be studied, and heuristics continued to be used as well. In recent years, meta-heuristic methods have taken their place. There are basically two different classifications for ARP that have been brought into the literature. One of them is precise methods and heuristic methods that give exact results [28].

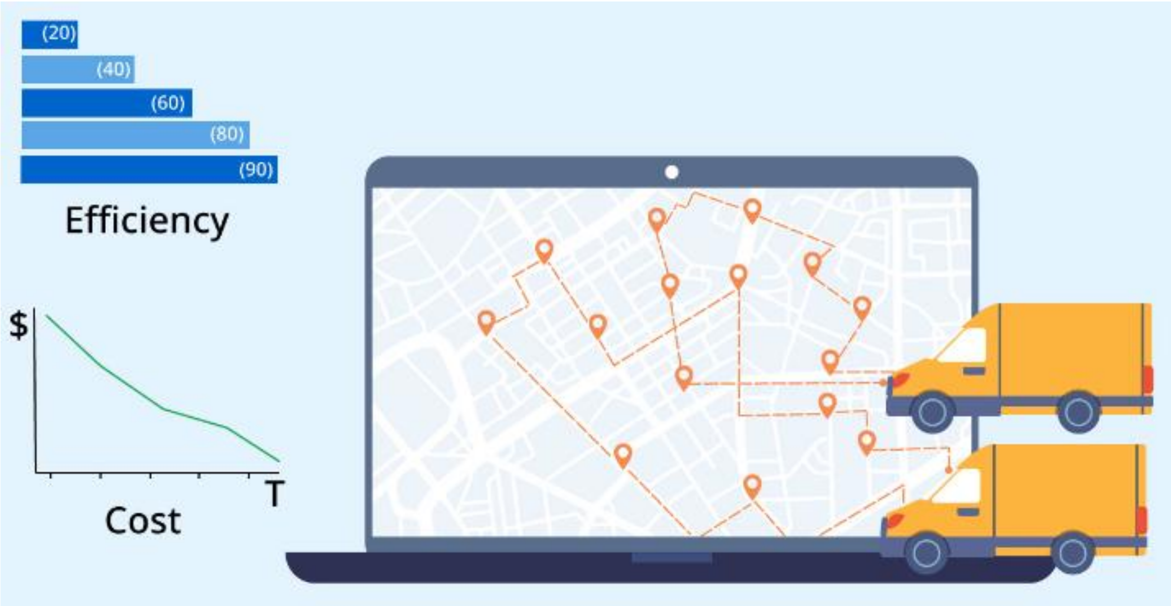

Figure 2.2: Vehicle routing optimization software.

2.3.2 Heuristic Methods

Heuristic methods are methods that work without exact results but have certain deviations from methods that give full results. However, they are more suitable methods in terms of practicality to reach the result. They are structurally convenient solution methods for large problems. Heuristics with a flexible solution structure are very fast for large problems with many variables, which is the biggest advantage of heuristics. When compared with the solution methods that give full results, it is understood that the benefits to the employees in big problems are quite high. Three categories of heuristics for ARP, respectively; structural heuristics, two-stage heuristics and improvement heuristics [29]. In addition, as Ropke stated, heuristics are divided into normal heuristics and meta-heuristics in terms of expediency. The advantages of heuristic algorithms for ARP are as follows [30];

a) Solution Quality and Computing Time,
b) Code Simplicity and Realizability,
c) Flexibility,
d) Vigor,
e) Simple and Analyzable,
f) Interactive Computing and Technology Changes.

2.3.3 Disaster and Post-Disaster Relief Services Concepts

The concept of disaster is a sensitive subject of today and it is very important to address this subject when its consequences and effects are considered. Disasters cause social wounds by affecting human life in many different ways. In order to minimize these social wounds, it is an indisputable fact that one should always be prepared for disasters. Disasters are a concept that brings great destruction, includes earthquakes, floods, fires, landslides and many other natural events and events not belonging to nature that are created by man. In order to minimize the consequences of this great destruction, disaster-fighting works are carried out continuously. In this regard, aid activities aimed at improving human life after a disaster, restoring people to their former welfare and erasing this great social trace are a very sensitive point. Providing aid activities at the optimum level possible is the element that will minimize these results. For this reason, disaster logistics, which develops with disasters, also reveals this situation. The most critical concept in disaster logistics is to help every individual who is in need of help after a disaster as soon as possible. It is possible to achieve this with the concepts of transportation and logistics under complex and dynamic environmental conditions after the disaster. Aid that does not arrive in a short time can increase the size of the destruction rather than decreasing it. The concept of disaster logistics emerges as a concept consisting of the concept of disaster. For this reason, it will be important to first recognize what the concept of disaster means with the studies carried out. disaster by TDK; "Destruction caused by various natural events." appears as. In a study from the literature, a disaster is defined as a destruction that threatens the priorities and objectives of a system and physically affects this system [31]. In another study in the literature, the definition made by the United Nations Disaster Reduction Strategies (UN/ISDR) is included, and disasters are defined as follows; It is a serious condition that disrupts the functions of society and has a wide range of significant effects on human life, human health, property and property of people, and the environment in which people live, which is caused by an accident, natural event or man-made or a sudden or long-term complex process [32]. Based on these definitions, it is seen that a post-disaster chaos and undesirable results are inevitable. On the other hand, a common deduction from the definitions is the concept of destruction. Post-disaster chaotic situation and destruction are common points for disasters. In the axis of these concepts, dealing with disasters will be an extremely critical role. The International Disaster Database (UAV) has analyzed the concept of disaster in a different way.

Based on the definition and classification of disasters, the process of delivering aid to the centers affected by the disaster after the disaster becomes important in order to minimize the negative consequences of disasters. When the concept of disaster and aid delivery are considered together, it can be seen that studies have been made under various headings in the literature. These aid activities can be grouped under 4 headings. These four titles are respectively;

a) Emergency aid services,

b) Aid services to provide rehabilitation,

c) Aid services to improve the current situation,

d) Aid services to make a living [33].

Considering these concepts mentioned by [34], emergency aid services provide aid activities that need to be met in a short time, rehabilitative aid services help processes needed to restore old life conditions after disasters, aid services that improve the current situation, help the society to be better. Aid services that will provide assistance and support services that will provide a livelihood correspond to the aid activity in which their basic needs are met. The activities of delivering aid services, which were categorized by Ludema and Ross (2000), were examined in two groups in another study in the literature. While the first group is "relief activities", the aid activities that need to be fulfilled as soon as possible with the aim of minimizing the risks experienced by those who struggle for life and health of people and where large quantities of services and products are delivered; The activities that must be performed in the long term in order to provide a continuous and reliable transportation, health, shelter and food needs in order for the society to be self-sufficient and sustainable are also examined in two categories as “development activities” [35].

The concept of disaster logistics was initially devoid of the concept of disaster in the literature; It is defined as the planning, implementation and control processes that involve the efficient and cost-effective transmission and storage of products or materials from a starting point to user points that will benefit from the products (Thomas and Mizushima, 2005). The sudden demands that the demands are unpredictable in terms of location, time, type and size, that the materials that need to be supplied in very large volumes must be supplied in a short time, that there is a large amount of materials to be procured on time and that the supply, people, technology, transportation capacity and Balcik and Beamon (2008) developed disaster logistics a little more by adding features under four different headings, such as lack of resources such as money [36]. From a definition point of view, disaster logistics developed over time and differentiated from the concept of logistics and started to become more special. The concept of disaster logistics, which emerged in a reactive structure to intervene in undesirable situations such as fire brigade and ambulance, and to fulfill its emergency duty, has evolved based on the aforementioned titles. It is seen that this differentiation and evolution has been examined in three different phases in the literature. These three phases are, in order, disaster preparedness, immediate assistance delivery, and post-disaster reconstruction [37]. The preparation phase is the first phase of disaster logistics, which describes a proactive structure in coordination with various organizations with a regional and supraregional perspective that requires being prepared for all kinds of disaster scenarios. The issue of being prepared for all kinds of scenarios is a strategic structure that covers a wide spectrum from positioning in suitable locations to using the most accurate and shortest vehicle routes. The immediate assistance service, on the other hand, covers the demand and supply management developed under the umbrella of a short-term project management, and a risk management rules should be ensured to work here. The last phase, restructuring, is a phase that includes continuity plans at the regional level and long-term project management from a supraregional perspective, in order to ensure that people and society regain a prosperous and sustainable life.

In disaster logistics, the part of immediate assistance, which describes the concept of post-disaster intervention, has been explained in the literature for certain periods. Priority actions must be taken within the first 72-36 hours after the earthquake, and the first 12 hours of this are of vital importance. The delay in these periods can cause the death of more people. In order to reduce the negative externality on the survivors in these time periods, it is critical to deliver products such as food, beverage and health supplies [38]. It is understood from this study that there are certain indispensable periods in disaster logistics and it is an important constraint for the damaged part of the society in terms of its externality. For this reason, considering the post-disaster relief efforts, it is extremely important to reach those affected by the disaster with aid vehicles within the first 12 hours in order to deliver aid as soon as possible. It can be said that the possible action options to reach these regions are divided into two. One of these is to choose the location of the warehouses where the aid products will go to the disaster victims at an optimum point, and the other is to create a transportation network consisting of routes that will reach these regions by using the shortest roads.

