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A Review of Meta-heuristic Methods for Solving Fuzzy Location Problems

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A B S T R A C T

In this article, we will examine the problems related to routing and positioning with real variables and examine the related questions. These decisions are made about location allocation, inventory and routing in a multi-layered supply chain, involving different suppliers, warehouses and customers. We are looking for new ways to manage location and routing efficiently and practically. In order to maximize the search space and achieve optimal results, exploratory and meta-heuristic methods have been used. The meta-heuristic technique is usually used to increase the performance of the hybrid technique. Therefore, this review article examines meta-heuristic methods and analyzes location problems using various values. It also examines the advantages and disadvantages of the proposed methods to solve these problems in order to introduce more efficient methods.

1. Introduction

One of the most important issues in optimization is the relationship between feature sets, possible warehouses, and customer sets. The purpose of LRP is to provide better services to applicants and consider different facilities (planning routes and warehouse locations). Overall, from a complete supply chain management perspective, location and routing seem to act as two components of serious concern in real-life applications. For instance, locating regional blood banks to serve hospitals Or and Pierskalla [55], or establishing journal mail delivery systems Jacobsen and Madsen [32], or publishing goods parcels philanthropic–care network distribution dynasty (Perl and Daskin [58]; Wasner and Zäpfel [82]), to recitation a few, handle location and routing problems together Obviously, this problem-solving procedure will be challenging for logistics managers and decision-makers.

However, despite the significance of nature-inspired meta heuristic approach mechanisms and techniques in the location problem, as far as we know, there is no public and systematic study in the conditions of antecedents and backgrounds in this field. Therefore, this study aims to investigate the existing nature-inspired algorithms

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for location problem, evaluate the differences among the mentioned techniques, and scheme the serious competes and important issues about the location problem that could address the cloud domain. Generally, the main allotment of this paper can contribute to the following areas:

- Providing insights and implementations of location issue optimization techniques, as well as describing the nature of meta heuristic algorithm applications for the location problem.
- Highlighting the significance of the nature-inspired meta heuristic optimization algorithms, and the many benefits they provide to tackle the challenges encountered in the location problem.
- Determining the relevant open issues and some clues to solve the existing issues.

In this article, Section 2 presents the analysis and review of the related work. Section 3 provides the research terminologies and preparation mechanisms. Section 4 discusses the review of the selected meta-heuristic algorithms for LRP problems. Section 5 includes the taxonomies and analogies of the reviewed mechanisms. Section 6 presents the same open issues. Finally, Section 7 concludes the article.

Table 1 shows the jointly used abbreviation in the article.

Table 1. Abbreviation table

Abbreviation	Definition	Abbreviation	Definition
LRP	Location Routing Problem	GA	Genetic algorithm
HM	Hybrid meta- heuristic	MA	Memetic algorithm
ACO	Ant colony optimization	PSO	Particle swarm optimization
HA	Hybrid Algorithm	HEA	Hybrid evolutionary algorithm
COA	Cuckoo optimization algorithm	TS	Tabu search
FA	Firefly algorithm	SA	Simulated annealing
SDO	Saturation degree based ordering	HGS	Hybrid Genetic simulated annealing
MFFA	Memetic firefly algorithm	ACS	Ant colony system
APSO	Particle swarm optimization		

2. Related work

Some LRP reviews have been conducted. In this section, we examine the review literature for location routing conditions or how to use the meta heuristic algorithms in LRP, and their weaknesses and strengths. This review was also conducted on articles from 2002 to 2019. A review of location-routing problem has been presented by Drexl and Schneider [16] because cost minimization. They are unaware of any articles on the union of revenue management aspects into location-routing models.

One of the significant studies of the location-routing problems has been provided out by Prodhon and Prins [64] . LRP integrates two types of intentions. Given the set of potential warehouses with variable costs, the same fleet of vehicles and the set of applicants with debt claims are available. Classic LRPs are used, including opening a subset of warehouses, assigning the applicant to them, and specifying vehicle routes, to minimize total costs such as assumed warehousing costs and fixed vehicle costs. They are also used throughout the project to minimize total costs. Since the last comprehensive scrutiny on LRP published by Nagy and Salhi [51], the number of articles devoted to this issue has increased quickly, requiring a review of new research works. This article analyzes the recent literature (72 articles) on standard LRPs and new extensions like multiple distribution access. To summarize and conclude, the following research directions have been considered:

1. Design of precise methods exploiting most of the problem structures.
2. Development of united met heuristics to avoid the proliferation of much similar variants.
3. Design of more evolved collaboration mechanisms and use of recent computer architectures (grids and multicourse).
4. Problems were not all applicants can be served.

Vallada, Ruiz, and Minella [79] Presented a review and extensive evaluation of heuristics and met heuristics for the m-machine stream shop scheduling problem aiming at minimizing general tardiness. He implemented 40various heuristics and met heuristics and examined their performance using the same criterion of instances. Their paper has presented an extensive and comprehensive review of heuristic and met heuristic procedures for the permutation flow department store scheduling problem aiming at minimizing the total tardiness. They have encrypted and tested 40 different algorithms to test their method performance under the same conditions. In addition, a benchmark is provided to evaluate all steps under a common dataset of 540 problems and a maximum of 350 related jobs and 50 new devices.

Notwithstanding, the important conditions of the met heuristic techniques in the location issue, a universal and systematic survey of the discussion on their categorization is not presented up to now. Additionally, the future challenges and the crucial role of the met heuristic techniques in a location problem are not presented appropriately. In general, the reviewed articles have several defective categories that are as follows:

The articles selection process has not been identified well.

Some authentic and written researches have not been scrutinized.

Future operations and open issues are not well stated.

The categorization of the approaches studied has not been properly described.

The strengths and weaknesses of the reviewed articles are well highlighted.

In many studies, few papers have been reviewed.

In this article, the next section discusses some questions about heuristic techniques in the routing and location problem, so that we can select the main studies to review the heuristic approaches to the location problem. Future challenges and trends will be answered by answering each of these questions.

3. Systematic literature review

To provide a clear picture of the meta-heuristic approach to the problem of location and routing, this section presents a systematic history review (SLR) of the proposed systems with a particular focus on location and routing research. Consistent with the study of Cook, Greengold, Ellrodt, and Weingarten (1997), a systematic review was distinguished from a standard one in the case of the replicable, theoretical, and transparent process. An SLR aims to provide a comprehensive summary of the linked literature to the research amplitudes(Aznoli & Navimipour, [4].Inspired by the field of medicine (Kitchenham, [37]), SLR, as a research procedure, provides a repeated procedure in which supplying sufficient details for being regurgitated by other researchers is carried out in(Charband & Navimipour, [10]; Cook et al., [11]; Kupiainen, Mäntylä, & Itkonen, [34]; Navimipour & Charband, [52]). A thorough search of the literature for relevant spread studies is the first step in conducting a principled review. This has been supported by foregone studies suggesting that this procedure for literature review can lead to limited systematic errors, reduced chance factors, and enhanced validity of data analyses (Aznoli & Navimipour, [4]; Navimipour & Charband, [52]).

3.1. Article selection process

To describe the keywords for various disciplines and exclusion criteria, the scientific database is used and linked together using Boolean and OR(Soltani & Navimipour, [76]). To conduct the review, we focused on searching in electronic databases such as Google scholar, Science direct, ACM Digital Library, IEEE, Wiley and Springer. The paper selection strategy consists of several important steps:

Stage1: Independent search relying on considered keywords.

Stage2: Elimination based on titles.

Stage3: Selection based on conclusions and abstracts.

Stage 4: Elimination based on full texts and abstracts

The search results for articles from journals, conference papers, books, notes, and any articles are presented in this study. This survey is based on both types of research articles: quantitative and qualitative written from 2005 to 2022 in English.Stage2 is optimized based on selected articles, and the search result is selected from 538 articles. In Stage3, the conclusions of the selected papers and abstracts are reviewed, and 103 articles are selected. In stage4, the articles obtained from stage3 are evaluated, and some are eliminated based on the problem needs. Finally, 49 articles are selected for further review. Table 2 shows the resulting articles based on their algorithms applied in practice.

