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IMPROVED GENETIC ALGORITHM USING HYBRID INITIAL POPULATION TO SOLVE TRAVELLING SALESMAN PROBLEM

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ABSTRACT

Genetic Algorithm is very useful to solve optimization problems. It performs genetic operators to solve optimization problems. Travelling Salesman Problem is a well-known optimization problem. TSP is useful to solve many problems of science and engineering. In this paper genetic algorithm is applied to solve TSP. A hybrid initial population is generated in genetic algorithm. The hybridization of initial population improves the performance of the genetic algorithm. Proposed genetic algorithm is applied on three standard instances of TSP and results are compared with other heuristic algorithms. From the experimental results it is observed that the proposed hybrid GA performs better than other techniques.

KEYWORDS: Genetic Algorithm, Travelling Salesman Problem, Hybrid Initial Population.

INTRODUCTION

Travelling Salesman Problem (TSP) is an optimization problem in operation research. The important task of TSP is to find Hamiltonian Cycle for given graph in minimum cost. TSP utilize in different applications like network routing, vehicle routing. electronic circuits board drilling etc. the various methods for solving TSP are given by many researcher in last recent years. Some of these researchers apply branch & bound, neural network (NN), PSO, Cutting planes, ACO (ant colony optimization) etc. for solving TSP.

These approaches provide solution near to the optimal rather than optimal within a specified time, for TSP. the TSP problem is like to Hamiltonian problem which given by a mathematician. In this problem, a salesman has to visit cities which are represented by node in a completed graph and select the path in such way each vertex of that graph must be at least once. A salesman starts to visit from one city and cover all cities. Path length should be minimum. Whenever increasing the number of cities (group of cities represented by n) then the possibilities of path may increase. To solve TSP problem, GA uses venous operators such as selection, reproduction and mutation. The flowchart of the slandered GA is shown in figure-1.

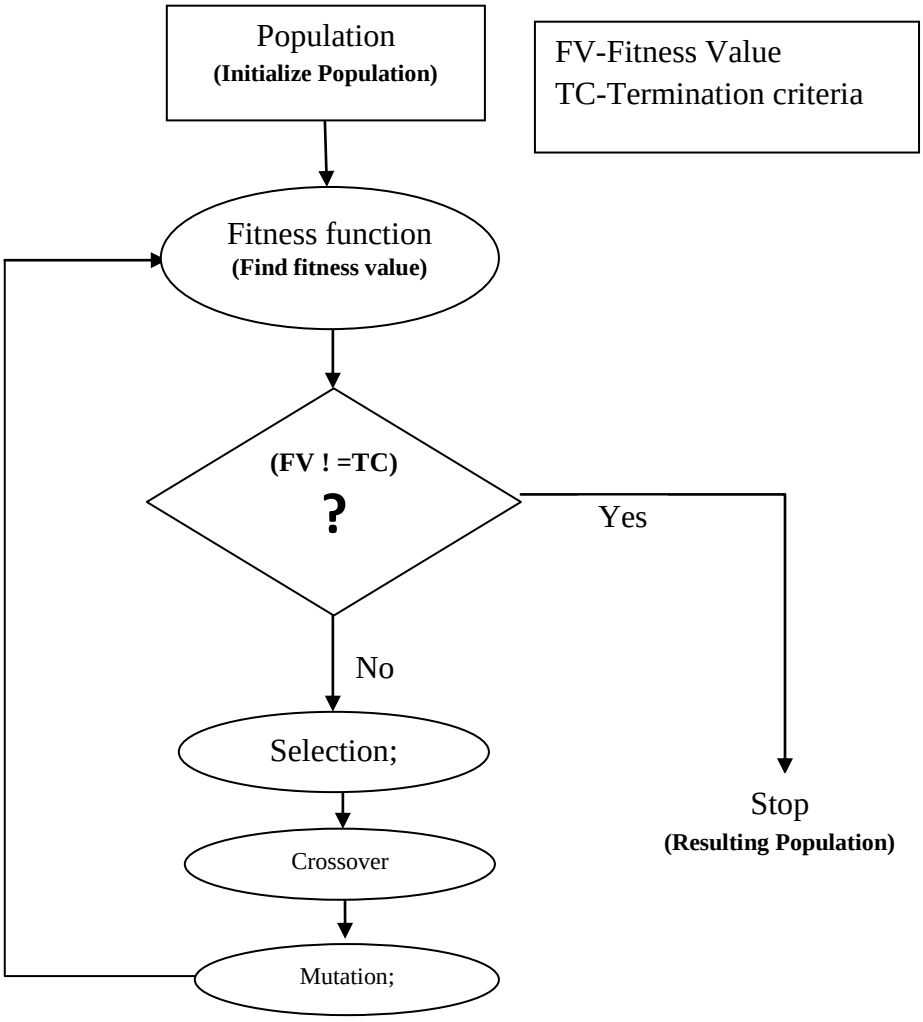

Figure 1: Flowchart of standard GA.