3. MATERIAL AND METHODS

3.1 THE RELATIONSHIP BETWEEN DISASTER LOGISTICS AND LOGISTICS CONCEPT

When the concept of humanitarian aid logistics, which has a reactive structure, is considered in detail, it is understood that the differentiation that started with the change observed in the definitions over the years has evolved to a different point from the logistics concept used by profit-oriented organizations. In the previous chapters, what disaster logistics is has been explained conceptually. Its functional structure will be explained by comparing it with the concept of logistics. In [39] examined the two concepts in their study and found that there was a similarity in activities such as preparation, planning, purchasing, transportation, storage, monitoring and customs procedures; but there is a fundamental difference and that is the focus. They stated that this focus point is to reach the end customer in the concept of logistics used in profit-oriented organizations, while in disaster logistics it is to compensate the losses of the injured. Beamon and Balçık have discussed in their study that the concept of disaster logistics differs from the concept of logistics used for profit-making organizations in terms of some basic features, and in this context, they stated that this difference is mainly based on 4 subjects. Strategic targets were handled in the form of customer and demand characteristics and environmental factors. In addition to these, they examined the humanitarian aid logistics in more detail under the umbrella of these subjects in a wide range and stated the features that differentiate them. Considering the features that differentiate disaster logistics by [40], the following items have emerged in disaster logistics:

a) It is not possible to predict when, location, type and size of the demands,

b) Large quantities and sudden requests are delivered in a short time.

c) The necessity of reaching the relevant points in sufficient quantity on time,

The lack of resources in matters such as the supply of the requested products, human resources, technology, transportation capacity and money. Safeer et al. (2014), on the other hand, evaluated disaster logistics by considering the aim of maximum aid response and minimum loss, and noted the difference. In another study, which shows the difference and indicates its key points, it is stated that the main purpose of the logistics concept used for profit-making organizations is to optimize processes such as production, distribution and waste recovery [40]. In addition, its main purpose is to minimize transportation costs, to be clearly aware of the fact that the products are delivered from the producer to the end consumer, to know the demand quantities, to have decision-making mechanisms, to supply high amounts of products in certain routines, to have a robust social network structure and support systems for these transactions. It also shows features such as being supported with. On the other hand, disaster logistics covers the activities of mitigation, preparedness, involvement and recovery for emergencies that occur at any time. They include concepts such as mitigation and preparedness for pre-disaster situations, responsiveness for post-disaster transportation services, and recovery for long or short-term recovery in post-disaster situations. [40]. In this context, [41] in his study; They tried to reveal the relationship and differentiation in 8 different subjects: purpose, source of flow of products, demand information, decision-making mechanism, period, volume of demands, social texture and network structure, and support systems in transportation. It is possible to encounter the differentiation of disaster logistics frequently in the literature. Although they have certain similarities, the differentiation between them is based on the concept of disaster, as stated in the previous sections [42]. It can be said that the nature of the concept of disaster to cause great destruction and the fact that it has the processes of emergency response to each affected region and improvement of the regions after this destruction has pushed disaster logistics to such a degree of differentiation. It is not in a structure that results only in the delivery of the product, as in the concept of logistics. When talking about differences, there is a structure that pushes this differentiation. This building is about transportation. When we look at the studies that indicate the differences of disaster logistics, these workers have always established the relationship between them through transportation activities, which is one of the activities [43].

3.2 OPTIMIZATION ALGORITHMS

Optimization is the process of finding the best solution to a problem. Optimization is used to find the most suitable theme within a theme. The goal of the project is to provide maximum system performance at minimum cost. With a classic design, the design proceeds only within the knowledge and experience of the designer. The designer validates the suitability of the project and carries out the project according to the desired performance or his own experience. While this approach is satisfactory in some ways, having too many constraints and variables in a design can confuse the designer and prevent the design from reaching the desired level. However, treating this process as an optimization approach faces design challenges in all respects. there; Optimization methods generally offer great advantages to designers over mathematical models. Figure 3.1 shows the optimal design process. After determining the design variables and design constraints in the figure, the design information is evaluated and a first draft is proposed. After this step, the design constraints are checked and it is determined whether the design performs as desired. If the project is suitable for the desired outcome, projects have been successfully completed. If the project is not suitable for the desired performance, the project is reanalyzed according to optimization to create another solution. While designing or manufacturing, there are many parameters that define the system and the most suitable ones should be selected from these parameters. For these reasons, optimization is used and the optimum values of the parameters must be found in the system. Optimum means the best, and optimization means the best. Optimization is the process of searching for the solution of the problem of maximizing or minimizing a real function by systematically using real or integer values within a set allowed for the solution. As can be understood from the definition, there is a difference between doing a job and doing it best. For this reason, optimization techniques are used and these techniques are mathematical methods. The aim of optimization is to find the optimum solution of a system or design by using optimization techniques. Today, differential calculation methods are still used for optimum solutions [44]. There are three important aspects that we should pay attention to in optimization problems. These are: 1. The problem will have a target function containing the target. 2. There should be design variables. 3. There should be constraints that define the limiting conditions in the problem. 63 Objective Function ; It indicates the degree of goodness of the system to be designed or optimized. It is defined as a maximum or minimum. Design-Problem Variables (Variables); It shows the variables of the problem to be designed or optimized. Constraints ; The constraints imposed on the design or problem are called constraints. Statements that show that the problem is appropriate in an optimization problem. There are many optimization methods depending on the functions used. Since the formula used in the calculation of the activity is exponential and nonlinear, it was determined that the most appropriate optimization function was lsqnonlin and it was used in the solution of this problem. It solves nonlinear problems using the Lsqnonlin least squares method and is used to minimize continuous functions. The results obtained are local, that is, the results within certain lower and upper limits. The least squares method is a standard regression method used to write down the mathematical relationship between two dependently varying physical quantities as an equation that is as realistic as possible. In other words, this method serves to find a function curve that will pass "as close as possible" to the measured data points.

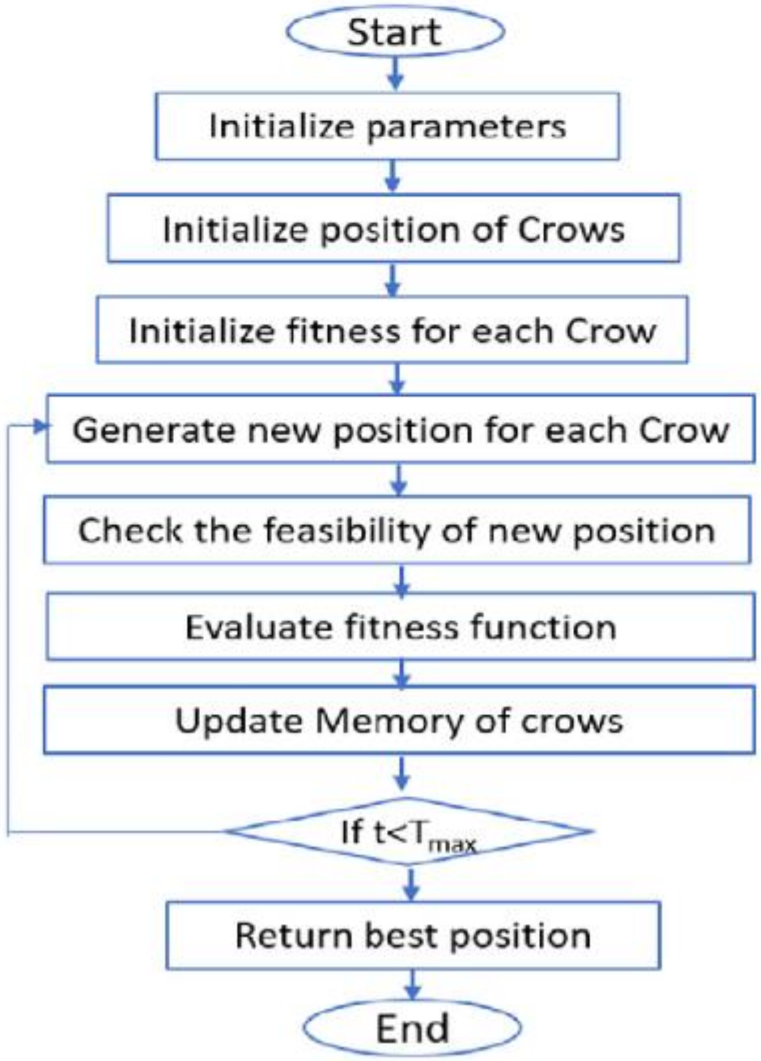

Figure 3.1: Optimization algorithm steps.

3.2.1 Genetic Algorithm (GA)

oday's complex and difficult conditions have led to the search for new solution methods that provide quick and easy solutions to problems. In particular, instead of hard optimization techniques, the use of soft computing and evolutionary algorithms has come to the fore. Genetic algorithms, one of the evolutionary approaches, have also started to take an important place in these searches. Genetic algorithms, whose application success is increasing and which are constantly being improved, are used together with other soft computing methods to develop hybrid solutions. Genetic algorithms are a search and optimization method based on natural selection principles. Its basic principles were put forward by John Holland. Genetic algorithms have successful applications in areas such as function optimization, scheduling, mechanical learning, design, and cellular production. Genetic algorithms, which differ from traditional optimization methods, use their encoded form, not 64 parameter sets. Genetic algorithms operating according to probability rules only need objective function. They scan a specific part of the solution space, not the whole. Thus, they reach the solution in a much shorter time by making an efficient search [45]. Another important advantage is that they analyze the population of solutions simultaneously and thus do not get stuck with the local best solutions. "Reeves; It states that more resources are allocated by national governments and organizations to genetic algorithm-based projects than to simulated annealing and taboo search-based projects" [46].As can be understood from this expression, genetic algorithms have advantages in various fields over the aforementioned artificial intelligence methods as well as traditional optimization methods. These advantages are related to the search structure of genetic algorithms. The search structure of genetic algorithms is explained by the subsequences theorem and the building blocks hypothesis. How genetic algorithms search is explained by the concept of subsequence. Subsequences are theoretical constructs used to explain the behavior of genetic algorithms. A subsequence is a sequence that describes the similarity between certain sets of sequences. Substrings are defined using the {0 ,1 , *} alphabet. For example, subsequence H is for the set of chromosomes with a value of 0 in the first position and 1 in the second and fourth positions. The symbol H = 0 1 * 1 * * means that it doesn't matter what value that position of the array takes or not. The array can take the value 0 or 1 at that location. If a sequence x fits the pattern of the substring, the sequence x is said to be "an instance of H". Substrings have two properties. These features are given below [45].1. Subsequence degree:

The degree of a substring H is denoted by o(H) and is the number of fixed positions found in the current substring pattern. This number is equal to the sum of the number of values 0 and 1 in the binary alphabet. 2. Substring length: The length of a substring H is denoted by δ(H) and is the distance between certain initial and final positions found in the current substring pattern. The concepts of subsequence order and subsequence length have an extremely important place in the fundamental theorem of genetic algorithms. Sequences with a low subarray degree and a short substring length are called "building blocks". This idea is known as the building blocks hypothesis. The basic theorem of the genetic algorithm is explained as follows [46]: Subsequences with short length and low degree, showing fitness above the population average of 65, multiply exponentially with the passage of time. This reproduction takes place through genetic processes, and as a result, individuals with superior characteristics than parents emerge. The increase in the quality of this solution from generation to generation is attributed to two reasons. These reasons can be explained as follows:

a) Since the reproductive chances of unsuccessful individuals are reduced, the deterioration becomes more difficult.

b) The structure of genetic algorithms not only prevents deterioration, but also provides a rapid improvement over time, according to the basic theorem of genetic algorithms. These reasons are better understood when the processing steps of genetic algorithms are examined. Due to its nature, genetic algorithms eliminate bad individuals, that is, unsuitable solutions, thanks to their operators. These processes continue in a loop until the stopping criterion is met. The processing steps of genetic algorithms, which have application possibilities and applications in many fields, can be explained as follows [47]:

c) All possible solutions in the search space are encoded as sequences. The first step in developing a genetic algorithm for solving a problem is to represent all solutions as a string of bits with the same dimensions. The coding of parameters allows problem-specific information to be translated into the form used by the genetic algorithm [48].

d) Usually a random solution set is chosen and considered as the starting population. A solution group is created in which possible solutions are coded. The solution group is called the population, and the codes of the solutions are called chromosomes. Random number generators can be used to generate the first population in the representation of chromosomes using the binary alphabet.