Table 2. Distribution meta heuristic algorithms for location problem

Meta-heuristic algorithms	publisher	Year	Author	Title
Hybrid algorithm	Elsevier	2022	Zhang, Gong, Liu, & Chen, [87]	A fast two-stage hybrid meta-heuristic algorithm for robust corridor allocation problem
	Elsevier	2022	Lv, Zhang, Ren, & Meng, [46]	A fuzzy correlation based heuristic for Dual-mode integrated Location routing problem
	Elsevier	2021	(Mokhtarzadeh, Tavakkoli-Moghaddam, Triki, &	A hybrid of clustering and meta-heuristic algorithms to solve a p-mobile hub location–allocation problem with the depreciation cost of

			Rahimi, [49]	hub facilities
	IIETA	2021	Fazli, Khiabani, & Daneshian, [18]	Hybrid Whale and Genetic Algorithms with Fuzzy Values to Solve the Location Problem
	Taylor & Francis	2022	Saffari, Zahiri, & Khishe, [68]	Fuzzy whale optimization algorithm: a new hybrid approach for automatic sonar target recognition
Ant Colony Optimization (ACO)	Elsevier	2016	Gao, Wang, Cheng, Inazumi, and Tang [20]	Ant colony optimization with clustering for solving the dynamic location routing problem
	Elsevier	2019	Bouamama, Blum, and Fages [7]	An algorithm based on ant colony optimization for the minimum connected dominating set problem
	IEEE	2013	Herazo-Padilla, Montoya-Torres, Muñoz-Villamizar, Isaza, and Polo [29]	Coupling ant colony optimization and discrete-event simulation to solve a stochastic location
	IEEE	2017	Liu, Leng, and Han [43]	Pheromone model selection in ant colony optimization for the travelling salesman problem
	IEEE	2013	Yang, Sun, and Chi [84]	An ant colony optimization algorithm and multi-agent system combined method to solve single source capacitated facility location problem
simulated annealing (SA)	Elsevier	2019	Küçükoğlu, Dewil, and Cattrysse [38]	Hybrid simulated annealing and tabu search method for the electric travelling salesman problem with time windows and mixed charging rate
	Elsevier	2015	Santosa and Kresna [70]	Simulated annealing to solve single stage capacitated warehouse location problem
	Elsevier	2016	Ghorbani and Jokar [22]	A hybrid imperialist competitive-simulated annealing algorithm for a multisource multi-product location-routing-inventory problem
	Elsevier	2014	Vincent and Lin [80]	Multi-start simulated annealing heuristic for the location routing problem with simultaneous pickup and delivery
	Elsevier	2015	Vincent and Lin [81]	A simulated annealing heuristic for the open location-routing problem
Firefly algorithm (FA)	Indjst	2014	Rao and Kumar [66]	Sensitivity analysis based optimal location and tuning of static VAR compensator using firefly algorithm
	Elsevier	2019	Prima and Arymurthy [63]	Optimization of school location-allocation using Firefly Algorithm. in Journal of Physics: Conference Series
	IEEE	2012	Sulaiman, Mustafa, Azmi, Aliman, and Rahim [77]	Optimal allocation and sizing of distributed generation in distribution system via firefly algorithm
	IEEE	2013	Nadhir, Chabane, and Tarek [50]	Distributed generation location and size determination to reduce power losses of a distribution feeder by firefly algorithm
Genetic algorithm (GA)	Elsevier	2016	Babaie-Kafaki, Ghanbari, and Mahdavi-Amiri [5]	Hybridizations of genetic algorithms and neighborhood search meta heuristics for fuzzy bus terminal location problems.
	Elsevier	2017	Hiassat, Diabat, and Rahwan [30]	A genetic algorithm approach for location-inventory-routing problem with perishable products
	Elsevier	2019	Saif-Eddine, El-	An improved genetic algorithm for optimizing

			Beheiry, and El-Kharbotly [69]	total supply chain cost in inventory location routing problem
	IEEE	2016	Rybičková, Burketová, and Mocková [67]	Solution to the Location-Routing Problem Using a Genetic Algorithm
	Elsevier	2014	Crossland, Jones, and Wade [12]	Planning the location and rating of distributed energy storage in LV networks using a genetic algorithm with simulated annealing
Particle Swarm Optimization (PSO)	Elsevier	2019	Peng, Cheng, and Jiang [57]	Inversion of UEP signatures induced by ships based on PSO method
	IEEE	2009	Peng and Chen [56]	Two-phase particle swarm optimization for multi-depot location-routing problem
	IEEE	2014	Rabie, El-Khodary, and Tharwat [65]	particle swarm optimization algorithm for the continuous p-median location problems
	IEEE	2014	Yu et al. [86]	particle swarm optimization based spatial location
Memetic Algorithm	Elsevier	2015	Karaoglan and Altiparmak [34]	A memetic algorithm for the capacitated location-routing problem with mixed backhauls
	Springer	2013	Marić, Stanimirović, and Stanojević [48]	An efficient memetic algorithm for the uncapacitated single allocation hub location problem
tabu search (TS)	Elsevier	2018	Li, Yue, Aneja, Chen, and Cui [41]	An Iterated Tabu Search Metaheuristic for the Regenerator Location Problem
	Elsevier	2017	Díaz, Luna, Camacho-Vallejo, and Casas-Ramírez [14]	GRASP and hybrid GRASP-tabu heuristics to solve a maximal covering location problem with customer preference ordering
	Elsevier	2015	Ho [31]	An iterated tabu search heuristic for the single source capacitated facility location problem
	Elsevier	2016	Lai, Demirag, and Leung [40]	A tabu search heuristic for the heterogeneous vehicle routing problem on a multigraph
	Elsevier	2017	Silvestrin and Ritt [75]	An Iterated Tabu Search for the Multi-compartment Vehicle Routing Problem
	Elsevier	2006	Sun Minghe [78]	Solving the uncapacitated facility location problem using tabu search
	Elsevier	2019	Polak and Boryczka [59]	*Tabu Search in revealing the internal state of RC4+ cipher.* Applied Soft Computing
	Elsevier	2012	Nguyen, Prins, and Prodhon [54]	A multi-start iterated local search with tabu list and path relinking for the two-echelon location-routing problem
	IEEE	2015	Xie, Mei, Ernst, Li, and Song [83]	A restricted neighbourhood tabu search for storage location assignment problem

4. Review meta-heuristic algorithms in location problem

In this section, we review the selected studies to meta-heuristic algorithms in the location problem. As for selecting in Section 3, we surveyed meta-heuristic algorithms in groups of ant colony optimization (ACO), genetic algorithm (GA), particle swarm optimization (PSO), firefly optimization (FA), tabu search (TS), simulated annealing (SA), memetic algorithm (MA) and hybrid algorithms (HA). Qualitative criteria for the location problem include execution times, comparisons, real plans, competitiveness, future development, algorithm improvements, parameter constraints, reduction of solution space and success.

4.1. Ant colony optimization technique

The ant colony optimization was first introduced by Ge, Wei, Tian, and Huang. It is a collaborative intelligence-based search algorithm inspired by the behavior of real ants. It was first practical to solve traveling salesman problems (TSP)(Brock, Green, Reich, & Evans, [9]), and then was efficiently used to solve a large number of tough problems such as the routing in telecommunication networks, quadratic assignment problem (QAP)(Abbasian, Mouhoub, & Jula, [1]), and graph coloring problems(Dorrigiv & Markib, [15]). This is largely based on the idea of indirect communication among the mass people of working ants. They go their own way by borrowing pheromones. This pheromone route helps them to find the shortest route between food sources and their nests. The rest of this section is as follows. Section 4.1.1 provides an overview of the selected mechanisms describing the main features of the selected articles, and Section 4.1.2 considers the results and comparisons of these articles.

