A new model for the green tourist trip design problem

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Tourist's decision-making process is a highly complex activity given the huge volume of online accessible information. The tourist is generally overwhelmed by the number of available options and choices.

Recently various Tourism Decision Support Systems (TDSS) were developed to fully assist a tourist to design his own trip. One of the crucial problems that a tourist is facing is to decide which points of interest (POIs) would be more interesting to visit and to determine the optimal one-day route trip tour. For a tourist visiting a particular city for one day, it is usually impossible to visit all the attractions. Therefore, they have to select a subset of the most valuable attractions and to find a feasible trip tour in order to visit them in the available time span. These planning problems are called Tourist Trip Design Problems (TTDP) (Vansteenwegen et al., 2009).

The main objective of the TTDP is to maximize the tourist satisfaction by selecting a sequence of POIs that match his preferences, while taking into account several constraints (e.g., total tour timeframe, time window of each POI, distances among POIs and travel time, average visiting time required for each POI, available budget, etc).

The TTDP is similar to the well-known traveling salesman problems (TSP) but it does not assume that all nodes must be visited exactly once, it rather allows to generate a tour containing a subset of nodes. Various researchers studied the TTDP, the reader can refer for the excellent survey of (Gavalas et al, 2014) where they reviewed the most recent models, algorithmic approaches and methodologies concerning TTDPs. Another major issue in tour planning problems is the question of sustainability for transportation operations. Sustainable and green transportation is gaining more importance due to the seriousness of environmental concerns.

In this paper, we propose a new environment friendly TTDP variant by assuming that the tourist is using an electric vehicle. In the literature, only few recent papers studied the Electric TSP (ETSP). One of the seminal papers on the subject is the work of (R. roberti el. 2016) where they proposed a new model and designed a three-phase heuristic algorithm as a solution approach. Doppstadt el al (2016) presented the hybrid ETSP, they assume that the vehicle has different modes of operation; the authors proposed the tabu search metaheuristic to solve this problem. In a broader context, Schneider et al. (2014) studied the electric vehicle routing problem with time windows, a hybrid heuristic combining Variable Neighborhood Search and tabu search was designed.

In this research, we consider a new variant that we call the Green Tourist Trip Design Problems (GTTDP). The GTTDP can be stated as the problem of finding an optimal tour for visiting a subset of POIs within a given timeframe. The tourist should stop at intermediate recharging stations to recharge the battery in such a way that the battery level of the electric vehicle is always positive. We assume that each POI has a predefined rate and the objective function is the maximize the tourist satisfaction (i.e. the sum of rates of the generated tour). To the best of our knowledge, this problem has not been addressed in the literature yet.

We first propose a new mathematical formulation for the GTTDP stated as a linear integer model. This model is tested on real-life instances. We choose the city of Paris as a destination. We assumed that the tourist has one day to visit the most attractive POIs. The rate of these places is crawled from the e-tourism web site Trip advisor through a web crawler named Web Harvy. Google maps API is also used to find the distances among the POIs using their geographic coordinates. The computational results of different instances are reported.

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