The first step after generating generations is to calculate the suitability of each member of the population. For example, for the maximization problem i, the term of the fit value f(i) is usually the value of the objective function at that point [48]. Every problem has a proper job that finds a solution. The trap function returns a numerical fitness value for a given chromosome that is proportional to the use or dose of the solution representing that chromosome. This information helps us choose the 66 best solutions for each generation. The higher the fitness of the solution, the greater the chances of survival, reproduction and representation in subsequent generations [46].

Transcription factors replicate sequences according to target functions and select individuals who are most likely to pass on good genetic traits to the next generation. Duplicate elements are artificial choices. Repeating sequences based on their fitness values increases the likelihood that sequences with higher fitness values will be produced for one or more offspring in the next generation. Replication consists of selection of individuals, transcription of selected individuals into a cohesive group, and pairwise fusion of group members [49]. The purpose of this method is to ensure that the values are twice the average.

To explore the potential of the current gene set, we use the intersection of factors to generate new chromosomes with characteristics that are superior to previous generations. Matching is usually applied to the chosen classification in subjects of the same probability as the selected transmission rate [48]. One of the main factors affecting the behavior of a genetic algorithm, the intersection factor, is the interception of the natural population. From the new set created by the multiplication process, two chromosomes are randomly selected and undergo crossing over.

Mating is used to find possible genetic potential. However, without the community having all the necessary coding information, we cannot provide a satisfactory solution at the interface level. So we need an agent capable of creating new chromosomes from existing chromosomes. Mutations solve this problem. In synthetic genetic systems, mutation operators prevent the irreversible loss of good solutions. The next generation is determined by the process of reproduction, mating and mutation, becoming the father of the next generation. This process continues with a certain degree of reproduction for the next generation. This process continues for a specified number of generations or until a target is reached or other discontinuation criteria are met. [50]. Parameters have a significant impact on the performance of genetic algorithms. Several studies have been conducted to find the optimal control parameters, but in general no parameters that can be used for all problems have been found [50]. These parameters are called control parameters. Control parameters included population size, exogenous probability, mutation probability, intergenerational difference, selection strategy, and functional measures. Genetic algorithms are able to solve complex problems quickly and almost perfectly, and can be applied to many different types of problems. Analyzing large areas of the solution using traditional methods leads to long computation times. However, genetic algorithms for these problems can be used to find acceptable solutions in a short time [51]. Genetic algorithms perform well, especially for large, discrete, and complex types of problems with solution spaces.

3.2.2 Ant Colony Optimization Algorithm (ACO)

ACO is a metaheuristic algorithm inspired by the behavior of real ants. Real ants are invisible. However, it can find the shortest path between the nest and the food source. Ants wander randomly, returning to their nests and, depending on their food, interfere with chemicals called pheromones. Other ants follow the pheromone trail to find food and reinforce the trail when they return to the nest. Over time, the pheromones begin to evaporate and become less attractive. Along the way, the strength of the pheromone is used to determine which route to mark. Ants find the most suitable path by choosing a path with a high concentration of pheromones. The Ant Colony setup is designed to solve the hawker problems and can be applied to merging problems as well. Due to the popularity and success of ACO, ACO data mining, semantic web, mobile bot path planning and pipeline alignment are used in various industrial sectors. GSP has cities and suppliers. The goal of the seller is to visit all cities once and complete the vicious circle as soon as possible.

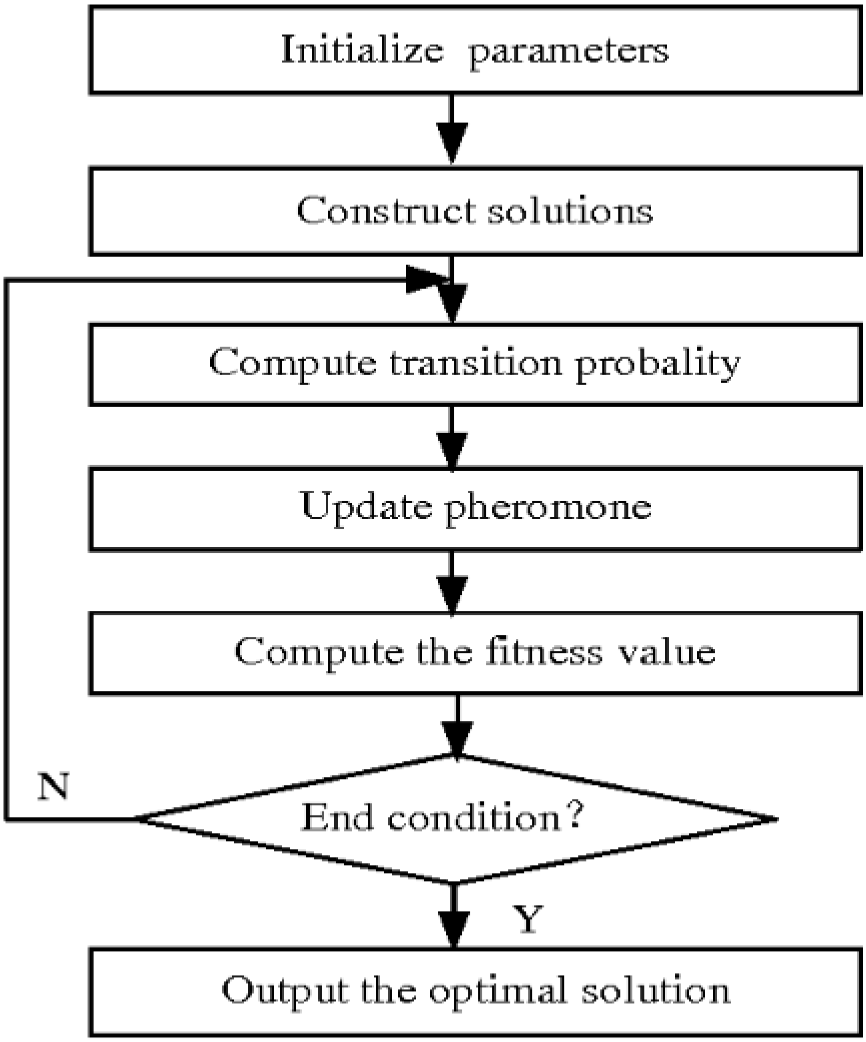

Figure 3.2: ACO.

3.2.3 Particle Swarm Optimization Algorithm (PSO)

As mentioned at the beginning of this article, explanatory algorithms are very effective in solving optimization problems. The PSO algorithm is one of them. Developed by Kennedy and Eberhart (1995), PSO is a population-based metaseutic optimization technique. The PSO algorithm is getting ideas about the social behavior of flocks of birds. Everyone in the community is called a particle and represents a possible solution. Particles converge optimally at the global level by scanning the search space following the best solutions available in the community. Thanks to the success and popularity of PSO, it has evolved into logistics, transportation, bioinformatics and economics. Finance, data mining, product design and manufacturing, automotive industry. The PSO algorithm works as follows. Each

PSO is new and offers a solution. Each particle has a fitness value that exists in the fitness function. Particles contain information about their velocity through the search space. PSO is initialized with many randomly generated particles. These particles search the search space for the best possible result and update their velocity and position information using equations (3.1) and (3.2) respectively. Update the particle position using the previous best solution (pbest) and the best global solution for all blocks (gbest). This value is always updated during the optimization process.

$$X_{k+1}^{i} = X_{k}^{i} + V_{k+1}^{i} \tag{3.1}$$

$$V_{k+1}^{i} = wV_{k}^{i} + c_1 r_1 \left(P_{k}^{i} - X_{k}^{i}\right) + c_2 r_2 \left(P_{k}^{g} - X_{k}^{i}\right) \tag{3.2}$$

. The PSO flowchart presented in the figure 4.5.