4.1.1. Overview of the selected mechanism

In order to solve the dynamic location routing problem (DLRP), a clustering ant colony algorithm (KACO) with three immigrant schemes has suggested by Gao et al. [20]. DLRP is divided into several parts consisting of a location problem (LAP) and vehicles routing problem (VRP) in dynamic environments. Experimental results reveal that KACO with three immigrant schemes can find favorable solutions for the DLRP within logical computational time. To confirm the impact of the K-means on KACO, the performance of KACO is also compared to that of ACO without K-means algorithm, which is called WKACO. The results support the beneficial role of the K-mean algorithm in the solution found by the ant search. Furthermore, it was proved to reinforce the impact of immigrant's schemes for three different scales of LRP instances on cyclic or random surroundings. Moreover, this method is not always able to find logical solutions.

Bouamama demonstrated the success of logistic system, which can be dependent on the decision of depot location and vehicle routing Bouamama et al. [7]. LRP involves both location and routing decisions coincidently to minimize the cost of total system. In this paper, LRP with capacity constraints (CLRP) on depots and touts is suggested to be solved by a developed MACO. They decompose the CLRP into the facility location problem (FLP) and the multiple depot vehicle routing problem. The computational investigations are conducted on four sets of examples. An extensive empirical evaluation provides a comparison of the proposed algorithm with the state-of-the-art techniques of the literature. The proposed algorithm solves problems better. For real purposes, they also developed a constrained programming approach based on fuzzy variables. Even if its performance is not good for larger problems, but overall, it performs well and solves 315 of 481 problems. In addition, it does not provide acceptable answers due to the lack of control of parameters in real problems.

Herazo-Padilla et al. [29] have proposed a stochastic version of the location-routing problem (SLRP) in which both the cost of transport and the number and speed of the vehicle are chosen randomly. A hybrid solution method based on ACO and DES is proposed. After applying a sequential heuristic algorithm to solve the location allocation problem, the ACO is used to solve the travel-related routing. They used a sequential approximation algorithm to solve the random positioning and routing problem (SLRP) (they proposed a new hybrid algorithm to solve the random positioning and then routing). The proposed method uses the ACO algorithm to solve the sequencing problem to refer customers to the distribution network. Then, the routing solution is used as input. This algorithm provides answers to real problems. Although it is also used to calculate costs, the process increases the computation time.

A meta-heuristic approach, ACO, has suggested by S. Liu et al. [43]. In the proposed method, selection of pheromone models is an important priority. It is natural to choose pheromone models having fewer constraints; this algorithm can be used especially for the passenger seller problem in which the first order pheromone is widely recognizable. In the tests used, the algorithms using the second model are capable of general searching and have better population diversity. In fact, there is a qualitative difference between these two techniques. As a conclusion, they believe that different pheromone models can be used for problems on small and large scales, while the need to develop this method is extremely sensible.

For solving Single Source Capacitated Facility Location Problem (SSCFLP)an effective method is developed by L. Yang et al. [84]. This approach has been studied in three comparative studies of less than two different data size requirements, which can support the use of multiple computers to construct MASs. It also enhances the efficiency of smart computing. Comparative analysis based on numerical simulation examples showed that when multi-factor parallel computing is performed on multiple computers, it can lead to intelligent computing. In addition, the speed of the data network transmission mission determines the computational efficiency of the calculation of multi-factor distribution. The computation and repeatability of this method is high despite its high performance.

4.1.2. Summary of the reviewed ACO-based techniques

In the previous sub-section, five selected ACO algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 3 shows the comparison of the most important advantages and disadvantages of each article.

Table 3. A side-by-side comparison of the most important advantages and disadvantages of the ACO for location problem

Paper	Advantage	Disadvantage
Gao et al. [20]	• Providing promising solutions • Logical calculation time • Strengthen the Immigrant Program in Randomized Environments	• not always able to find the optimal solutions
Bouamama et al. [7]	• Provide optimal solutions • Logical calculation time	• Failure to check the same control parameters • Unreliable answers for real issues
Herazo-Padilla et al. [29]	• Comparability • Cost Estimation • Close to real answers	• Development of the method in the future • Lot of calculations
S. Liu et al. [43]	• Improve the existing solution • Application in practical matters	• Development of the method in the future
L. Yang et al. [84]	• High computing efficiency • Apply most restrictions	• Many repetitions

4.2. Firefly algorithm (FA) optimization technique

Yang (X.-S. Yang, [85]) produced the firefly algorithm based on the idealized conduct of the flashing characteristics of fireflies. The following three rules can be effective in implementing these features of the proposed method.

- All fireflies are born as unisex, meaning that a firefly can attract other things regardless of their gender.
- Their appeal is due to their brightness, which means that for both flashlights, the light moves less brightly and decreases with increase of distance. If no one is brighter than a certain firefly, it will move randomly.
- The intensity or light intensity of a firefly is influenced and optimized by its objective function and performance.

In this method and algorithm, all fireflies are assumed unisex ed so that a firefly goes to other fireflies based on the amount of light and regardless of their gender, so for both Fireflies move less light towards light. It is attractive to light and decreases with increasing distance. If there is no brighter one than a particular firefly, it will move randomly, and the brightness of a firefly is determined by the landscape of the objective function. For a maximization problem, lighting can simply be related to the value of objective performance (Bramer & Petridis, [8]; Ellis & Petridis, [17]). FA is also used to solve load balancing and load scheduling problems, where each firefly is the solution to the task allocation that is followed by the search space number of constraints. The remainder of this section provides an overview of the selected methods and mechanisms for routing and locating using FA and their distinguishing features.

4.2.1. Overview of the selected mechanism

A new Meta heuristic optimization algorithm called firefly algorithm (FA) for solving the multi objective is developed by Rao and Kumar [66] based on a multi-criterion objective function that has several goals minimize total power loss, minimizing total voltage magnitude deviations, the fuel cost of total generation and the branch loading to obtain the optimal flow. The results of this study demonstrate that installing SVC can significantly improve the voltage stability of system. Moreover, the comparison between their proposed technique and another optimization technique called Genetic Algorithm (GA) indicated that FA was an easy-to-use, robust, and powerful optimization technique. Additionally, incorporation of the SVC into the IEEE 14bus and IEEE 30 bus system can reduce the total active power losses and improves the profile of the system. However, the method involves many repetitions, which can lead to higher run time.

Prima and Arymurthy [63] introduced the school situation as the school location-allocation optimization problem aiming at obtaining the optimum student distribution so that the total of students travel distance is minimized. This problem is modeled as the p-median problem, and can be solved using the meta-heuristic approach. In this study, the firefly algorithm with two-dimensional firefly individual representation is utilized to solve the South Jakarta junior school location-allocation problem. Therefore, a gradual random decrease may improve the quality of the solution. Another advance in the convergence of the parameter shift algorithm is slowly, since the optimality is approaching and can be helpful for further research. In addition, as a relatively simple suggestion, the firefly algorithm can be adapted to solve multi-objective and two-level optimization problems. However, for large scales, the method needs to be further developed.

Sulaiman et al. [77] introduced the firefly algorithm to determine the optimal location and size of distributed generation (DG) in distribution power networks. As mentioned earlier, FA is a meta-heuristic algorithm corresponding to the flashing behavior of fireflies. It views this behavior as a signal system in the attraction of other neighboring worms as the main target of the problem. In the article above, a new swarm-based firefly algorithm is introduced to solve the optimal DG allocation and size problem. The effectiveness of FA is discussed with few practical examples. The results show that combining DG in the distribution system can reduce the total line losses and significantly improve the system voltage characteristics. Compare with GA also to see the performance of FA where GA is performed well in solving the optimal allocation problem. However, the design of this method is not suitable for large-scale problems.

Nadhir et al. [50] introduced a method known as the firefly algorithm. This is a meta-heuristic algorithm investigating the response space inspired by the flashing worm behavior. The main purpose of fireflies' flash is to act as a vibrating wave system to attract other fireflies. Networks that tested 69 buses and 33 buses are used to evaluate the outcome of this method. The results are compared by the genetic algorithm (GA) and frog mutation algorithm for 69 buses and for 33 buses. The proposed method was tested in distribution systems with three DGs without DG and with one DG and two DGs in the system. The FA function is suitable to solve the optimal location and size problem in the distribution system. Furthermore, incorporation of DG into the distribution system can reduce total line losses and improve voltage characteristics. Although the system performance has improved, it does not work for real problems.

4.2.2. Summary of the reviewed FA based techniques

In the previous sub-section, four selected FA algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 4 shows the comparison of the most important advantages and disadvantages of each article.

