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Performance Improvement of Ant Colony Optimization Algorithm Using Multi-Attribute Rating Simple Technique Exploiting Ranks

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ABSTRACT

The other research to improve the performance of the ant colony optimization (ACO) algorithm by using the simple multi attribute rating technique exploiting ranks (SMARTER) algorithm in getting the fastest time in providing alternative path solutions that can be used in solving TSP case examples and producing new algorithms that are better at solving instances of nearest path search cases. The data used for this study is in the form of a 200-city problem a dataset from the krolak felts and nelson repository. The ACO algorithm functions to optimize the total distance for the TSP dataset while the SMARTER algorithm is used to provide recommendations for the best routes based on the total trip distance generated by ACO. The experimental results obtained of the comparison criteria in this study are the optimum distance (best), average optimum distance (AVG) and processing time (running time). The three criteria, the ACO-SMARTER algorithm is superior except for the AVG criteria for large datasets pr439 and pr1002. Overall the ACO-SMARTER algorithm is better by 26.17% compared to the ACO algorithm in the research of Junjie, P. & Dingwei, W. (2016).

Keywords: Ant Colony Optimization (ACO), Simple Multi Attribute Rating Technique Exploiting Ranks (SMARTER)

INTRODUCTION

Traveling salesman problem (TSP) is a problem when a sales person has to visit all the members of the city and only the city has been visited once, and must start and return to the original city. The goal is to determine the total distance or minimum cost. In addition to the problem of transportation issues, the efficiency of shipping or goods is also determined by the path taken to send the letter or the item. The height of the complexity of the issue of CSR is still not known. This makes TSP a problem that has not yet been resolved in many mathematical optimization problems.

The problems of mathematics about traveling salesman problems were raised in 1800 by Irish mathematician William Rowan Hamilton and English mathematician Thomas Penyngton (Aulia, 2012).

On the research of Junjie, P. & Dingwei, W. (2016) entitled an ant colony optimization algorithm for multi-traveling traveling salesman problems (TSP) is the optimal problem of multiple salesman traveling (MTSP) is a complex problem of combinatorial combinatorial complex, which is the development of the problem of traveling salesman traveling (TSP). This research has been shown to show how optimizing colonic cells (ACO) can be applied to MTSP. In this paper, we compare the ACO algorithm with the modified genetic algorithm (MGA) by testing several sets of TSPLIB. To evaluate its effectiveness, we compared the ACO algorithm with MGA with testing the problem from the standard TSPLIB. In the proposed algorithm the algorithm did not find all the best solutions but competitive

competitive methods in rational time, especially in large data problems. ACO only has the ability to find good results as much as 1% more optimum for small datasets, where the ACO method used in this research is not as efficient in finding solutions for problems with large datasets.

According to Jufri, A., Sunaryo & Santoso (2016) with the title ACO modification for determining the shortest route to the Regency/City in Java, concluded that the modification of the ACO algorithm by providing an automatic value of the ant parameter of 35% of the size of the problem proved to be able to increase the speed of route search shortest by 3 times.

Ant colony optimization (ACO) is included in the intelligence group, which is one of the types of development paradigms used to resolve optimization problems and the aspirations used to solve the problem stems from the ants' behavior. In ACO, every ant in the running herd will leave a pheromone (a kind of chemical) in the path it is passing. The short path will leave a stronger signal. The next ant, when it decides which path should be chosen, usually tends to choose to follow the path with the strongest signal, so that the shortest paths are identified by more and more ants that will pass through the path.

The SMARTER algorithm (simple multi-attribute rating technique exploiting ranks) is a multi-criteria decision making method proposed by Edwards and Baron in 1994. This multi-criteria decision making technique is based on the theory that each alternative consists of a number of criteria that have values and each criteria have weights that illustrate how important one criterion is compared to other criteria. Weighting on the SMARTER algorithm uses a range between 0 to 1, making it easier to calculate and compare values for each alternative (Edwards, W. & Barron, F.H, 1994).