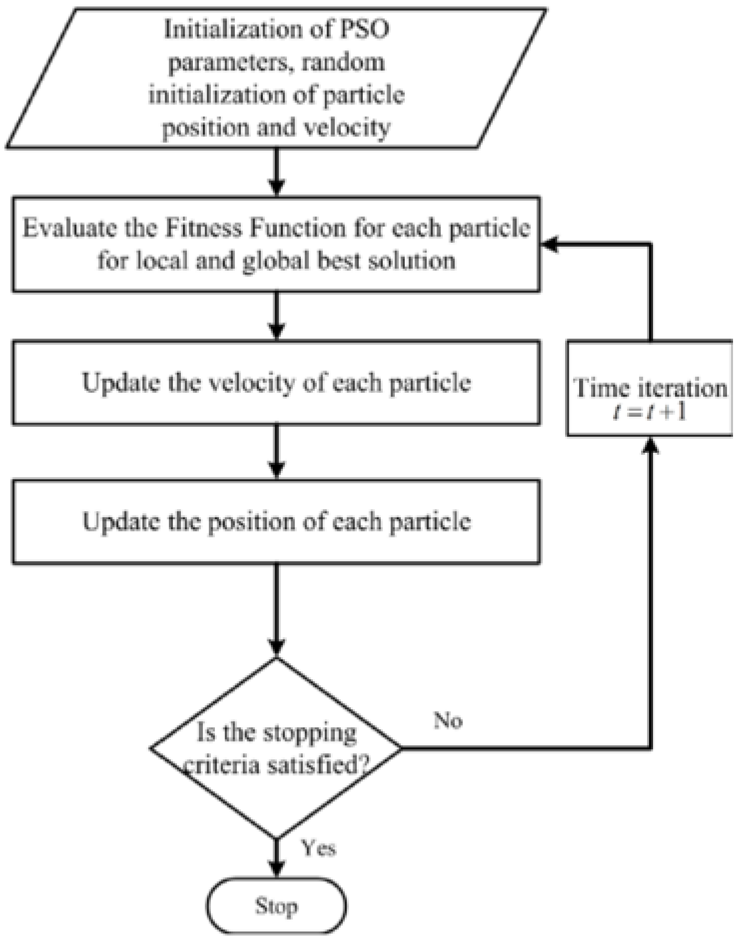

Figure 3.3: PSO flowchart [73].

3.3 PROPOSED METHOD

The developed algorithm allows you to find the best way to avoid obstacles and achieve your goals in various static environments. Set the fitness function to the most suitable route (shortest route). The flexible robots move according to the optimal position of the particles (gbest) until they reach the target point. The path length is optimized using the PSO algorithm to obtain the optimal path. The task of planning the path of the robot around fixed obstacles is to find the optimal trajectory with the optimal particle placement function. The best site, global H(gbest), was chosen to identify particles with the weakest swarm. After determining the position of the moving robot and the obstacles, the PSO algorithm was applied when planning the route. The application chose the minimum global position of the particle in each iteration ($gbest$)

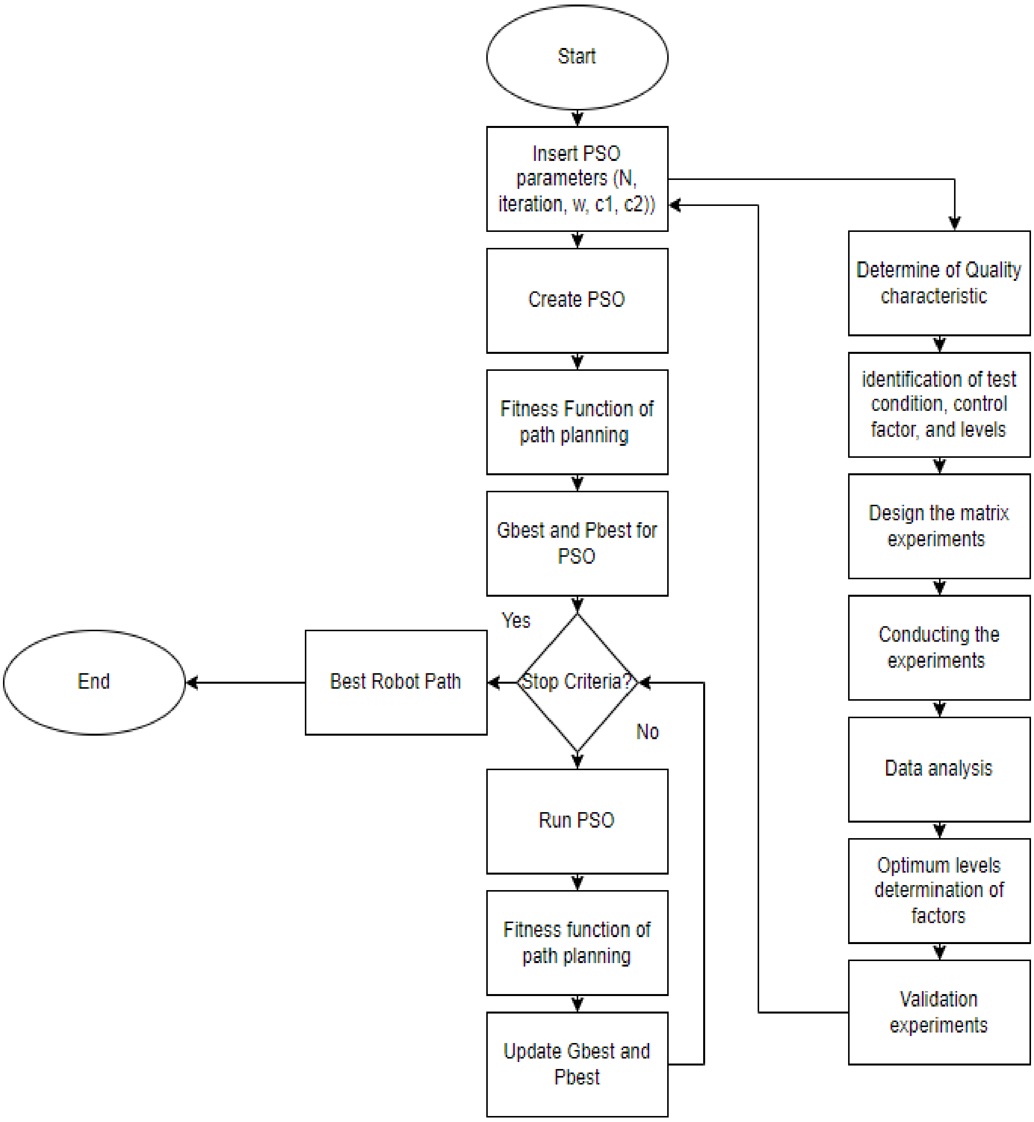

Figure 3.4: Proposed method.

The details steps of Figure 3.7 presented in details in the flowing:

a) The initial parameters of the PSO tuned using Ant Conny optimization method. This is the main contribution of this study which lead to find the best combination of parameters within minimum time.
b) The PSO will be created in the second step.
c) The fitness function of the path planning will be formulated as can be understood by PSO.
d) The Gbest and Pbest will be determined during the operation to find the best location.

e) In the case of the best path will determined the operation will complete. Or the operation of the running the PSO will be repeated again to select best Gbest and Pbest and then find the best path for the robot.
f) Complete

4. RESULTS

Within the scope of this thesis, some simulation scenarios were designed for the robot path planning problem and the performances of PSO based Ant Conny optimization method and other heuristic algorithms were evaluated over these simulation scenarios. Figure 4.1 shows a path planning scenario for a robot.

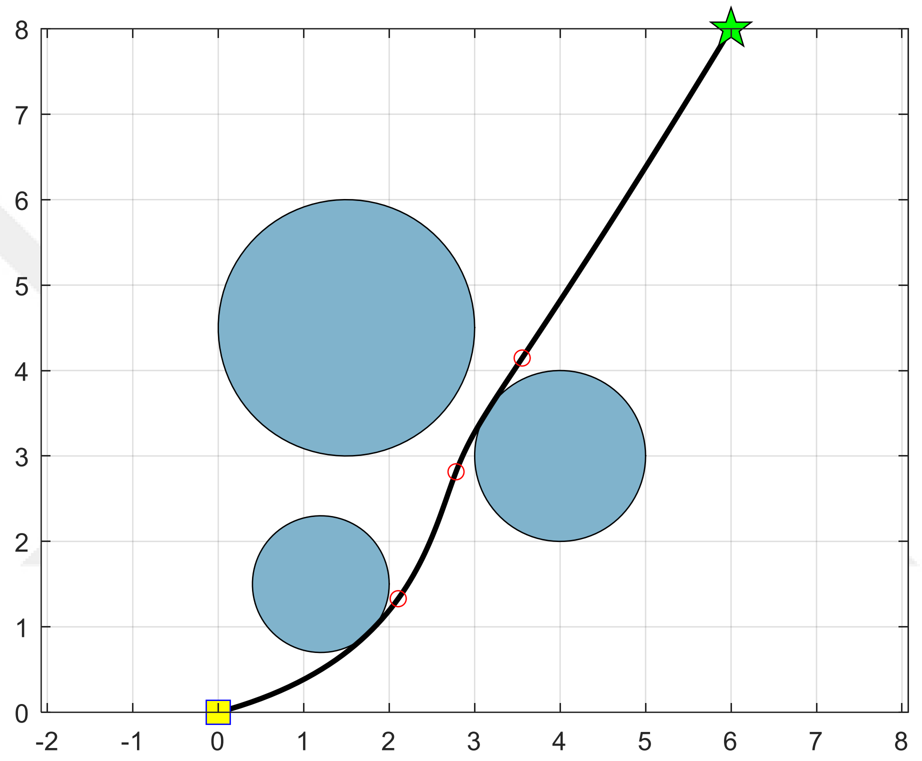

Figure 4.1: Scenario 1.

As shown in Figure 4.1, the route planning is planned to start at the starting point and end at the end point without obstacles. The goal here is to plan a route that takes the shortest path to the destination and overcomes the circular obstacles. The cost function for this scenario was also calculated using the presented application and is shown in the figure. 4.2.