Table 4. A side-by-side comparison of the most important advantages and disadvantages of the FA for location problem

Paper	Advantage	Disadvantage
Rao and Kumar [66]	• Increase total power • High optimization power • Comparability	• Many repetitions
Prima and Arymurthy [63]	• better results on medium scale	• Run on small scales • improving algorithm in the future • no iterations • no runtime
Sulaiman et al. [77]	• Improved voltage profile • Reduce line losses • Measuring distributed production • Optimal allocation of DG	• Future development • Suitable for small scale issues
Nadhir et al. [50]	• Improve system performance • Increase total power	• Run on small scales

4.3 genetic algorithm (GA) optimization techniques

In operational research and mathematics and computer science, the genetic method and algorithm is a meta-heuristic inspired by the natural sciences used to select the next generation and is one of the evolutionary approaches. Genetic algorithms are commonly used to generate appropriate-quality solutions for optimization and search problems by relying on bio-inspired operators such ass election, mutation and crossover(Schorle, Meier, Buchert, Jaenisch, & Mitchell, [71]). The genetic algorithm (GA) (D. Goldberg, [27]; D. E. Goldberg, [28]) is an evolutionary algorithm based on the idea of natural selection and evolution. This method in the spectrum has made it possible for you. In the algorithm, there are many different solutions making up the population. The GA performs different genetic operations on the initial population until the given stopping criteria are applied. The parallel genetic algorithm (PGA) is the GA extension. The major advantage of PGAs is their ability to facilitate different subsets to be evolved in different directions with other limitations (Lim, Ong, Jin, Sendhoff, & Lee, [42]). It has been proven that PGAs improve the search process and can provide almost accurate solutions to various problems (Cui, Fogarty, & Gammack, [13]; Z. Liu, Liu, Wang, & Niu, [44]; Sena, Megherbi, & Isern, [72]).

4.3.1 Overview of the selected mechanism

Babaie-Kafaki et al. [5] have introduced a combination of genetic methods by increasing the number of repetitions of genetic algorithms and gradually increasing the probability of using the neighborhood search method on the best individuals. They implemented the proposed hybrid algorithms and compared their performance to several recently proposed hybrid methods. On the contrary, it uses the neighborhood search method for all the people surveyed, the two hybrid algorithms apply simulated annealing to the best person in the population in each iteration. They presented algorithms for them called terminal location problem models with fuzzy values. To investigate the effectiveness of the proposed algorithms, they implemented and solved fuzzy terminal location problem models. It is assumed that the fuzzy model has a fuzzy number of passengers proportional to the hypothesis as well as fuzzy neighborhoods with predetermined upper and lower boundaries for the number of positions required. They randomly generated algorithms on various terminal locations with large-scale fuzzy values where the cost function coefficient is assumed as the fuzzy value. Although the proposed method, it has many iterations, it is suitable for real-time problems.

Crossland et al. [12] presented an exploration planning tool using a simulated system. It uses a genetic algorithm to investigate the storage problem and measure energy storage in productive LV networks. This method is used to investigate the configuration and topology of energy storage to solve voltage gain problems as a result of increasing PV efficiency. Regarding the energy absorption by PV, distributed storage has been demonstrated to be a good alternative to the creation and repair of the LV network. In addition, it has been shown that a single-phase storage configuration inside the target home can solve the voltage problem using a two-phase or three-phase system on the street. The paper presents an exploratory planning tool for energy storage in distributed LV networks. Storing a single phase at the customer site offers solutions that should be evaluated for lower energy and three phase storage at the main input. Storage at home can benefit the customer by saving energy and reducing consumer bills due to the energy tariff structure. This will generate more revenue to offset system costs. In addition, due to some limitations, this method needs to be developed.

Hiassat et al. [30] applied a location routing model for corrupt products. In this problem model, the number and location of year-round warehouses, the amount of inventory available to each vendor, and the routes traveled by all vehicles are evaluated. The proposed model incorporates location decisions into a recently published inventory routing problem to make the problem more practical and thus makes the common claim that the integration of strategic, tactical and operational level decisions will yield better results for supply chains. Given that the model developed here is NP hard and without the algorithm capable of finding practical solutions in polynomial time, they develop a genetic algorithm to solve the problem efficiently and effectively. Numerical papers prove that this model is more cost-effective than previous models. Possible formats include the use of several different products, the use of different storage time windows for products (depending on the time of year or temperature, etc.) and carbon emissions accounting that the authors work on. The genetic algorithm here effectively solves large and small samples. Solving this model is carried out using the meta-heuristic algorithm. Success is the result of the fact that the exact method does not solve many instances in a reasonable time. To optimize the performance of this method, various parameters of the algorithm have been studied and tested. The proposed method calculates the best solutions among similar methods despite using random models and parameter constraints.

Saif-Eddine et al. [69] introduced two new hybrid algorithms. By combining them, they solve the optimization problem called hybrid algorithm (HGA). Their paper addresses the problem of inventory location routing (ILRP) when adopting a VMI strategy. To minimize the total cost of supply chain, a mathematical model is applied, which is NP-hard. An improved genetic algorithm (IGA) is designed and used to solve the problem. In the implemented problems, two samples (10 and 30 customers) have been investigated and resolved. To illustrate the effect of this approach, the total vehicle capacity (number of vehicles in stock and vehicle capacity) on the total cost of the supply chain is considered. The results show that IGA performs better than GA in achieving lower cost, especially for a large number of customers. Improvement of the efficiency of the solution obtained is mainly achieved at the cost of computational time. Despite the limitations of the parameters, this method is highly efficient and has good computational time compared to similar methods.

Rybičková et al. [67] proposed a location routing problem that was difficult to solve for NP-hard problems and was used in optimization projects for supply chains and distribution systems. The purpose of the routing problem is to locate multiple warehouses, along with the vehicle's paths, so that the total cost of the system is minimal. In the proposed problem of this paper, a genetic algorithm to solve a routing problem is considered. The representatives of individuals with genetic operators are designed to interfere and resolve both location and routing areas. Various parameters have been tested using the genetic algorithm to prove their impact on the results and acceptable performance of the proposed algorithm. The problem presented by them involves the optimal location of several warehouses, along with the optimal route distribution. The proposed algorithm uses the results of two separate genetic algorithms continuously with 2.9%. In the experiment, several interesting dependencies of the parameters were found on the results. The proposed method, despite its dependence on the parameters and the large amount of computing, can provide an optimal solution and reduce costs.

4.3.2. Summary of the reviewed GA based techniques

In the previous sub-section, five selected GA algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 5 shows the comparison of the most important advantages and disadvantages of each article.

Table 5. A side-by-side comparison of the most important advantages and disadvantages of the GA for location routing

Paper	Advantage	Disadvantage
Babaie-Kafaki et al. [5]	• Real-world application • Low computing time • It works for great issues	• Repeated algorithms
Crossland et al. [12]	• Acceptable alternative in the real world • Real-world cost reduction	• The need for real planning • Having some limitations • Improve the algorithm in the future
Hiassat et al. [30]	• Comparability • Application in practical matters • Provide the best solution to similar methods	• Use random models • Parameter Limit
Saif-Eddine et al. [69]	• Low computing time • Compare with similar algorithms • Little repeats	• Having some limitations • Using random data in the algorithm
Rybičková et al. [67]	• Minimizing the total cost of the system • Provide the optimal solution	• Dependence on parameters • Lot of calculations

4.4 Simulated Annealing (SA) algorithm technique

Simulated annealing (SA) is a probabilistic technique for approximating the global optimum of a given function. The simulation of annealing as an approach that reduces a minimization of a function of large number of variables to the statistical mechanics of equilibration (annealing) of the mathematically equivalent artificial multiple system was first formulated by Glover [89] and by Khachaturyan, Semenovsovskaya, and Vainshtein [36]. To find the optimal solution, these authors used computer simulations mimicking the simulated annealing of such a system. In particular, reference optimization lies almost in a large meta-cognitive search space. This is often used when a discrete search space is assumed (for example, all tours passing through a specific set of tourist spots). For problems in which finding an approximate overall optimal is more important than finding a local optimal locally at a given time, simulated annealing may be preferred to other alternatives of similar algorithms.

