THE COMPARISON OF METHODS SOLVING THE TRAVEL SALESMAN PROBLEM

Abstract: *The travel salesman problem is a well known problem which has become a comparison benchmark test for different computational methods. Its solution is computationally difficult, although the problem is easily expressed. A salesperson must make a closed complete tour of a given number of cities. All cities are connected by roads, and each city can be visited only once. The program must solve the optimization problem by minimizing the value represented by total tour length, and by changing the order of the city.*

1. Introduction

The travelling salesman problem is a well known problem which has become a comparison benchmark test for different computational methods. Its solution is computationally difficult, although the problem is easily expressed. A salesperson must make a closed complete tour of a given number of cities. All cities are connected by roads, and each city can be visited only once. The program must solve the optimization problem by minimizing the value represented by total tour length, by changing the order of the city. Each city is assigned an ordinal number from 1 to *N*, where *N* is the number of cities. The tour is represented as the entire sequence of city numbers.

2. Used Methods

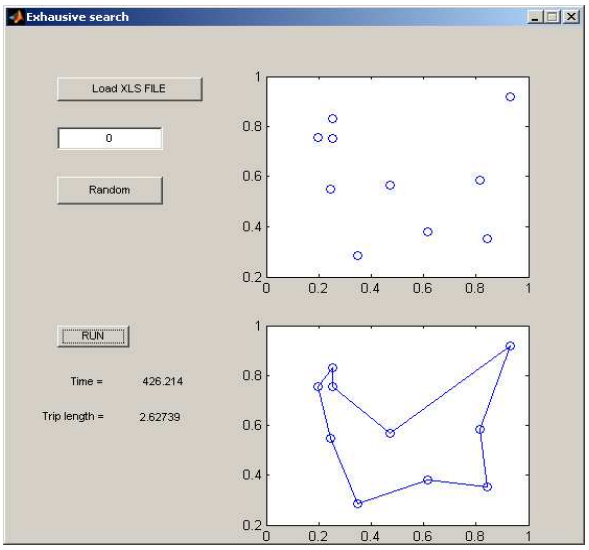
For the solution of optimization tasks it is possible to use various algorithms. Some methods give better results and some give worse ones. We can obtain various methods for various tasks. The tests were done by twelve methods for the solution of travel salesmen problem. The tests include ten cities and it was searched the time of calculation, the value of fitness function, if the global minimum was found and the number of attempts. The tested algorithms are as follows: Exhaustive, Back Tracking, Random Search, Greedy, Hill Climbing, Simulated Annealing, Tabu Search, Ant Colony, Genetic Search and Particle Swarms.

3. Results

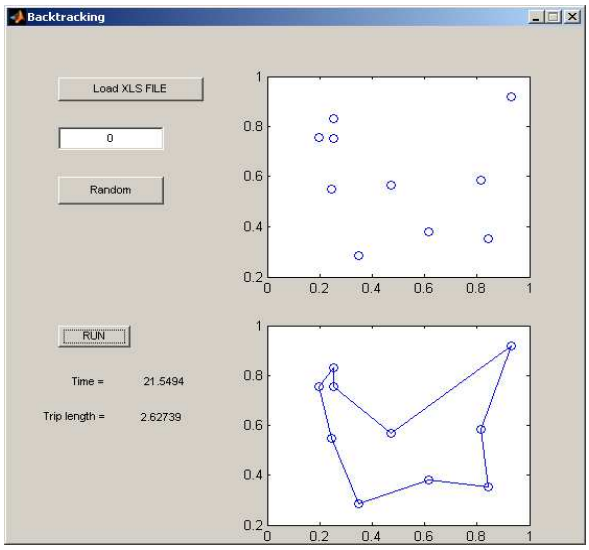
The results are presented in tab.1 and fig.1. The best results from the point of view of fitness function, speed of calculation and number of attempts give Greedy and Ant Colony algorithm. The good results give Tabu Search, Particle Swarms. The problem to find the shortest tour had Random Search and Simulated Annealing algorithm. The Exhaustive algorithm search had the highest calculation time, but it searched for global minimum.