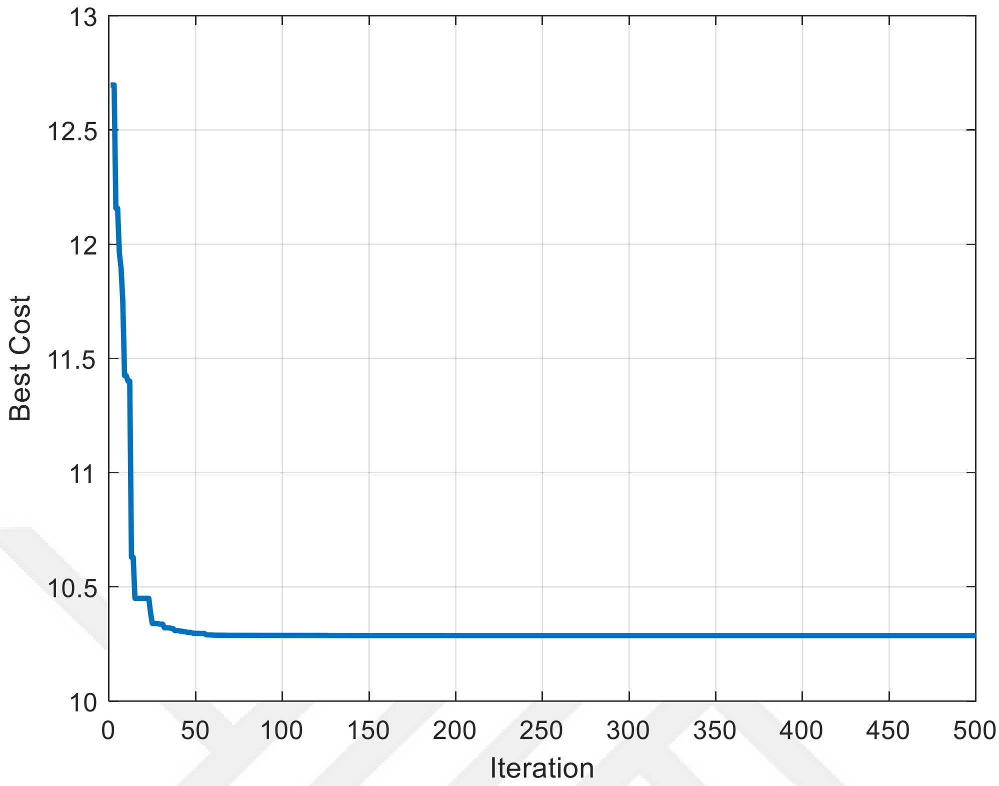

Figure 4.2: Scenario 1 cost curve.

The yellow square indicates the starting point of the moving robot and the green star indicates the end point. An attempt was made to solve this problem by adapting the algorithm of the PSO-based Ant Conny optimization method to the route planning problem.

Also, in the second scenario, PSO was also applied to solve the same problem. A scenario for these experiments is presented in figure 4.3.

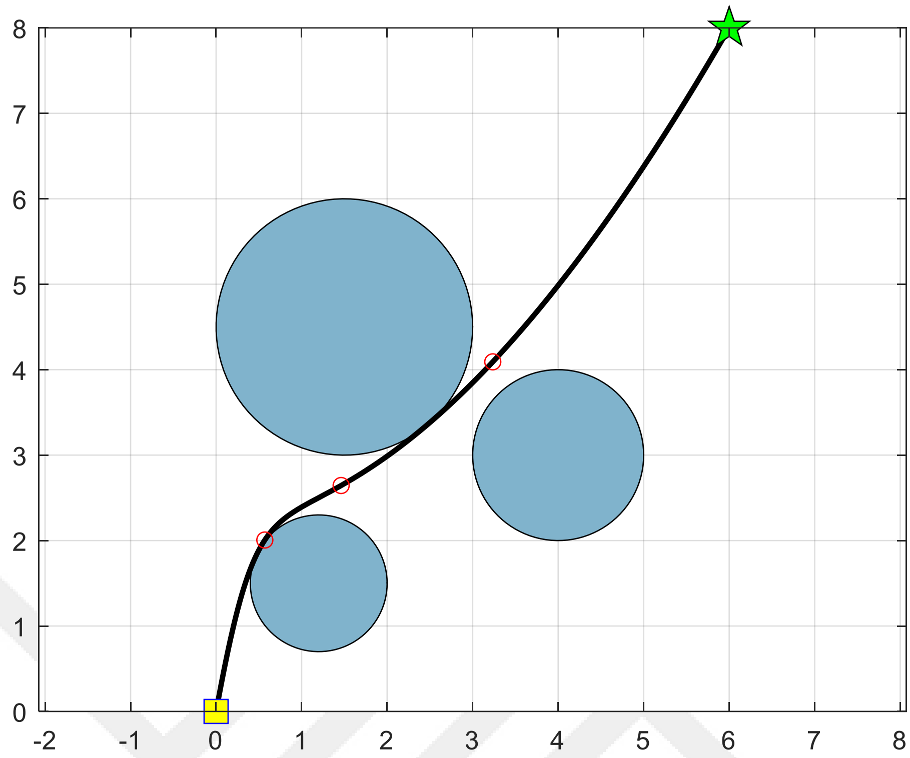

Figure 4.3: Scenario 2.

The objective curve of this scenario presented in this figure 4.4.

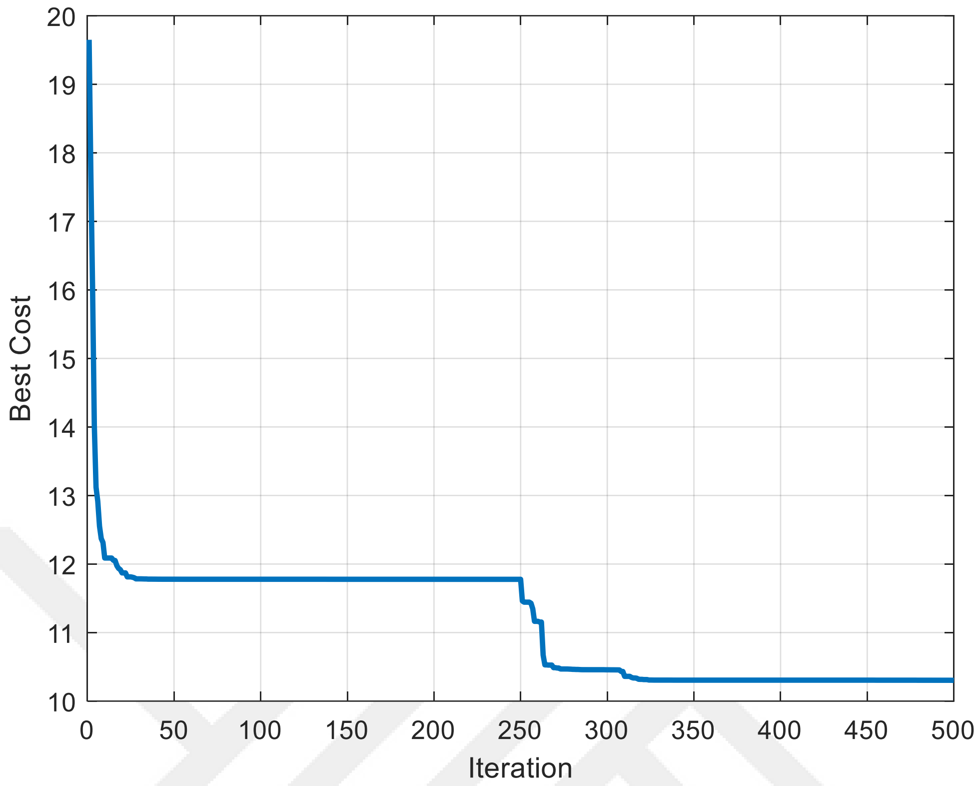

Figure 4.4: Scenario 2 cost rate.

Furthermore, the 3rd scenario also show that remarkable results using PSO based Ant Conny optimization method which show that the presented method find the best and shortest path between the source and target.

Where the locations of the source is % Source xs=10; ys=6; and the location of the target (Destination)is xt=2; yt=2;

This scenario path shown in the Figure 4.5.

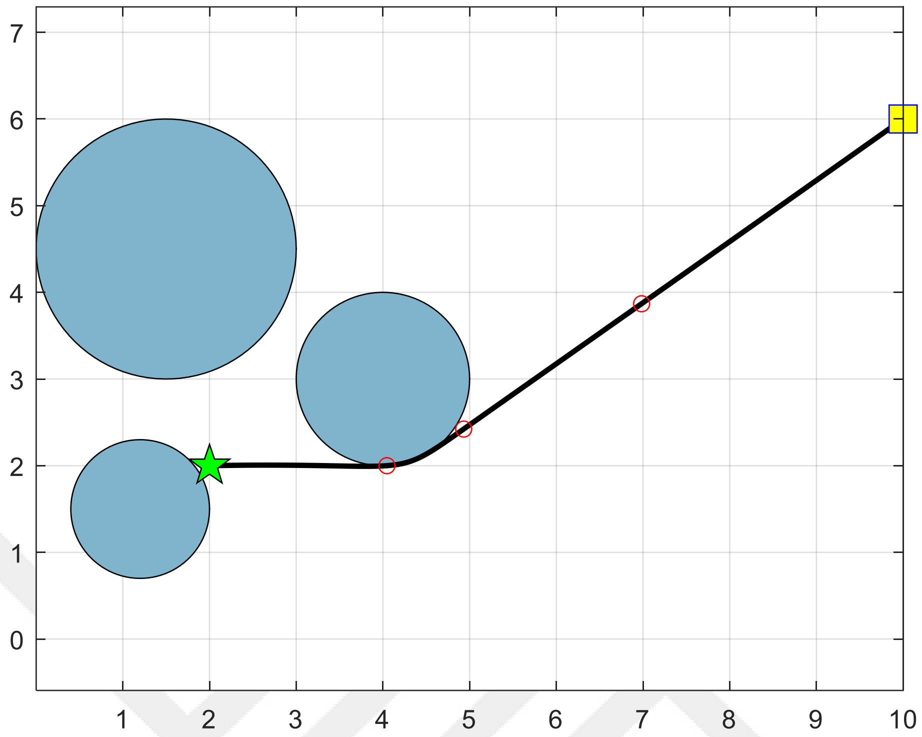

Figure 4.5: Scenario 3.

The cost rate of the objective function is only 9.2473 and shown in the Figure 4.6.