4.4.1 Overview of the selected mechanism

Küçükoğlu et al. [38] proposed the considers recharging operations of the electric vehicle at identical charging stations. We should keep in mind that different charging technologies used in public or private stations lead to different charging times for electric vehicles. Therefore, this study extends the ETSPTW by considering charging operations at customer locations with different charging rates. This is the first study considering private and public charging stations for the ETSPTW with other limitations in mind. In addition to the expanded version of ETSPTW, this paper applies a new simulation algorithm (SA) to solve the ETSPTW-MCR problem effectively. This algorithm uses efficient search methods based on the TSPTW constraints, and uses a modified solution acceptance criterion and an advanced list structure. However, the main purpose of this comparison is to show that the approach can be applied respecting the quality of the solution.

Ghorbani and Jokar [22] designed multi-step and multi-product routing issues. There is also the imperial competition to solve the problem. For this paper, the simulated annealing method is implemented, and a comprehensive numerical problem of this problem is presented, which is examined by the above-mentioned method. Additionally, the proposed method is solved and compared to the annealing algorithm in large and small samples. The results show that the proposed algorithm simulating imperialist competition (IC-SA algorithm) is better than the payback algorithm (SA) in terms of time and quality of the CPU solution. Furthermore, the solutions obtained using IC-SA algorithm and SA algorithm are evaluated in several small and large cases. The results obtained from numerical examples show that: The IC-SA algorithm performs significantly better than the SA algorithm in terms of solution quality and convergence. However, trying to find a better algorithm is regarded as future research. For example, a combination of particle optimization (PSO) and simulated annealing (SA) and comparison with the IC-SA method can be helpful. However, given the high volume of computations, the proposed method has to be developed.

Santosa and Kresna [70] presented the facility location problem (FLP). FLP is an important aspect of the supply chain designing an efficient supply chain. Situation problems refer to modeling, shaping, and problem-solving that determine the location of the particular area in question. The warehouse problem is a facility pattern of accommodation tar getting the set of facilities as one of the distribution facilities. In this study, a single-stage warehouse planning model (SSCWLP) was used to determine the optimal storage location for PT material distribution. In essence, SSCWLP is a complex NP problem, requiring extensive computational time using common methods. The problem of this paper is solved using the meta-heuristic algorithm, where SA is used. The next stage of SA performance testing is to compare SA results with branch and boundary (BB) results. SA offers good suggestions to solve the SSCWLP problem, and produces solutions that are a short distance from the exact methods. Solutions are also better than existing solutions. SA provides good solutions for SSCWLP computation taking acceptable computation time. The results of the examples indicate that SSCWLP is improved in PT. Never the less, given the cost and the fact that the answers are approximate, this method can be developed in the future.

Vincent and Lin [80] presented a new type of routing problem (LRP). The purpose of the LRPSPD designed problem is to minimize the total cost of the distribution system, including the cost of transporting vehicles, the cost of repayment and the fixed cost of the vehicle. Over all, warehouses and setting car routes simultaneously to meet the supply and demand for each customer deliver a NP-hard problem. This study proposes a simulated annealing algorithm (MSA) to solve the LRPSPD algorithm incorporating several effective initial strategies into the simulation analysis framework. The MSA algorithm has been tested in 360 samples to evaluate its performance. The calculations show that the proposed MSA algorithm is effective in solving LRPSPD. This algorithm integrates the cooling simulation algorithm and other advanced methods presented in the literature. Researchers may also bring LRPSPD closer to reality with operational constraints like time windows to find the problem.

Vincent and Lin [81] introduced the open location-routing problem (OLRP) that is a variant of the capacitated location-routing problem (CLRP). OLRPs are working with third-party logistics companies (TPLs) on a contract increase, and with CLRP there are major differences, in which after-service vehicles are not distributed to all customers. The purpose of OLRP is to minimize the total cost, including facility operating costs, maintenance costs, fixed vehicle costs and travel costs. The programming model of this problem increases the search space solution and improves the search for better solutions. Compared to the solutions obtained from CPLEX, the proposed exploration SA performs better than CPLEX in terms of quality and timing of results. Moreover, CPLEX cannot solve large, high-parameter OLRP samples, but SA 85 solves the sample in several sets of OLRP criteria. Furthermore, given the limitations of this problem, the proposed approach has a great impact on large issues.

4.4.2. Summary of the reviewed SA based techniques

In the previous sub-section, five selected SA algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 6 shows the comparison of the most important advantages and disadvantages of each article.

Table 6. A side-by-side comparison of the most important advantages and disadvantages of the SA for location problem

Paper	Advantage	Disadvantage
Küçükoğlu et al. [38]	• solving routing problem simultaneously • Compatibility with other algorithms	• Long computing time • Many repetitions
Ghorbani and Jokar [22]	• Convergent • Comparison with similar methods • high efficiency	• Many repetitions • Computation time
Santosa and Kresna [70]	• working better than existing methods • Less computing time • reduction in costs • High sensitivity of the algorithm	• Need more feasibility studies • There is an accurate 11% spacing with precise methods • The need to examine the performance comparison of the future algorithm
Vincent and Lin [80]	• Cost-saving operation • Increasing the performance of classic techniques • The best solution for random samples	• Operating limit like time • Failure to deal with real issues
Vincent and Lin [81]	• Comparability with other methods • Search space intensification • Increasing the performance of algorithms	• Development of the method in the future • Failure to adapt to real problems

4.5. tabu search (TS) algorithm technique

The Tongan language used the word taboo. The Tonga natives and local people used them to illustrate things that could not be used, since they were sacred. Banned search is a metaphor algorithm that can be used to solve large and hybrid optimization problems (problems optimizing the order and selecting the desired options). Tabu search, created by Glover [86] in 1986 and formalized in 1989,(Glover, [25], [26]) is a meta heuristic search method employing local search methods used for mathematical optimization. The Tabu Search complies with its constitution, applies the local search function, and strives to improve it. Firstly, in the absence of improved movement, worse movements can be accepted (such as when the search is at a tight local minimum). In addition, prohibitions (hereinafter referred to as taboos) have been banned to prevent the return of previously visited solutions. The implementation of the Tabu search uses memory structures describing the visited solutions or user-provided sets of rules(Glover, [24]). If you have visited a potential solution or violated a rule for a specified, short period, you declare it "taboo" so that its algorithm cannot be repeatedly considered.

4.5.1. Overview of the selected mechanism

Díaz et al. [14] presented a housing problem. In this problem, he aimed to cover the maximum demand for a set of customers considering the constraints and set of problem possibilities. Applicants should be among the potential sites. It is assumed that there is a set of facilities owned by other companies, and customers freely choose the facility to search within. Two meta-heuristic algorithms have been employed to obtain low values to solve the problem in question: GRASP-based heuristic and GRASP-tabu heuristic replacing the local GRASP heuristic with a taboo search method. Both algorithms were randomly generated with a set of 60 random samples, and several computational experiments were evaluated to evaluate the proposed method. The computational results show that the numerical effort required by FICO XPRESS increases substantially. In the initial experiments on these samples, for the largest case, FICO XPRESS took more than 15 hours. In the worst case, the time required is approximately250 seconds. Thus, despite limiting the parameters, it has improved compared to previous methods.

Li et al. [41] studied several purposes of the LRP and compared it to several multi-purpose heuristic and meta-heuristic approaches. In their problem, they must place some plants in a set of locations to meet the demands of a number of clients with several major goals. This type of planning is used to solve the problem of real data in the system. To solve this problem, the taboo-based meta-search technique (TS) and its limitations were used. Using a compatible memory method, MOAMP attempts to adapt the taboo search method to the optimal start-up structure of a problem with multiple objectives. Therefore, this is an initial set of hypothetical points (the first step of the algorithm) and uses this to obtain a good approximation of the rest using a search resonance process. This meta-heuristic approach addresses a real problem, and information is provided from two fire departments and an animal waste disposal plant in Andalusia receiving a broad approximation of the efficient set of problems. Future work involves trying to apply this model to areas remaining in larger areas. However, some new aspects of the meta-cognitive process, such as interactive mode and fuzzy information, will be used to provide sufficient information to the actual decision maker in the process. This method is suitable for small problems. Additionally, the way to create larger problems must be formulated. In addition, the computation time is not compared to other methods.