In the SMARTER method, weights are calculated using the centroid rank-order weighting formula (ROC), (Baker, D., Bridges, D., Hunter, R., Johnson, G., Krupa, J., Murphy, J. & Sorenson, K. 2002), (Jayanath Ananda & Gamini Herath, 2009). This ROC is based on the level of importance or priority of criteria. ROC weighting is obtained by simple mathematical procedures from priority. The basic idea can be illustrated with 2 attributes, A and B. If A is ranked first, then its weight must be between 0.5 and 1 so that the midpoint of the 0.75 interval is taken as an estimated weighting, which is the basis of a minimum commitment principle.

The SMARTER (Simple Multi-Attribute Rating Technique Exploiting Ranks) Method is a method of taking multi-criteria made by Edwards and Baron in 1994. The SMARTER weighting method uses a range between 0 to 1, so that it makes it easier to calculate and compare the values of each alternative (Haryanti, D., Nasution, H. & Sukamto, A. S, 2016).

By looking at the background above in particular the research of Junjie, P. & Dingwei, W. (2016), then the writer of this adjudication is the Improvement of AC performance algorithm by Using SMARTER.

RESEARCH METHODS

In this chapter explains the stages carried out in research. Data processed in this study is a dataset of 200 cities taken from the TSP Reinelt Library. As for the steps to improve the performance of the ant colony optimization (ACO) algorithm using the SMARTER algorithm is as follows:

1.Find the closest route with the ant colony optimization (ACO) algorithm.

2.Find the closest route with the ant colony optimization (ACO) algorithm - and with the simple multi-attribute rating technique exploiting ranks (SMARTER) algorithm

The ACO algorithm chart for searching for the closest route to the TSP problem can be seen in Figure 1.

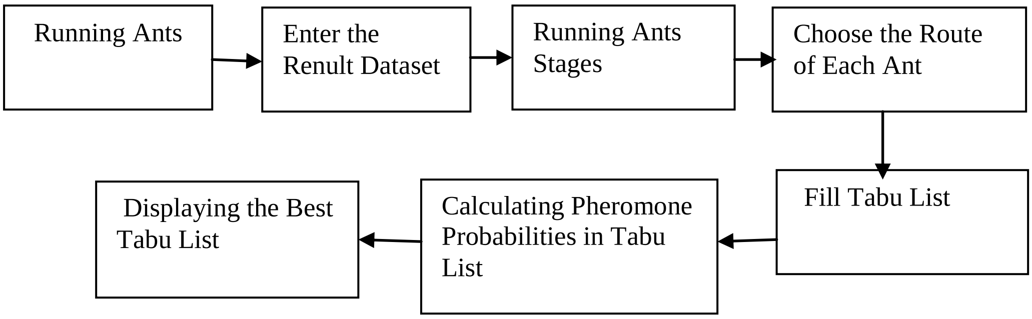

Figure 1. ACO Algorithm Chart

RESULT

From the results of research on the improvement of ACO algorithm performance by using SMARTER that the performance of the ant colony optimization (ACO) algorithm can be improved by using the SMARTER algorithm to obtain optimal distance on the traveling merchant traveling problem traveling salesman problem (TSP) with a dataset with a number of cities consisting of coordinates, the pr76 dataset consists of 76 cities, pr152 consists of 152 cities, pr226 consists of 226 cities, pr299 consists of 299 cities, pr 439 consists of 439 cities and pr1002 consists of 1002 cities compared to the ACO algorithm from the research from Junjie , P. & Dingwei, W. (2016).