Method	Time [sec]	Fit. f.	Count	Min
1) Exhaustive	426,214	2,627	1	Y
2) Back Tracking	21,549	2,627	1	Y
3) Random Search	0,019	3,438	20	Y
4) Greedy	0,020	2,627	1	Y
5) Hill Climbing	0,005	2,627	10	Y
6) Simulated Annealing	0,016	2,914	20	N
7) Tabu Search	0,385	2,627	2	Y
8) Ant Colony	1,092	2,627	1	Y
9) Genetic search	1,337	2,658	20	N
10) Particle swarms	1,753	2,627	3	Y

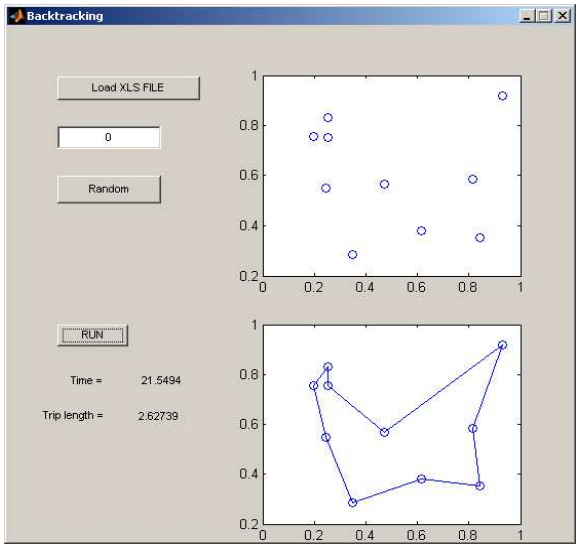
Tab.1 Table of results of calculation



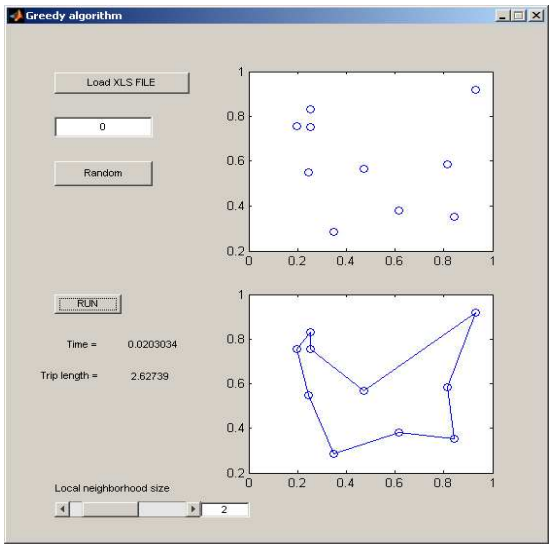
1) Exhaustive



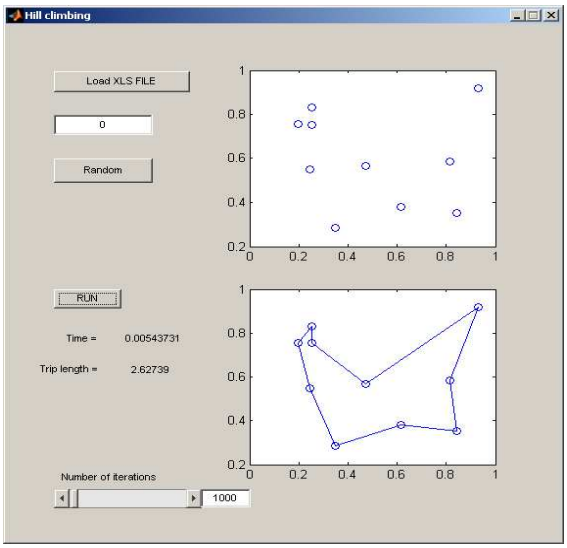
2) Back Tracing



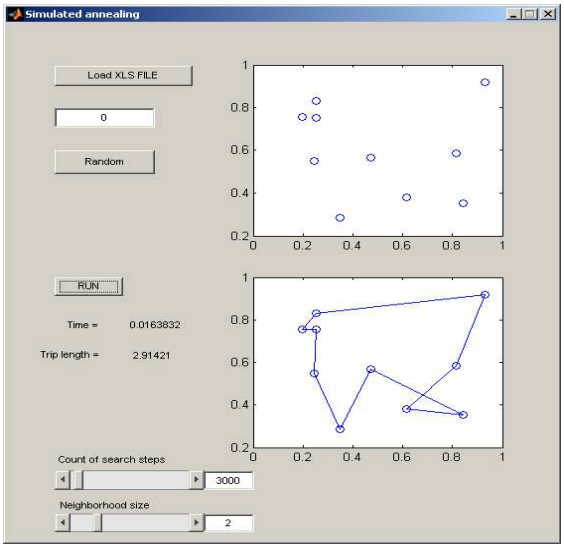
3) Random Search



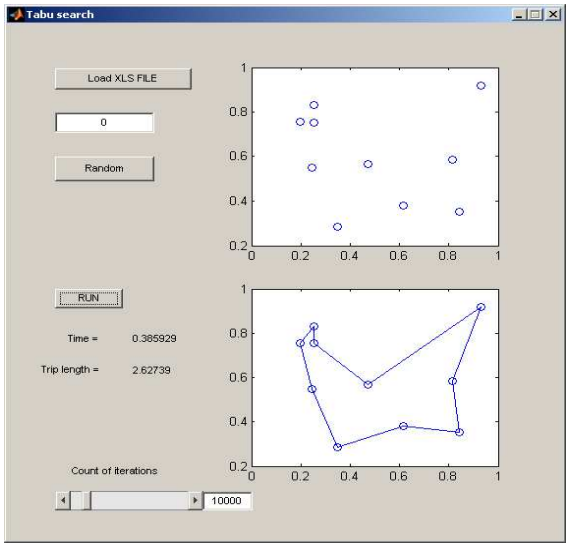