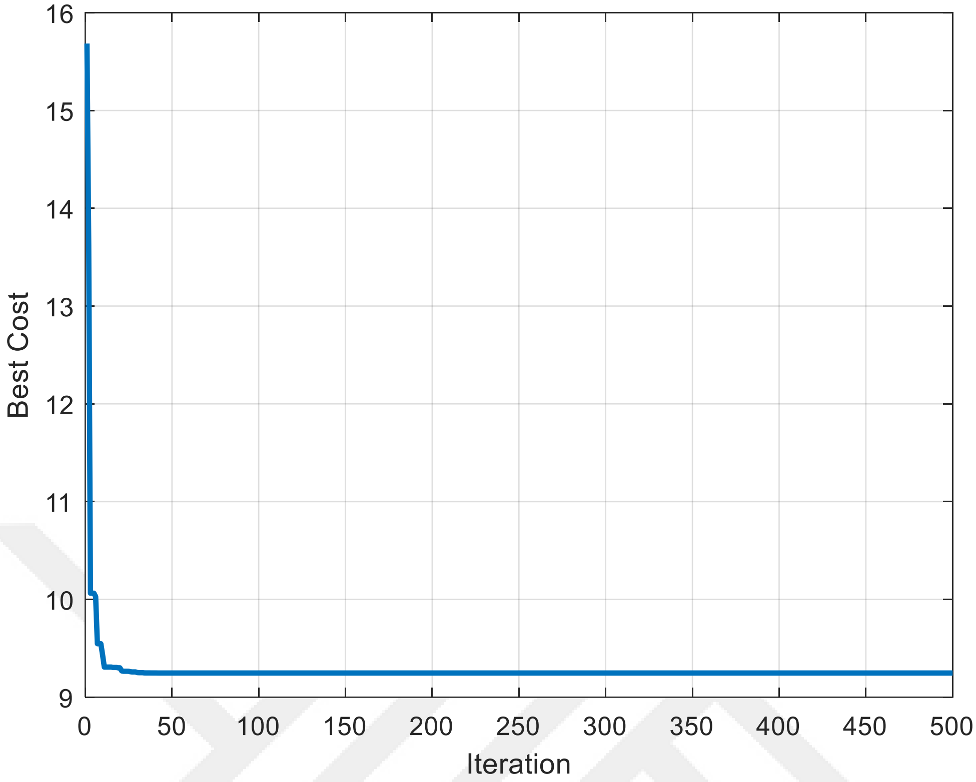

Figure 4.6: Scenario 3 cost rate.

The 4th situation in another reason show up also that the PSO find the optimal route between source and the destination. The location of the of the source is source xs=10; ys=6; Target (Destination) xt=1; yt=2. The path planning of the 4th scenario presented in the Figure 4.6 which the path between the source and destination become more complicate.

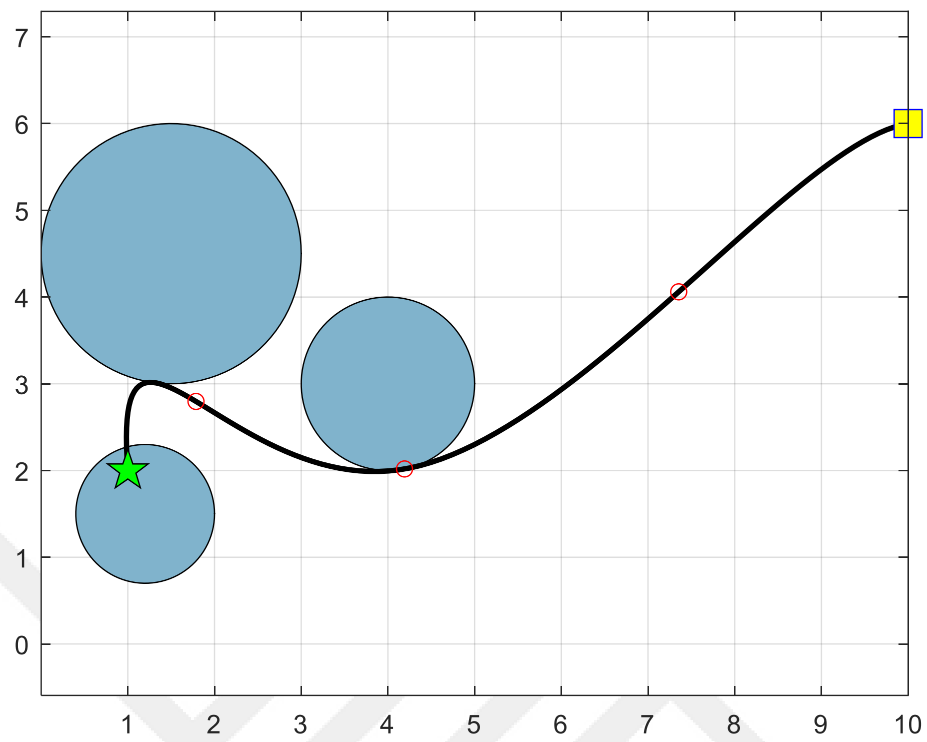

Figure 4.7: Scenario 4.

Therefore, it shows that the objective function exponent and the cost level are small, which is a very important issue in the optimization problem, and are only 0.0048341. The cost ratio is shown in Figure 4.8.

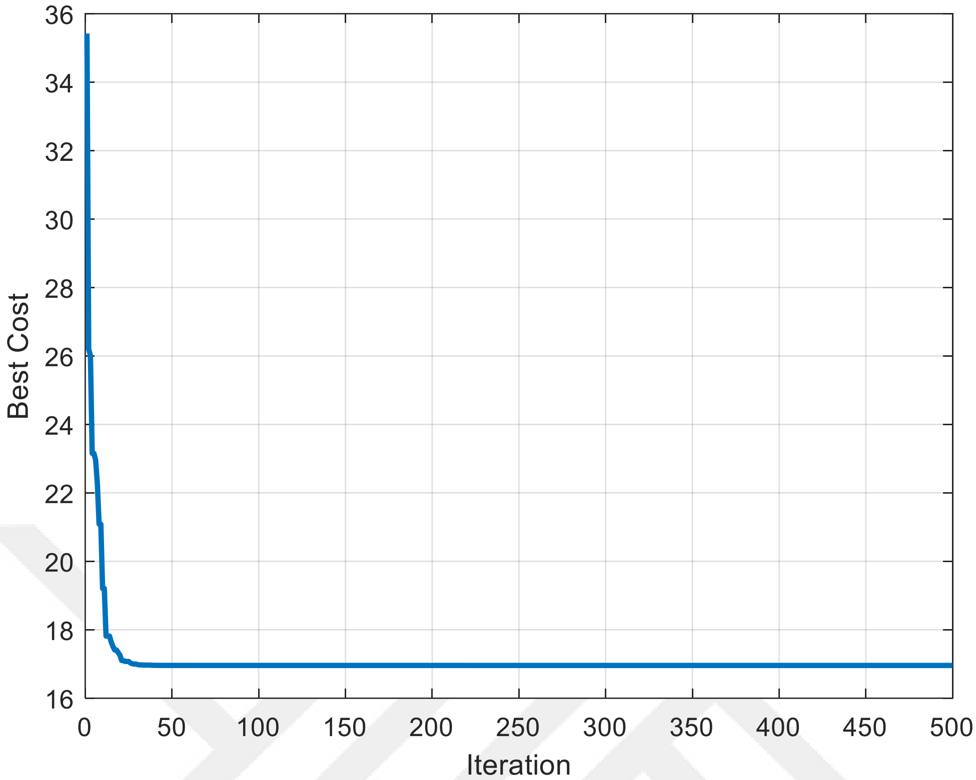

Figure 4.8: Scenario 4 cost rate.

Additionally, trajectory planning for scenario 5 shows that the robot can find the optimal trajectory between the three pins to reach the source. The location of this scenario is: yes =6; target (target) xt=0; yt=3. Route plan shown in Figure 4.9.

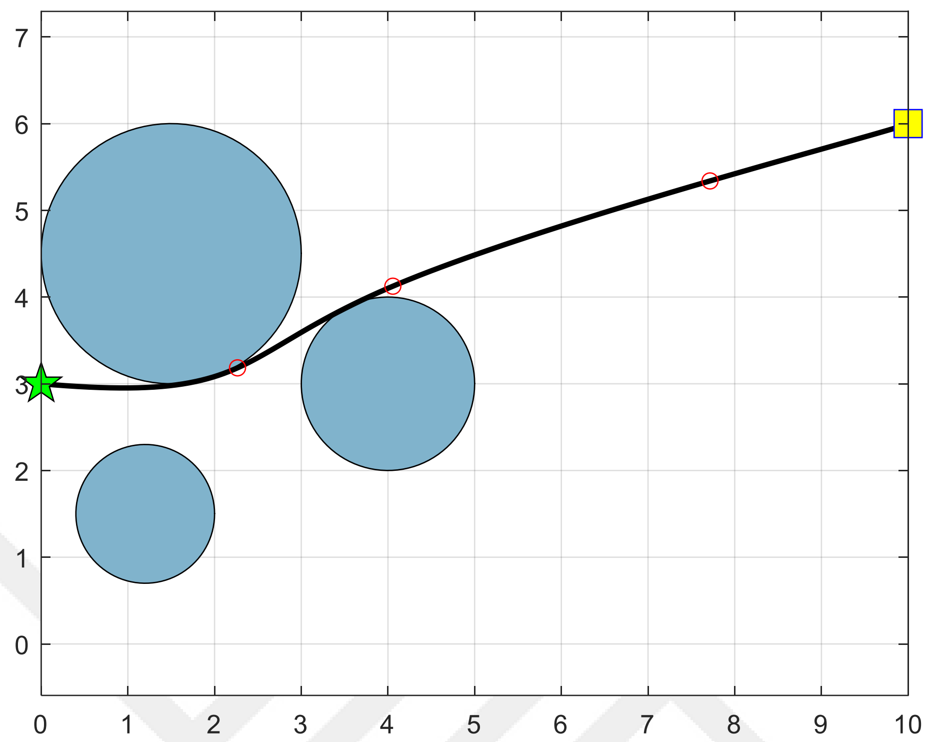

Figure 4.9: Scenario 5.

furthermore, the cost of the path also appear low amount as indicated in the Figure 4.10.