Table 1. Results of ACO-SMARTER Research Improvement
- Junjie, P. & Dingwei, W. (2016)

		ACO-SMARTER		Penelitian Jungjie's Research (ACO)			
No	Cities	(Best)	(AVG)	(Best)	(AVG)	Enhancement (%)	
1	76	118021	152960	178597	180690	33.92	15.35
2	152	86249	109820	130953	136341	34.14	19.45
3	226	97981	134810	167646	170877	41.55	21.11
4	299	63653	82474	82106	83845	22.47	1.64
5	439	144702	178920	161955	165035	10.65	-8.41
6	1002	356664	424640	382198	387205	6.68	-9.67
Average		144545	180604	183909	187332	24.90	6.58

From the information on the results of an optimal search route search on Table 1 above, the optimum distance obtained (best) as in Figure 2.

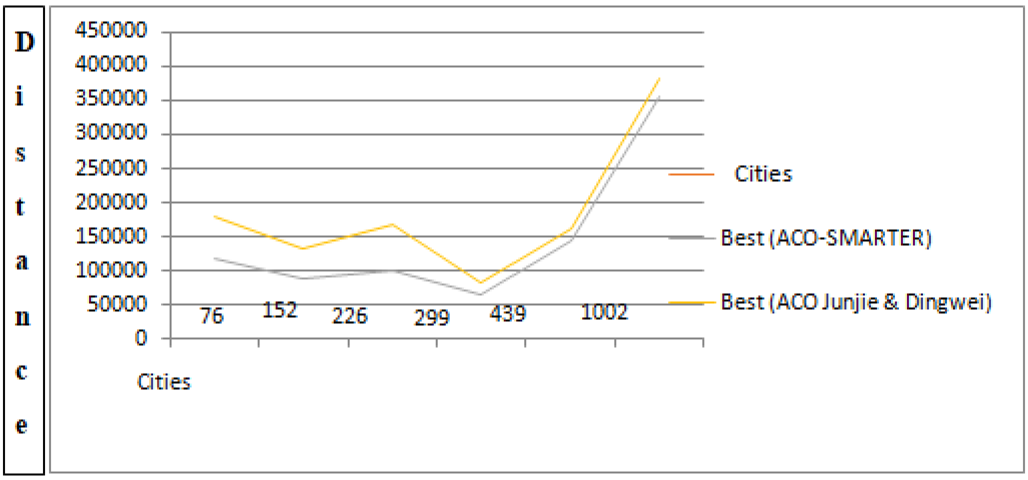

Figure 2 Graph of ACO-SMARTER Best Algorithm with ACO Junjie & Dingwei

From the data in Table 1 above, the average distance (AVG) graphic as shown in Figure 3 is obtained.

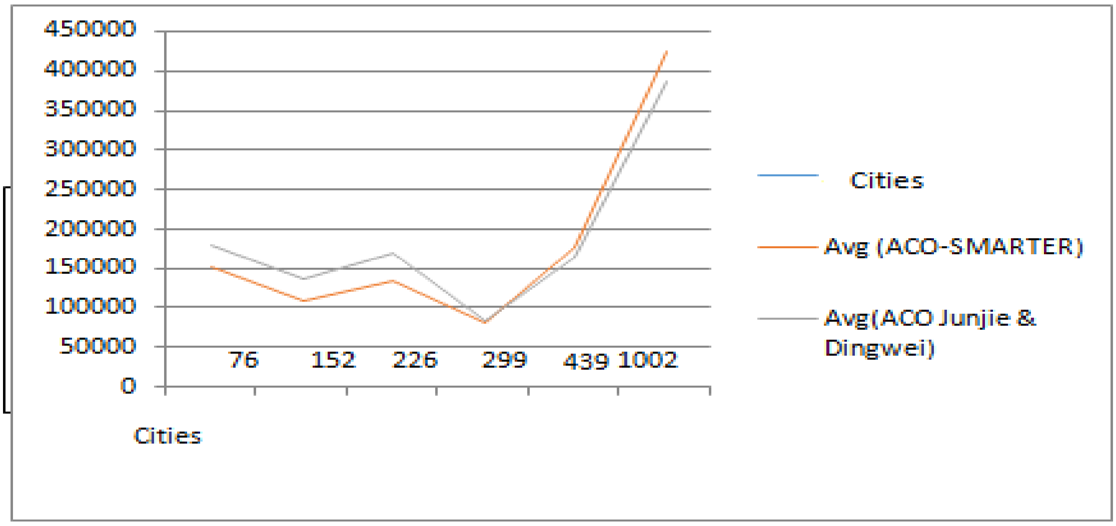

Figure 3. Graph of AVG ACO-SMARTER Algorithm with ACO Junjie & Dingwei

From the data in Table 1 above, the average process time (running time) as shown in Figure 4.

