DEVELOPING AN OPTIMAL PATH FOR TIME-BASED CONSTRAINED TRANSPORTATION NETWORKS

By

Eymard Alvin M. Babista

Rico Angelo H. Rivera

SCHOOL OF ARTS AND SCIENCES

ATENEO DE DAVAO UNIVERSITY

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Eymard Alvin M. Babista

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ABSTRACT

The study designed a well formulated problem, the traveling tourist problem. Such problem is deemed as a practical problem for tourists. It is a specialized class of finding an optimal path on time-based constrained transportation network. The practicality of the traveling tourist problem needs a corresponding complex, interrelated, and well-devised theories in order to give solution to it. Existing theories are re-designed and new theories are integrated into those existing ones in order to come up with a unified theory to address the theoretical complexity of the traveling tourist problem.

Keywords:
Optimal path, time-based constrained, transportation networks

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

A tourist is having a break from his demanding work. With this, he plans to have a tour to his country of choice and perform different activities in his preferred order. For instance, he wants to go to a beach and to a heritage site afterwards. He also wants to play golf, do mountain trekking, and surfing. It might also be the case that he would repeat the said activities again on the same or different tourist spot, depending on his preference.

He already set the duration for each activity. For example, he wants to spend two days for beach, one day for heritage site seeing, one day playing golf, three days trekking the mountain, four days surfing the ocean, a couple of days for a wildlife site, and another two days for beach. Note, the order of activities should be followed.

He has also planned where will be his origin city and last stop city. One or both of these two cities might or might not be included in his tourist spot destinations, depending on his preference. Furthermore, the origin city and last stop city might be the same. Moreover, he also indicates when he will be free for the said tour, the date being accurate up to the minute of time.

To make things more realistic, the tourist also prefers the mode of transportation he will take for the said tour. It might be his choice that he takes only airplane instead of ferries or both. He can also take bus if preferred. Furthermore, not only he indicates what transport mode he will take, but also the

particular carrier company which he likes. For instance, he wants to take aircraft but only Cebu Pacific and/or Air Philippines, not including Philippine Airlines.

The carriers are scheduled, indicating the day-of-week and time-of-day, to travel between cities.

With regards to the activities, there are a lot of locations where they can be done. For example, there are several beaches in the Philippines namely Boracay, El Nido, Honda Bay, Panglao Island, Pearl Farm, and etc.

The tourist might select one or more or even all among the possible tourist spot destinations for a certain activity. Among those being selected, one will be his tourist spot destination for the said activity. However, it might be the case that more than one tourist spot destination will be offered to him, as a result of his selections, as long as those spots are on the same city. In such case, he needs to choose one.

The above tourist preferences are all set up. However, the tourist needs to perform the tour with full respect to his preferences as fast as he can. This does not refer to the duration of each activity since the activity duration preferences need to be followed. Hence, what needs to be minimized is the overall travel duration and idle time of the tour.

This implies the need for a route planner which satisfies the requirements stated above.

1.2 Statement of the Problem

The traveling tourist problem is as follows:

Given the following tourist route preferences which consists a route query:

- Source city
- Last stop city
- Complete date, up to the minute of time, when the tourist is free for a tour
- Preferred carriers for travel between cities
- Ordered sequence of activities
- Per activity
    - Duration of the activity
    - Preferred tourist spot/s for the activity
- Preference whether to exclude the source city from the possible tourist spot destinations
- Preference whether to exclude the last stop city from the possible tourist spot destinations

Given the inter-city transportation network consisting of the following:

- Routes between cities
- Carriers scheduled, indicating the day-of-week and time-of-day, to travel on the routes
- Tourist spots of the cities

Find an optimal path on the inter-city transportation network, as to the fastest time to travel such path, which suffices the route query with full respect.

Specifically, the optimal path refers to the overall travel duration and idle time of the tour being the minimum among those of all the other possible paths satisfying the route query with full respect.

1.3 Objectives of the Study

The study aimed to re-design existing theories and create new ones to be integrated into those existing which give the solution to the traveling tourist problem.

Particularly, the REG-SHP theory, labeled network theory, linear finite automaton theory, implicit product network construction theory, the trip chaining theory, Dijkstra's shortest path algorithm, relaxation theory, predecessor sub graph theory, and the shortest path tree theory need to be re-designed in order to deal with time-based constrained transportation networks.

In other words, the study needed to devise an efficient route planner which minimizes the overall travel duration and idle time of the tour with full respect to the every requirement of the route query.

Hence, it sought to provide an optimal path on the inter-city transportation network satisfying the tourist's tour preferences.

1.4 Significance of the Study

The study gave the solution to the traveling tourist problem.

Specifically, it offered a unified theory comprising of re-designed existing theories and new theories that minimizes the overall travel duration and idle time of the tour with respect to such problem.

1.5 Scope and Limitations of the Study

The study limited itself on dealing with inter-city transportation networks.

Secondly, the cities within a network were restricted to those of the same time zone.

Moreover, the carriers were scheduled to travel between cities, indicating the day-of-week and time-of-day.

Lastly, the study did not aim to minimize the duration of each activity to be performed by the tourist, as it is fixed by the tourist.

It only wanted to minimize the overall travel duration and idle time of the tour with full respect to the tourist's route query.

1.6 Definition of Terms

Optimal Path

In this study, optimal path refers to the minimum overall travel duration and idle time of the tour among those of all the other possible paths on the inter-city transportation network satisfying the tourist's route query with full respect.

Time-based Constrained

In this study, in the context of inter-city transportation network, the carriers traveling between cities serve as the network constraint. Those carriers are scheduled to travel between cities, indicating the day-of-week and time-of-day. Hence, the term time-based constrained.

Moreover, the time-based constrained theory is extended to linear finite automata network, which represents the tourist's route query. The activities which need to be performed serve as the constraint of the network. Each of those activities has finite duration of time to be performed. Thus, the time-based constrained theory can be applied to linear finite automata network.

The time-based constrained theory applied to labeled network and linear finite automaton is the major variant of this thesis against those presented in *Chapter 2 – Review of Related Literature.*

Transportation Network

In this study, the term transportation network is limited to inter-city transportation networks. An inter-city transportation network consists of routes between cities, carriers scheduled to travel on the said routes, and the tourist spots of the cities.