4) Greedy



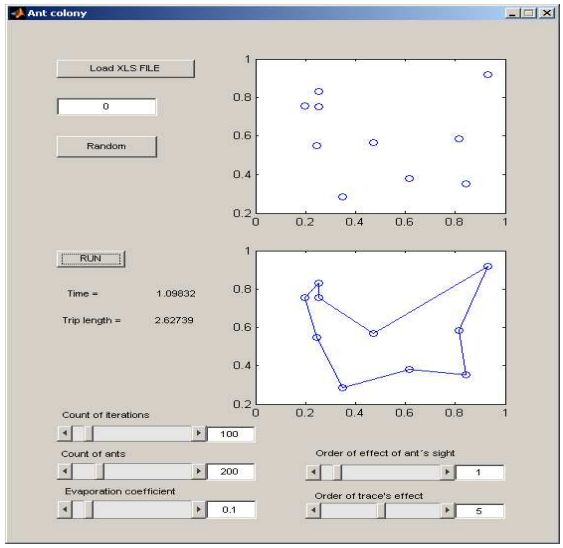
5) Hill Climbing



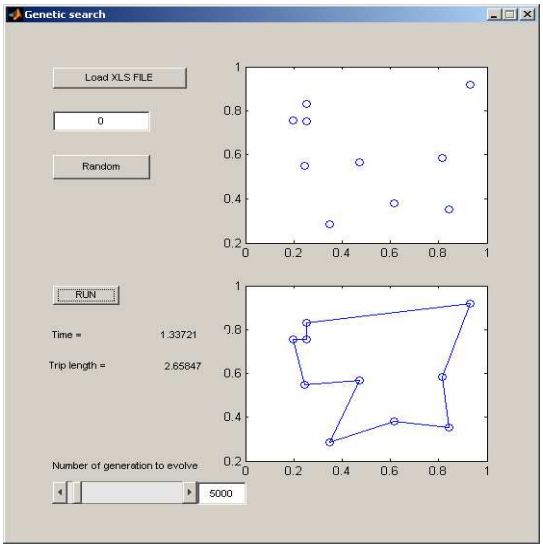
6) Simulated Annealing



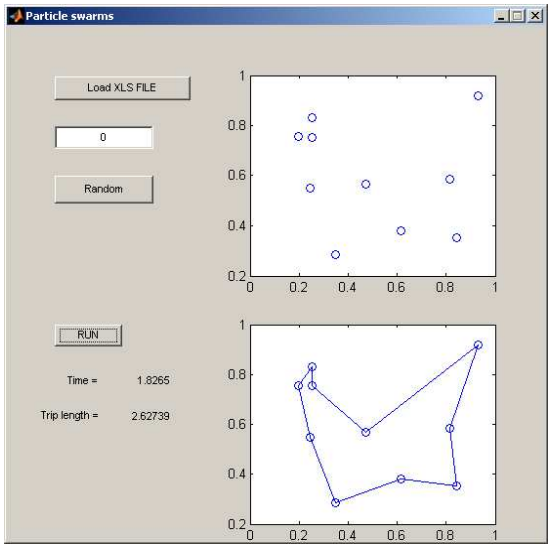
7) Tabu Search



8) Ant Colony



9) Genetic Search



10) Particle Swarms

Fig.1 Graphs of results of calculation

4. Conclusion

The best method for the solution of travel salesman problem was searched. From the twelve used methods the Ant Colony and Greedy algorithm were found to be the best. The speed of calculation can be an important parameter when the shortest way is searched at on line access. The found shortest tour saves time and money.