MATERIAL AND METHODS

Various researchers have attempts to solve TSP by using Genetic Algorithm. And discussed their pros & cons, So in this section discuss work of some researches in this area.

In 2004, Long Jin et. al.,[1] Authors initially find the advantages & limitations over genetic operators beside with local search methods for TSP. Proposed an algorithm to solving large TSP, known as Heterogeneous Selection Evolutionary Algorithm (HeSEA) which integrates EA (Edge Assembly) Crossover, LK (Lin–Kernighan) local search. In 2008, Sumanta Basu and Diptesh Ghosh,[2] authors survey and find to solving TSP, Tabu search is one of the most frequently used and point out the research gap in literature after reviewing various research paper. In 2009, K Rajanand et. al.,[3] gives a novel algorithm on the basis of evolutionary optimize technique to solve TSP. this technique gives the better results to solve large dimension TSP. In 2010, Yang Yi et. al.,[4] provide a solution for TSP (Travelling Salesman Problem). It is NP hard problem and most frequently used. Heuristic global optimization search algorithm like used to simulate the BES (Biology Evolutionary System).In 2010, Masafumi K et al.,[5] gives a solution to solve large scale TSP using GA. This algorithm is compared with maximum preservative, greedy cross over etc. In 2012, N Kumar et. al.,[6] Survey that GA gives best performance to solve various NP hard problem like TSP. GA always utilize natural evaluation process to solve the problem. In this author present a critical survey on TSP solutions which are proposed by many researchers in last recent year. After survey state that need to improve GA to solve TSP. In 2012, A Singh et. al.,[7] gives overviews about Bee Colony Optimization to solving TSP with its basic method of bee foraging behaviour. It is also used after each bee cycle to improve the quality of the solutions. In 2012, S Basu,[8] survey that Tabu Search is very frequently used to solving TSP. and author also survey on various those paper which consider Tabu search on TSP and bring out some important research gab for future work. In 2012, K H. Hingrajiya et. al.[9] state that ACO (Ant Colony Optimization) is a heuristic algorithm which applied on CO (Combinatorial Optimization) Problems. Reason behind to utilize is that the working process of ACO is easily understandable. Author gives an approach to solve the TSP using improved ACO Algorithm. In 2013, Saloni Gupta et. al.[10] is develop a GA which used to determine the better solution of TSP, however it work on the basis of the nature of the problem. Author analyze different solution technique of TSP which proposed by researcher in last recent years. In 2014, S. Khattar et. al.,[11] Gives the details (step by step) process of solving TSP using GA. Genetic algorithm provides the better solution for TSP. Author also surveyed on various research paper which are proposed to solving TSP and find the research gap for new research. In 2015, K. S. Suresh et.al.[12] proposed a solution for Robot Path Planning RPP using Travelling Salesman Problem. Author apply GA to solve TSP and than apply the solution in RPP. In 2016, K. Bharathi and C. Vijayalakshmi,[13] developed a new GA for Multi TPS. The

various algorithms based on evolutionary, developed by many researchers in last recent years based on natural biological world behaviours. In 2015, A Fouad, et.al.[4] Proposed an AP (Affinity Propagation) Clustering Technique which optimize the performance of the GA to solve TSP, The main purpose is to create cluster of cities and apply GS on each cluster individually, thus the require less computational time to solve.

In 2015, S Ahmed et.al.,[15] Author compare various meta heuristic to solve the TSP and apply ACO & GA on different three instances with different size & complexity. Author state that GA is very fast, cost effective computation resources and implementation is very esay. While The ACO a greedy approach but returns better results for large problem. A. I. Hammouri et al. apply Dragonfly algorithm to solve TAP. The Dragonfly algorithm was applied on many instances of TSP and results were compared with other algorithms such as ACO, PSO, GA. After doing a analysis of this literature survey it is concluded that the performance of GA can be further improved using hybridization of its operators. Next section discussed the proposed work.