Ho [31] discussed the single source facility location problem (SSCFLP), which is a subset of facilities to meet the demands of applicants, so that the model tries to minimize costs. Achieving this research enables repeated searches for SSCFLP. The executed program uses random and hard-sampled samples to obtain variation in the search. The experiments were performed on two sets of benchmark samples. The proposed algorithm finds the final solution in 40 of the first 57 samples of the first set of standard samples and at least eight mean deviations (0.019%) were obtained among the eight meta-theoretical methods. In addition, in the case of 61 out of 71 samples from the second set of selected samples, the method has been able to achieve an optimal solution. This algorithm works by computing time and comparing it to similar methods. However, given the approximate nature of the response, the method has to be formulated.

Lai et al. [40] suggested a problem of blocking the heterogeneous time domain for multiple purposes, in which the parallax shows the different travel options based on scales such as time, cost, distance and number of trips. He formulated this problem as a complex, numerical linear programming model, and proposed a taboo search exploration to effectively solve the computational challenges of a parallel problem. Numerical experiments show that the meta-algorithm is effective. Vehicle routing has been the main use of logistics and distribution systems. Answers show that acceptable savings are made on shipping costs, using an alternative route, especially when items are delivered to customers within a limited timeframe. This is because multiple structures use solutions using multiple arches; for example, an arc with higher travel costs but shorter trip times can be added to a vehicle path, which may reduce the need for additional vehicle dispatching. Furthermore, the large amount of calculation of this method will cause its execution time to be high.

Nguyen et al. [54] designed a two-way lane routing error line (LRP-2E) for the first-time trips from one of the main warehouses as a set of satellite caches to be placed. Additionally, the second trips are the level of customer supply from these satellites. In the proposed multiple local search (LT-ILS), the three greedy random cycles generated are averaged. Two search spaces (Giant and LRP-2E hybrid tours), two VND methods instead of local search, and a taboo list used to stop the current ILS and faster than the original combination. The next step is to design the lower bound and precise methods for LRP-2E. They work on a new shear algorithm for more accurate evaluation, which can optimize most cases with 50 clients. This method has to be developed despite the increased search space and competition with similar methods, due to the lack of parameters.

Silvestrin and Ritt [75] presented a kind of automobile routing problem processing vehicles with different departments to obtain the best deal. Meta-heuristic methods are used to solve MCVRP problems. Inspired by symptoms (ITS), they search the place and provide the best solution. Accordingly, they find a solution by searching locally and then find a local taboo by finding a taboo. Furthermore, they continue to search for the optimal value until they reach the stop criteria. The need for different parts often occurs in practical applications. They have shown that ITS in VRP performs reasonably well. In existing methods, on average and in most cases, combined quality and timing are applied in different cases. However, methods may have general principles for different types of VRP. Nevertheless, the extra time does not improve the results significantly, while ITS has improved significantly over time. The results of ITS surveys also show that the number of different constraints is relatively limited; this approach works for small problems, while it does not work for large problems, so that it should be developed for larger issues.

Sun [78] presented an efficient approach to real routing problems, which were based on prototypes in UFL and TS problems. He developed a meta-heuristic algorithm to increase its efficiency. He tried to optimize and improve the values of the TS parameters. Owing to various strategies and intensification of the search of the desired space, it has also achieved some success demonstrating the effectiveness of the proposed method in solving the proposed problem. However, this method is only able to solve the given problem, while it does not solve other issues of location. Therefore, the approach to the problem of larger facilities should be rewritten.

Polak and Boryczka [59] presented a combination of location and vehicle decisions known as NP hard issues. Given the complexity of the problem, the discovery strategies simultaneously solved the problem of routing and routing decisions. This two-dimensional architecture speeds up space search, so that optimal solutions can be created without over-computing. An extensive study in this area shows that the performance of the TS algorithm has improved significantly over an active LRP problem. This method provides satisfactory answers to various issues and searches. However, to extend it, minor revisions have to be made.

Xie et al. [83] explored the problem of allocating storage location. SLAP is an important optimization problem in the storage of raw materials. Owing to various restrictions and products available, each faces a different set of popularity items. SLAP is to provide the best location for products in stock to minimize warehouse operation costs. Generally, operating costs include the estimated cost of taking orders with the limitations in mind. Accordingly, the goods belong to a more desirable product for the combination. In the present study, the SLAP with constraint grouping constraints (SLAP-GC) is considered, and for this purpose, RNTS with optimal performance is presented. Experimental results in real-world data show that RNTS has advanced algorithms for SLAP-GC in terms of quality and speed. This has provided optimal solutions for many smaller projects faster and more successfully. The GP method in terms of quality and runtime can create reusable allocation rules that can produce a complete solution in a short period, while the proposed RNTS can effectively seek overall and optimal solutions. However, for large scales, it does not work well.

4.5.2. Summary of the reviewed TS based techniques

In the previous sub-section, nine selected TS algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 7 shows the comparison of the most important advantages and disadvantages of each article.

4.6. Memetic algorithm (MA) optimization technique

Memetic algorithms in evolutionary computing represent one of the growing areas of research. The term MA in optimization science is widely used as an evolutionary approach or any population-based approach with separate learning methods to improve local methods in order to find optimal problem solving. Evolutionary algorithms based on local and genetic searching and MA are often referred to in the literature. Memetic algorithm is a population-based technique in which a local search method is used instead of the traditional mutation operator (Amaya, Porras, & Leiva, [2]; Jin, Hao, & Hamiez, [13]; Neri, Cotta, & Moscato, [53]). These methods are powerful paradigms for solving NP-hard hybrid optimization problems. Specifically, they have been successfully implemented in fully relevant GCPs (Galinier & Hao, [19]; Lü & Hao, [45]; Malaguti, Monaci, & Toth, [47]; Porumbel, Hao, & Kuntz, [62]).

4.6.1. Overview of the selected mechanism

Karaoglan and Altiparmak [34] investigated one of the real routing and location issues. In their approach, using the complex return paths (CLRPMB), the problem design is addressed. CLRPMB seeks to minimize system costs by finding parking spaces and designing car routes on such demand for delivery and how each customer is tracked by the same vehicle. Since CLRPMB is a difficult NP problem, they propose a special algorithm to solve the problem. To evaluate the performance of the proposed technique, they conduct an extensive study and compare their results with those obtained for similar problems.
- They consider the capacitated location-routing difficulty with mixed backhauls.
- They propose a memetic algorithm based on simulated annealing and genetic and programming formulation.
- The Memetic algorithm offers reasonable or optimal solutions over an acceptable period.

Table 7. A side-by-side comparison of the most important advantages and disadvantages of the TS for location routing problems

Paper	Advantage	Disadvantage
Díaz et al. [14]	• Optimality more universal • Good computing time • Improve the performance of previous methods • Using large scale	• Parameter Limit
Li et al. [41]	• better results on medium scale	• Run on small scales • improving algorithm in the future • no iterations • no runtime
Ho [31]	• Low computing time • Compete with similar methods	• Improve the method in the future • Reaching the approximate answer
Lai et al. [40]	• System cost savings • Using the alternative path	• Lot of calculations • Time of calculation
Nguyen et al. [54]	• Competing with other methods • Comparability • Search space intensification	• Approximation Method • Parameter Limit • Improve the method in the future
Silvestrin and Ritt [75]	• Competing with similar methods • Comparability • better results on medium scale	• Improve the method in the future
Minghe Sun [78]	• Low computing time	• Lot of calculations • Failure to adapt to real problems
Polak and Boryczka [59]	• Solving the two problems at the same time • Less computing	• Parameter Limit • Using Non-Optional Variables
Xie et al. [83]	• Provide a better solution • Quality and higher speed	• Future development • Inefficiencies for big issues

Marić et al. [48] presented a memetic algorithm (MA) to solve the Indifference single allotment hub location problem (USAHLP). Two impressive local search heuristics are designed and executed in the form of an evolutionary algorithm to improve the position and allocation of a part of the problem. They have designed the MA-magnet to solve USAHLP. The evolutionary part of the MA uses binary encryption, good tournament selection, two dots, and jumps with frozen bits. An important feature of the proposed MA is its new and efficient local search. Its limitations are included in the evolutionary algorithm framework. The first attempt is to find the best hubs, while the second is to improve the allocation of source nodes / nodes to the hubs, when a set of poles is already inserted. The empirical studies presented demonstrate the reliability, good performance, and feasibility of MA. The MA method is highly effective to obtain known solutions in small and medium-sized CAB and AP cases. This method works well for small to medium problems, but it is not suitable for large problems.