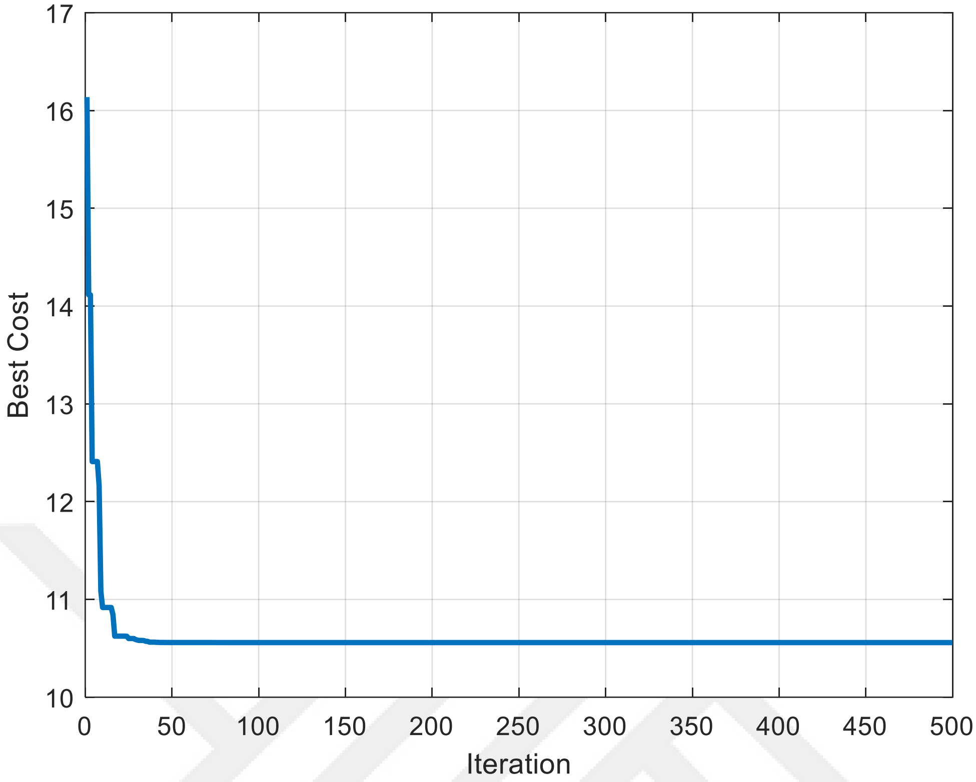

Figure 4.10: Scenario 5 cost rate.

Also in Scenario 6, the positions of the deflectors changed slightly depending on the start and finish locations. Source and destination locations: source xs = 10. ys = 6; target (target) xt = 1; yt = 2. The roadmap for this scenario is shown in Figure 4.11.

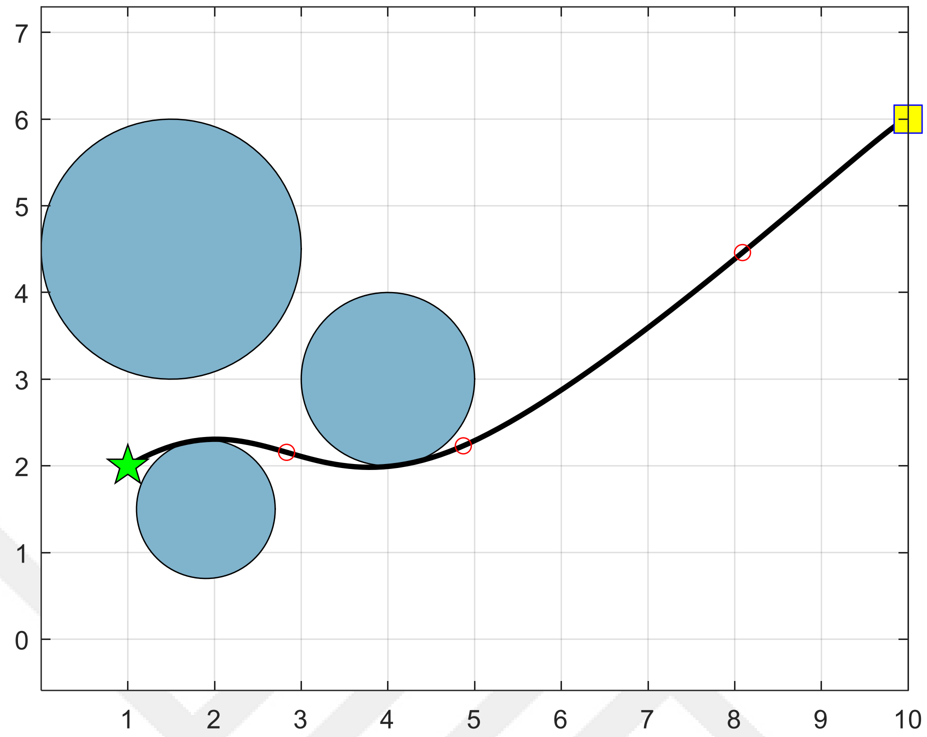

Figure 4.11: Scenario 6.

This scenario is more complex than the other scenarios where there are multiple paths for the robot to take the best one. The cost function gives 10.3881 and the cost curve is shown in fig. 4.12.

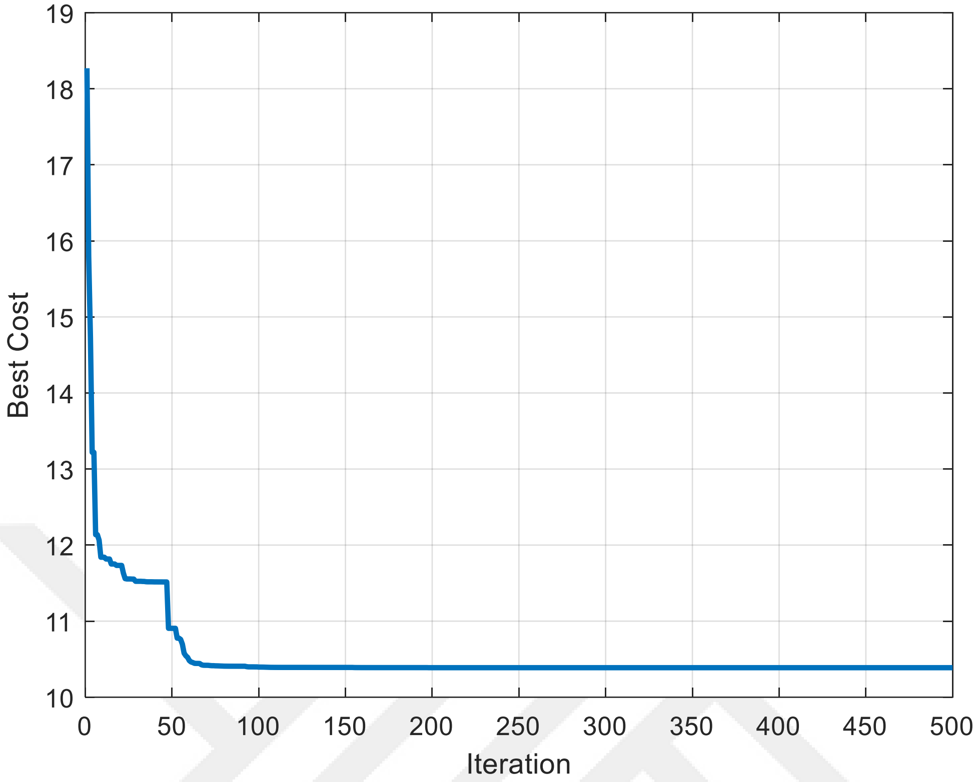

Figure 4.12: Scenario 6 cost rate.

Scenario 7 also changes the location and size of the partition, making it more difficult to find the path from destination to source. The PSO-based Ant-Conny optimization method also shows good results and finds the optimal path. The diagram shows the scenario 4.13.

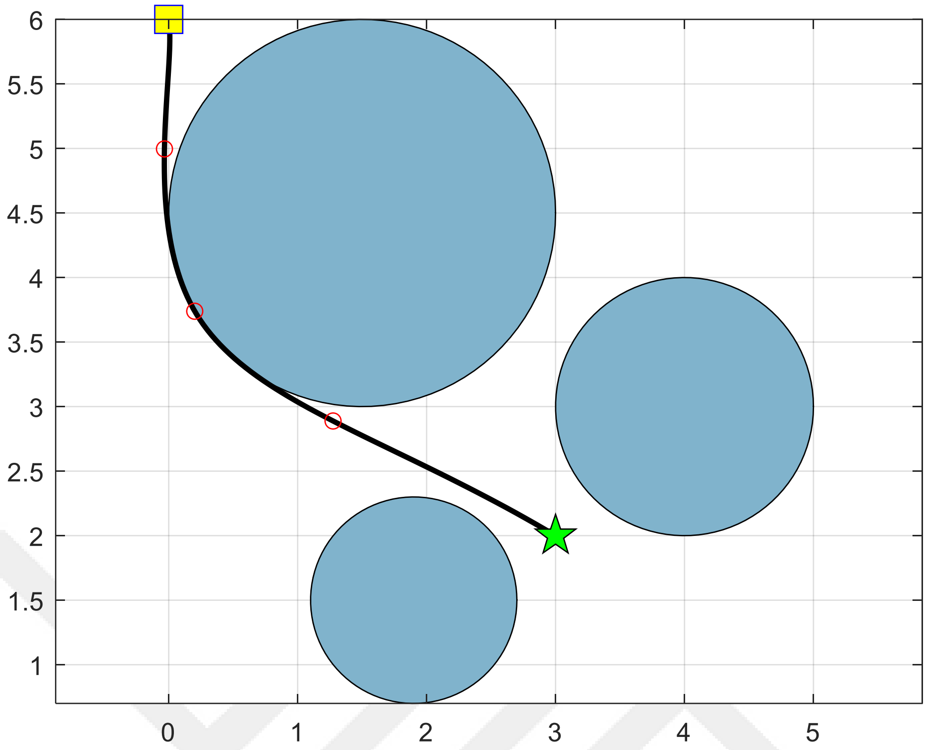

Figure 4.13: Scenario 7.

The cost of this method is only 5.6292 and presented in the Figure 4.14.