In this paper an optimized genetic algorithm using hybrid initial population generation is proposed. The proposed algorithm makes the initial population hybrid. The initial population is generated using hybridization of random technique and nearest neighbour technique. The two techniques used for generation of chromosomes are (a) Random generation of chromosomes (b) Nearest Neighbour First approach of chromosome generation.

(a) Random generation of chromosomes

Randomness is the power behind the genetic algorithm. In this work random approach is used to generate chromosomes of initial population. In random approach the sequence of cities visited in a tour by the salesman are selected randomly. These chromosomes will generate chromosomes with high fitness value later on in the process of cross over and mutation.

(b) Nearest Neighbour First approach of chromosome generation.

TSP is basically a fully connected graph. Nearest neighbour first is a useful technique to traverse the graph with minimum path length. After selecting a starting city, the next city is selected which is having the minimum path length among all then cities which are to be visited. The nearest city is then added in the path and that city become the current city. Then from this current city, a city at nearest distance is selected from all the remaining cities. This procedure continues till all the cities are not traversed.

In this work, the a hybrid initial population of chromosomes using random approach and nearest neighbour first approach is generated. Because the fitness value (1/path-length) of the chromosomes generated using nearest neighbour first approach is very high, so the average fitness value of the initial population is very high as compared to standard GA. This improvement in the standard GA will improve the performance of the GA. The next section discussed the results of the hybrid GA.

RESULTS AND DISCUSSION

The hybrid genetic algorithm is implemented and the performance of hybrid GA is tested on three instances of TSP from TSPIB online data set. Table 1 is showing the results. From the results shown in Table 1 it is clear that the proposed hybrid GA perfrom better as compared to other heuristic techniques such as ACO, PSO, BH and DA. It also performed better than the standard GA. The performance of BH for Att48 instance is better than the proposed algorithm otherwise proposed hybrid GA outperform the other techniques. Figure 2 is showing a graph to compare the performance of proposed hybrid GA and other techniques.

Sr No.	TSP Instance	ACO	PSO	GA	BH	DA	Proposed Hybrid GA
1	Att48	35230.90	36996.44	35312.52	34200.86	37225.85	35135
2	ST70	711.65	1030.85	1112.31	723.27	797.47	698
3	berlin52	7757.03	9218.47	8779.76	8188.07	9400.75	7310

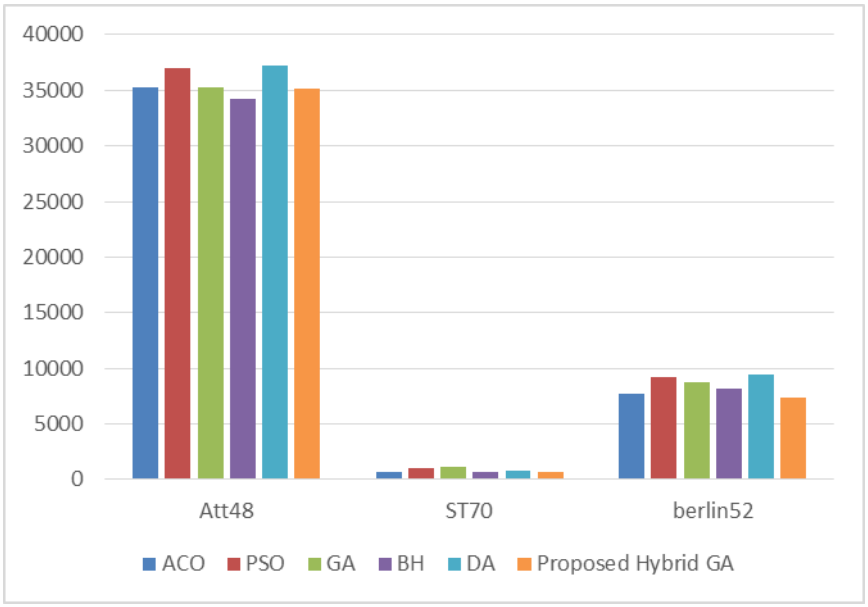

Figure 2: Comparison of results of proposed hybrid GA and other techniques.

CONCLUSION AND FUTURE SCOPE

In this paper, genetic algorithm is applied to solve Travelling Salesman Problem. A hybrid initial population using random approach and nearest neighbour approach is generated. The hybridization of initial population improves the average fitness value of the initial population. This improved initial population help in cross over and mutation operations and generate good quality solutions of TSP. The proposed hybrid genetic algorithm was applied on three standard TSP instances. From the results it is concluded that proposed hybrid GA performs better than other techniques.

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