4.6.2. Summary of the reviewed MA based techniques

In the previous sub-section, two selected MA algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 8 shows the comparison of the most important advantages and disadvantages of each article.

Table 8. A side-by-side comparison of the most important advantages and disadvantages of the MA for location problem

Paper	Advantage	Disadvantage
Karaoglan and Altiparmak [34]	• Low run time • Run on large scales • High quality solutions	• High iterations • Need to develop method
Marić et al. [48]	• Improve the quality and time of the CPU • Solving the two problems at the same time • Application for large samples	• Need to develop method • Many repetitions

4.7 Particle Swarm Optimization (PSO) technique

In mathematics, particle swarm optimization (PSO) is a pragmatic computational method optimized by repeating the effort to amend a solution in observing with the criteria to measure the response. Consider this problem with a number of early solutions, particles that are considered to be the answer, and the movement of these particles into the search space. They solve the problem using simple mathematical formulas to move the particle in velocity and position. At each step, the particles are directed to their known location, but also to known positions in the search space, which are updated by other systems if desired. This process is expected to lead to the best response. PSO is originally ascribed to Kennedy, Eberhart and Shi(Shi & Eberhart, [73]; Shi & Eberhart, [74]) and was first predetermine for simulating public behavior,(Kennedy, [35]) as a stylized representation of the motion of organisms in a bird flock or fish school. This algorithm is simplified and seen in the examples that perform the optimization. The book by Kennedy and Eberhart explains many philosophical appearances of PSO and swarm intelligence. An immense survey of PSO applications is made by Poli (Poli, [60], [61]). Recently, a comprehensive review on theoretical and empiric works on PSO has been propagated by Bonyadi et al. [6].

4.7.1. Overview of the selected mechanism

Yu Peng et al. [57] tried a location model with randomized parameters and artificial intelligence techniques. A Value-at-Risk (VaR) based fuzzy random possibility location model (VaR-FRFLM) is produced in which both costs and requests are assumed to be fuzzy random value, and the capacity of each possibility is fixed and an intention value is assumed continuous. Hybridization of the improved particle swarm optimization (MPSO) process is proposed to solve the VaR-FRFLM. In this hybridization technique, an approximation algorithm is employed to compute the fuzzy random VaR purpose. Numerical responses show that the combination of MPSO performs better than when PSO and GA are used regularly, but they only solve VaR-FRFLM. The capacity in the new model is not fixed, but it is assumed that a decision will be made. This practice will lead to the model being implemented based on running work, the proposed MPSO hybrid algorithm can be extended to the other integrated 0-1 integration optimization with the VaR criterion. In addition, a VaR-based fuzzy randomized interim model may be distant to a multi-objective model regarding the expected gain as another goal. In general, the use of fuzzy variables is a rising result. Although, there are problems of optimization in random models, the amount of profit and loss is not considered.

Yang Peng and Chen [56] presented a routing problem in drafting a logistics distribution and operation network whose mathematical instance is presented in that paper. Since finding an optimal solution for this example is a NP problem (non-polynomial), they separate the main problem into several sub-problems, for example, one of the allocation problems of the location, and the other is the route routing of the car. Investigations are conducted with an available model and applied with a penalty. Two-dimensional research is concerned with: (1) developing a model and method for multi-product routing and (2) combining the PSO procedure with another optimization algorithm to solve a more complex location than the routing problem.

There are two problems at the same time and a viable solution to the problem. Never the less, this method suffers from parameter constraints.

Rabie et al. [65] presented a particle swarm optimization (PSO) procedure to solve large-scale continuous p-median location subjects in plane. A PSO algorithm, formerly developed for the P-center continuously, has been distanted to solve the p-median position problem. The p-location query goes to finding locations on the plane to minimize the total Euclidean distance from the p-range to the set of final demand points. A significant aspect of the prevalent work is that in the main issues, the problem was studied in most cases formerly discussed in the literature. The results are compared to several similar location problems. The Median-PSO-ED algorithm is used to find suitable solutions to problems of various sizes. The results indicate the superiority of this technique to the results obtained in previous methods. In general, this method has become a particular problem and has yielded acceptable results, but it is not generalized to other subjects.

Yu et al. [86] proposed a spatial location allocation for urban parks based on particle optimization (PSO). In the SLA for public park, there are several operators such as competitiveness, society compression, and accessibility. This indicates that a number of parks have been investigated in the study. To find the required parking spaces, SLAs are investigated using a highly sophisticated roofing method. The PSO algorithm can reduce the computation and adjust the set of parks in the expected time. For example, allocating locations for hospital services, agriculture, water-saving systems, cinemas and supermarkets, etc., this method can be used for other services. Compared to other methods of artificial intelligence, this model is simpler and more practical and requires fewer parameters. Housing size parameter, grid distance, and local laboratory parameters for different locations in estimating population density are also considered in the optimization method. The SLA results indicate that this approach is simple and cost-effective, and the visual development tool can help local managers to make better decisions in urban planning. However, in terms of computational time, this method has some shortcomings.

4.7.2. Summary of the reviewed PSO based techniques

In the previous sub-section, four selected PSO algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 9 shows the comparison of the most important advantages and disadvantages of each article.

Table 9. Compare side by side the most important advantages and disadvantages of PSO for problem location

Paper	Advantage	Disadvantage
Yu Peng et al. [57]	• achieve the promising performance • Using Fuzzy Variables • Better time calculations	• Not generalizing the algorithm to integers • Random optimization problems • Not considering the expected profit
Yang Peng and Chen [56]	• Solving the two problems at the same time • Provide practical solutions • Improve the performance of the algorithm	• Performance Limit
Rabie et al. [65]	• Solving big problems • comparing results • Finding the best solution	• Having some limitations
Yu et al. [86]	• Need less parameters • Can be generalized to most urban services in the real world • Simpler, more sophisticated than other AI techniques	• Computation time

4.8. Hybridization of metaheuristic algorithms technique

Currently, combining different methods and using fuzzy values is one of the best and most prosperous trends in optimization. Metacognitive hybridization, such as evolution and optimization algorithms of ants and variable neighborhood search with artificial intelligence techniques and operations research, plays an important role. The resulting hybrid algorithms are usually labeled as hybrid meta-heuristics. The rise in this new research field is because the basis of optimization research has shifted from an algorithmic point of view to an uncertain one. In this brief review, we review the combined methods and the use of fuzzy logic.

4.8.1. Overview of the selected mechanism

Zhang et al. [87] considered the row layout optimization problem when the material flow between facilities fluctuates within a certain range. The new model can be used to obtain the overall optimization solution under the conditions of the floating material flow matrix to achieve the goal of optimizing the entire MHC in the entire production process. Since the new model introduces more intermediate variables and parameters, a two-step solution method is already required, which greatly increases the time to solve the problem. This paper proposes a goal-directed meta-heuristic algorithm optimization method that combines the advantages of the tabu search algorithm and the harmony search algorithm, which simplifies the solution phase of calling the exact solver in the two-stage algorithm of the row facility layout problem and improves the problem-solving efficiency. And it makes it possible to solve big problems. The proposed model is confirmed through Lingo software, and then the model and the combined algorithm are confirmed together in the MATLAB environment. Finally, the proposed simplified algorithm is used to solve large-scale problems that previously could not be solved by the two-step algorithm.

