The Investigation of the Transitional Stage in TSP and its Effect on the Optimal Solution

E-mail: 9315382@ mail.dyu.edu.tw

ABSTRACT

The K-Opt Algorithm is often applied as the move strategy when using Simulated Annealing method with Threshold Accepting method to solve Traveling Salesman problem (TSP). However, the limitations of the K-Opt emerge from the surface when the number of the searching node increases. It is neither efficient nor effective to obtain an optimal solution to the problems through this move strategy. To overcome this problem, one adopts a newly developed method called Ruin & Recreate (R&R) in this study. This method contains more flexibility than that of K-Opt Algorithm in terms of the neighborhood number. In particular, the new concept of the rules in the mess is introduced. The mess means the scope of explosion is uncertain. The rules means the scope of explosion follow the initial sequence of the TSP. The Ruin & Recreate method constructs a new path with Random-Best-Insertion. And then, combine with another two accepting methods Greedy Acceptance and Double Threshold Acceptance. Finally, it is tested based on the examples of international standard in TSPLIB website (Att48~Rat783). From the research result we found out that Double Threshold Acceptance method is better than Greedy Acceptance method concerning the efficacy. When the number of the searching nodes is greater than or equal to 442, one would only get approximate solutions. Whereas when the number of the searching node is less then 442, and under the preset number of iterations, one had a high probability to reach the global optimal solution. At this moment, the improvement in R&R method and the parameters involved in its framework will be the key issue for one to find out the optimal for the problem with number of nodes which is greater than 442.

Keywords : Simulated Annealing ; Threshold Accepting ; Traveling Salesman Problem ; Ruin & ; Recreate ; Greedy Acceptance

Table of Contents

REFERENCES

1.   ,"   TSP   TA   ,"   , 2002   2.   ,"   :   ,"   , 2001   3.   ,"   TABU SEARCH   TSP   ,"   , 1997   4.   ,"   TSP   ,"   , Vol. 25, No. 2, pp. 163-188, 1996   5.   ,"   ,"   , Vol. 26, No. 2, pp. 253-280, 1997   6.   ,"   TSP   ,"   , 2001   7. Abbound, N., Sakawa, M. and Inuiguchi, M., " School scheduling using threshold accepting," Cybernetic and Systems, 29, pp. 593-611, 1998. 8. Alothfer, I. and Koshnick, K.U., " On the Convergence of Threshold Accepting," Applied Mathematics and Optimization, 24, pp. 183-195, 1991. 9. Angle, E. and Zissimopoulos, V.," On the classification of NP-complete problem in terms of their correlation coefficient, " Discrete Applied Mathematics, 99, pp.261-277, 2000. 10. Angle, E. and Zissimopoulos, V.," On the landscape ruggedness of the quadratic assignment problem," Theoretical Computer Science, 263, pp. 159-172,2001. 11. Anily, S. and Federgruen, A., " Ergodicity in parameter nonstationary markov chains: an application to simulated annealing methods," Operations Research, 35, pp. 867-874, 1987. 12. Cerny, V., " Thermodynamical approach to the traveling salesman problem: an efficient simulated annealing," Journal of Optimization Theory and Application, 45, pp. 41-51, 1985. 13. Dueck, G. and Scheuer, T., " Threshold accepting: a general purpose optimizatiom algorithm appeared superior to simulated annealing," Journal of Computational Physics, 90, pp. 161-175, 1990. 14. Kirkpatrick, S., Gelatt, C. D. and Vecchi, M. P., " Optimization by simulated annealing," Science, 200(4956), pp.671-680, 1983. 15. Lin, S., " Computer solutions of the traveling salesman problem," The Bell System Technical Journal, 44, pp. 2245-2269, 1965. 16. Lin, S. and Kernighan, B. W., " An effective heuristic algorithm for the traveling salesman problem," Operations Research, 21, pp.498-516, 1973. 17. Norback, J. P. and Love, R. F., " Geometric approaches to solving the traveling salesman problem,"

Management Science, 23, pp. 1208-1223, 1977. 18. Norback, J. P. and Love, R. F., "Heuristic for the Hamiltonian path problem in Euclidean two space," Journal of Operations Research Society, 30, pp. 363-368, 1979. 19. Penna, T. J. P., "Traveling salesman problem and Tsallis statistics," Physical Review E, 51, pp.R1-R3, 1995. 20. Puri, R. and Gu, J.," An Efficient Algorithm for Microword Length Minimization," IEEE Transactions on CAD, 12(10), pp.1449-1437,1993. 21. Righini, G., " A double annealing algorithm for discrete local allocation problem," European Journal of Operational Research, 86, pp. 452-468, 1995. 22. Rosenkrantz, D. J., Stearns, R. E. and Lewis, P. N., " An analysis of Several Heuristics for the Traveling Salesman Problem," SLAM Journal on Computing, 6, pp. 563-581, 1977. 23. Schrimpf, G., Schneider, J., Stamm-Wilbrandt, J. and Dueck, G.," Record Breaking Optimization Result Using the Ruin and Recreate Principle," Journal of Computational Physics, 159, pp. 139-171, 2000. 24. Tsallis, C., " Possible generalization of Boltzmann-Gibbs statistics," Journal of Statistical Physics, 52(1/2), pp. 479-487, 1988. 25. Voudouris, C. and Tsang, E.," Guided local search and its application to the traveling salesman problem," European Journal of Operational Research, 113, pp.469-499, 1999.