Traveling Salesman Problems with Constrains

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1 Introduction

When we visit several places in a sightseeing tour or several attractions in a theme park, we often make an efficient plan to visit them. The efficient plan takes the shortest route and the shortest time to visit all places that we list. To make the efficient plan is the same as the traveling salesman problem (TSP), which is one of the most famous combinatorial problems. In the symmetric two-dimensional TSP, phase transition phenomena appear [1]. In this study, we discuss the phase transition in a traveling salesman problems with time constraints.

2 Traveling Salesman Problem

In the TSP, a list of n cities and their locations (or distances between each pair of cities) are given. The TSP is the problem to find the shortest route to visit all n cities exactly once before returning to the starting city. We here consider the decision version of the problem, namely, whether there is a tour of length l or less. If l is very short, a route shorter than l is not likely to exist. If l is very long, routes shorter than l are likely to exist. The probability that a tour of length l or less exists for n cities on a square of area A can be calculated numerically. If we plot the probability with the control parameter $l/\sqrt{nA}$, we can see the transition between soluble and insoluble phases occurs around a fixed value of the control parameter [1].

3 Traveling Salesman Problem with Constraints

We can add some constraints on the TSP. The TSP with time window constraints requires that the visit to each city be made within specified time windows [2]. In this study, we would like to discuss the phase transition in the TSP with constraints. We consider constrains on not only time window but also the time to spend in each city. We expect this study can be applied to planning sightseeing tours and theme park visits.

References

[1] I. P. Gent, T. Walsh, "The TSP phase transition", Artificial Intelligence, vol. 88, 349-358, (1996).

[2] E. K. Baker, "An Exact Algorithm for the Time-Constrained Traveling Salesman Problem", Operations Research, Vol. 38, No. 5, 938-945, (1983).