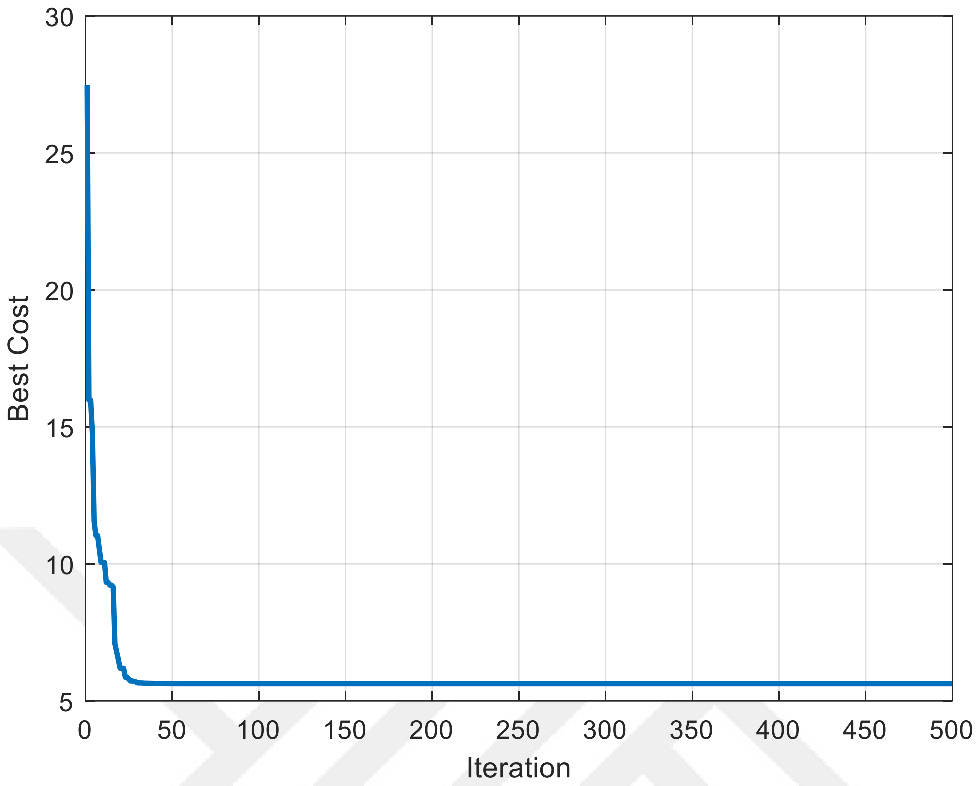

Figure 4.14: Scenario 7 cost rate.

Then change the deflector, source and target to get new results and complete the final scenario showing how the robot can find its way very cheaply. Route planning Figure 4.15.

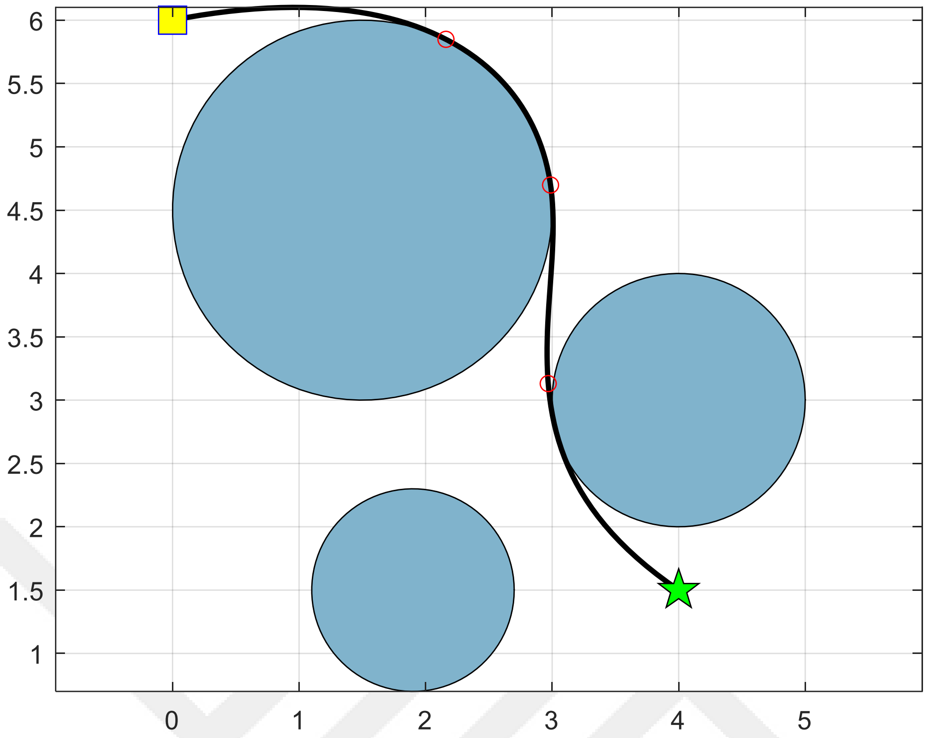

Figure 4.15: Scenario 8.

Finally, the cost also presented as shown in previous scenarios and calculated to evaluate the method efficiency. The cost curve presented in the Figure 4.16.

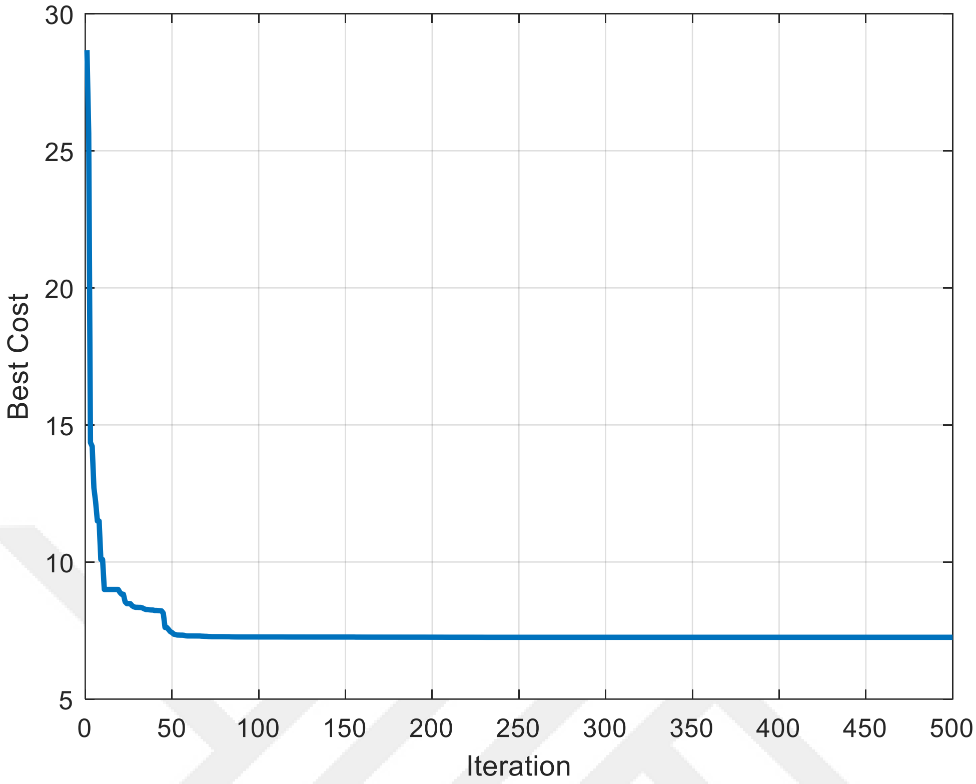

Figure 4.16: Scenario 8 cost rate.

Results analysis clearly shows that the proposed technique gives excellent results. Based on these results, the main advantages of the PSO system can be evaluated as follows. Simple idea, simple implementation, parameter control reliability, computational efficiency with other numerical systems and detection improvement methods. The maximum number of repetitions, the number of repetitions allowed for repetitions.

Ant Conny optimization technology is also used to power the most comprehensive form of PSO. Using PSO without using the Ant Conny optimization method resulted in a loss of running time and parameter optimization. Then the Anta Konny optimization method introduced an optimal PSO structure that creates an ideal shortest path.

The aim of this study is to develop a novel algorithm for planning the trajectory of hybrid mobile robots based on metaheuristic algorithms. By using the developed hybrid algorithms, the route can be minimized to increase the efficiency and performance of route planning. In this study, we developed and implemented a unique hybrid path planning algorithm for one or more mobile robots under static barriers. Results are obtained using some metaheuristic algorithms such as PSO (Particle Swarm Optimization) based on the Ant Conny optimization method. This study results show that applying PSO combined with ACO lead to enhance the performance of the application and assist people in the natural problems.

5. CONCLUSIONS

The reason why the topic of planning a transportation network with vehicle routing is discussed is based on many different reasons, such as the increasing popularity of this topic in recent years, the fact that it has been a topic that has been studied frequently since the past, and that it provides solutions to other important issues. Disruptions in transportation and transportation services, which have become a major problem today, have been another point of view of the thesis. The increase in population, the rate of urbanization and the number of vehicles increasing due to these disruptions, and the vehicle carrying capacities of the roads that could not develop in parallel with these concepts can be given as the cause of these disruptions. At this point, it tries to offer more appropriate, effective and useful solutions to real-world models in order to prevent problems in vehicle routing and planning, transportation and transportation issues. Disaster logistics, which is a transportation service, was also discussed within the scope of the study and was chosen as the subject of application. In this way, it is important to establish a transportation model that will minimize the suffering of individuals after a disaster and meet their needs at the maximum level. Considering the devastating effect of the concept of disaster, there must be a network structure that provides optimum conditions. With such a strong network structure, a helping hand can be successfully extended to disaster victims after a disaster. This strong network structure means that the routes have the least risk as well as having the least distance. Since a route plan that is not supported by risk analysis may cause disruptions after a certain time, the minimum risk value constraint has been acted upon in the creation of the routes.

The aim of this study is to develop a novel algorithm for planning the trajectory of hybrid mobile robots based on metaheuristic algorithms. By using the developed hybrid algorithms, the route can be minimized to increase the efficiency and performance of route planning. In this study, we developed and implemented a unique hybrid path planning algorithm for one or more mobile robots under static barriers. Results are obtained using some metaheuristic algorithms such as PSO (Particle Swarm Optimization) based on the Ant Conny optimization method.

The proposed method presented number of advantages as shown below:

a) With the proposed PSO based on Ant Conny's optimization method, many mobile robots actually achieved their goals by traveling the shortest/optimal paths without encountering obstacles in static environments.

b) The efficiency, applicability and applicability of the developed routing algorithms were analyzed using MATLAB software in simulation and experimental environments. Moreover, the efficiency and effectiveness of the developed algorithm were validated by comparing methods developed by other researchers in the literature and presented in a simulation environment.

c) The suggested methods have been analyzed in simulation with single vehicle in different situations with various source and target positions.

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