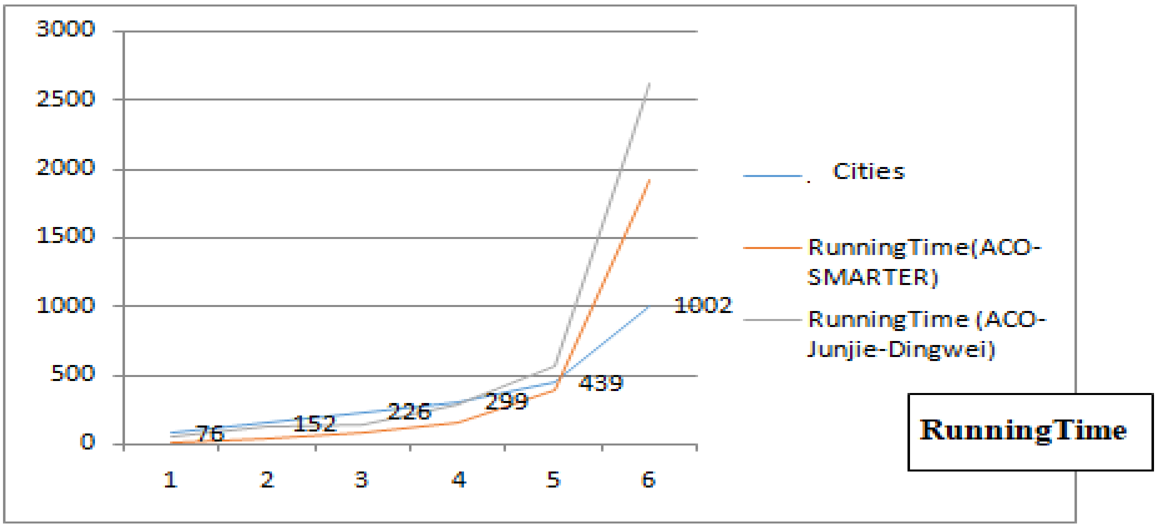

Figure 4. ACO-SMARTER Running Time Algorithm Graph with ACO Junjie & Dingwei

From the graphical information in Figures 2, 3 and 4 above, it can be seen that the ACO-SMARTER algorithm is superior compared to the ACO algorithm in the Junjie, P. & Dingwei, W. (2016) study with the same dataset and overall that the increase (%) can be calculated by an average The best increase, average (AVG) and average running time are the improvement of ACO-SMARTER algorithm:

= (24.90 + 6.58 + 47.04) / 3 = 26.17%.

The ACO-SMARTER algorithm can be better than the ACO algorithm because on the ACO-SMARTER each weight is calculated, where the highest weight has a better visibility and probability value as the route that is the closest distance.

CONCLUSION AND SUGGESTION

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The comparison criteria in this study are the optimum distance (best), average optimum distance (AVG) and processing time (running time). Of the three criteria, the ACO-SMARTER algorithm is superior except for the AVG criteria for large datasets pr439 and pr1002. Overall the ACO-SMARTER algorithm is better by 26.17% compared to the ACO algorithm in the research of Junjie, P. & Dingwei, W. (2016).

SUGGESTION

The suggestions for further research are:

a.Use other algorithms to get a better running time.

b.Using datasets instead of just coordinate cities, but other criteria such as difficulty level and density are not compact.

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