Lv et al. [46] This paper focuses on a location routing problem (LRP) called dual mode integrated location routing problem (DMI-LRP) in modern supply chain logistics system. Warehouses in DMI-LRP serve the needs of retailers and online shopping customers simultaneously, and retailers and customers follow two different order cycles. The problem is presented in a two-story structure where products are transported from the factory to distribution centers (DCs) on the first floor and from DCs to retailers and customers on the second floor. Mathematical formulation is provided along with some valid inequalities to strengthen the model for exact method. We propose fuzzy correlation (FC) based location for DCs and allocation for retailers and customers in LRP. Also, an adaptive neighborhood search algorithm based on fuzzy correlation arc (FCA-AVNS) is designed for path planning. The proposed method is tested on three adapted benchmark samples and the results are compared with the exact and three other heuristic methods. Numerical experiments show the feasibility and efficiency of the proposed method, especially in solving large-scale problems.

Mokhtarzadeh et al. [49] developed a new p-mobile hub location-allocation problem. Hub facilities can be transferred to other hubs for the next period. Implementing mobile hubs can reduce the costs of opening and closing hubs, especially in an environment where demands are changing rapidly. On the other hand, the relocation of facilities reduces the lifespan and increases the related costs. Depreciation cost and lifetime of the hub facility should be considered and the number of hub facility relocations should be limited. Three objective functions are considered to minimize the costs, noise pollution, and annoyance caused by creating a hub for people. To solve the proposed model, four meta-heuristic algorithms, namely multi-objective particle swarm optimization (MOPSO), a Non-dominated sorting genetic algorithm (NSGA-II), a combination of k-medoids as a well-known clustering algorithm and NSGA-II (KNSGA-II), and a combination of k-medoids and MOPSO (KMOPSO) are implemented. The results show that KNSGA-II is superior to other algorithms.

Fazli et al. [18] proposed a two-phase hybrid heuristic method for solving the vehicle location problem (FLRP). The FLRP method checks location and routing intent. They are, at the time of arrival, a set of identical vehicles (each with fixed cost and capacity), a set of offices with finite arm costs, finite capacity, and a set of customers with deterministic demand. In this case, they used fuzzy variables to make the answers more realistic. Practical calculation results show that the proposed framework can solve other problems such as periodic routing problem (PLRP) and multiple routing problems (MDVRP) and several extensions of CLRP. In other words, adding constraints such as window time and heterogeneous fleet becomes problematic. In general, the proposed method is favorable in terms of computing time compared to similar methods. With the help of using Fari values, it has a good application in real

Saffari et al. [68] developed an integrated logistics procedure in which the main decisions about storage location, route allocation by vehicle is made simultaneously. The equilibrium skill of joint decision criteria and total system costs show that concurrent versions have capacity constraints on sequential problems, but they do not temporally conflict with each other. Concurrent versions are also more effective productive non-dominant solutions than sequential versions. This procedure considers both problems at the same time and tries to reduce costs, but the situation is not favorable in terms of efficiency and timing of checks. They used RBF-NN using the fuzzy model design of the control parameters of the whale algorithm. FWOA, WOA, GWO, ChOA, GA, ES, GA, LCA and GSA algorithms have been used to use RBF-NN. FWOA can well define the boundary between exploration and exploitation phases. Hence, it does not stick to local optimizations and proves its ability to find global optimizations to solve high-dimensional problems such as sonar data. The results show that RBF-FWOA, RBF-GWO, RBF-ChOA and RBF-WOA have the best classification accuracy, respectively. Also, the convergence speed of FWOA is better than the other seven used algorithms.

4.8.2. Summary of the reviewed HA based techniques

In the previous sub-section, five selected HA algorithms for location routing problem were analyzed, and their advantages and disadvantages were discussed. Table 10 shows the comparison of the most important advantages and disadvantages of each article.

Table 10. A side-by-side comparison of the most important advantages and disadvantages of the HA for location routing problems

Paper	Advantage	Disadvantage
Zhang et al. [87]	• Solving the two problems at the same time • Provide practical solutions • Improve the performance of the algorithm	• Having limits on big problems
Lv et al. [46]	• Generate synchronous version • Average cost improvement • Low computing time • Average and proper distance	• Applying medium graphs
Mokhtarzadeh et al. [49]	• Improve the quality and time of the CPU • Solving the two problems at the same time • Application for large samples	• Computation time
Fazli et al. [18]	• Low computing • Using real values • Comparability	• Having some limitations
Saffari et al. [68]	• Generate synchronous version • Average cost improvement • Low computing time • Average and proper distance	• Applying medium graphs

5. Limitation

This study was designed to lead a systematic review as rigorously as possible, but there may be some limitations. Hence, in this study, the limitations outlined below should be considered by future studies:

Research scope: The location problem was coverage in different sources such as academic publications, editorial notes, technical reports and web pages. Particularly, the researchers eliminated articles published in national journals and conferences. Additionally, the researchers eliminated the articles that were not about location problem. Therefore, in the competency of this review, it must be regarded that this systematic review considered studies published in the major international journals.

Study and publication: The researchers chose Google scholar as a dependable electronic database. Based on the existing statistics, this electronic database would suggest the most related and valid studies. However, it could not be guaranteed that all selected studies are applicable. There is a probability that some applicable studies overlooked the proceeding of article selection mentioned in Section 3. May be some applicable articles go unnoticed because of different reasons that these reasons can limit from the searching of wrong keywords to the data extraction.

6. Open issue

This section presents the main location problem techniques that have not been extensively and comprehensively studied yet; this can be research guidance for future studies. Considering the meta-heuristic techniques, the problem of location problem and the criteria mentioned in this article is like competitive, iteration number, and runtime, while some completely disregard these issues. For example in Díaz et al. [14], it is necessary to consider convergence, iteration number, runtime and improving algorithms. Also, some techniques consider competitive, Comparable, success, while some completely disregard these issues. For example, in Lai et al. [40] , it is great to consider considering competitive, Comparable, success. Therefore, by converting and analyzing the referred meta-heuristic techniques, there is no independent technique addressing all issues included in the location problem. Another attractive point of future study could be investigation of solving the location problem by meta-heuristic algorithms. In addition, some meta-heuristic algorithms that are more efficient on these issues are considered. Their review will be interesting. When the size of location problem increases, it is clear that the runtime and the number of repetitions of the algorithm increase. To avoid these difficulties, meta-heuristic algorithms should be designed aiming at eliminating the difficulties caused by such cases. Furthermore, the efficiency of meta-heuristic algorithms in solving the location problem is one of the important factors, including in large-scale problems. Therefore, the efficiency of the algorithm for global optimal solutions, the number of success and convergence, are good and interesting criteria for future studies.

In the most of the reviewed techniques, many new meta-heuristic algorithms such as simulated annealing optimization, artificial fish optimization algorithm, and cat swarm optimization with the balancing aim were not applied to this problem, especially in trusted and prestigious journals. Additionally, some factors such as large-scale graph, the dependence of algorithms on parameters, decreasing solutions space, starts with random non-feasible solutions, global best position and standard deviations were not considered. Moreover, the paper widely reviews the application of meta-heuristic algorithms in the location problem. By reviewing the papers, we observed that the results of combined meta-heuristic algorithms were better than those of innovative algorithms; in other words, most of the criteria improve with the proposed hybrid algorithms; therefore, some new hybrid approaches are needed in the future.

7. Conclusion

Location navigation problems can have different effects on the economy of the community. Although meta-heuristic algorithms are applicable methods for solving location problems, due to computational time and more iterations, in recent years the desire to combine these methods has been suggested to increase their efficiency. Therefore, we propose combined meta-discovery to solve these kinds of problems. These methods give the best results and work best on the same set of problems at the same time. Again, the calculations show that: Meta-hybrid results are better than heuristic and meta-cognitive combinations. As its creation mechanism to create new solutions, it allows for the storage and use of relatively large equations of good and diverse solutions throughout the search process. These methods require a minimum of computation time and are very suitable in line with similar experiments presented in the literature. In general, combined meta-cognitive methods are a very effective tool for finding suitable solutions. Case studies illustrate the approaches needed for social learning research, as long-term process analysis requires sensitivity to social and economic contexts. Therefore, fuzzy data can be used to solve the problem in obtaining a dataset of real problems. This could also be the subject of future research.

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