Study of driver behaviour and the impact of navigation devices on route choice

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1 Introduction

The European Commission estimates that traffic congestion can be reduced through effective deployment of Intelligent Transport System Technologies. In particular, the use of navigation systems offers the possibility to aggregate the information on traffic flows and feed them back to the driver who can, for instance, avoid congestion. Moreover, if information on real time are provided, the performance of an algorithm can be improved by the development of heuristic solution methods. An integrate use of different applications and functions in the automotive domain is expected to bring benefits to whole transport network by the optimization of the existing infrastructure.

This study aims to modeling driver decision making process in response to the availability of alternative routes and to evaluate the impact of navigation systems. With the support of geographical information system (GIS), we present a case study for the transportation flows in Reggio Emilia (Italy). We intend to determine the minimum path by the identification of the objectives that are important, in practice, for the driver. For this purpose, a multi-objective optimization problem is solved first of all with an exact algorithm, successively a heuristic algorithm is developed. The multi-objective optimization allows to take into account different and often conflicting objectives during the route selection process and to determine the set of paths that minimizes a number of objective functions which efficiently satisfies all the trade-offs [1].

In the literature, different evaluation criteria are used in order to model driver behavior [2]. For instance, the driver can be interested in minimizing the distance, the travel time, the cost or the trip complexity by avoiding intersections or traffic signals and the number of turns needed to reach the destination. The driver selects the path that best fits his/her preferences basing on a set of criteria (objective functions). We will study the impact of these criteria and possibly identify new ones.

2 Data set

With the aim to modeling driver behavior and to evaluate the impact of navigation systems on the decision process, two types of data are used: traffic data provided by the Municipality of Reggio Emilia and travel diary data collected in the context of the European Union project, TeleFOT [3]. The first set of data are aggregated traffic flows collected during peak hours in Reggio Emilia. These flows are georeferenced and they specify, for each arc, the traffic flows and the capacity of the road. This set gives us information on arcs congestion. The second set of data was collected by the University of Modena of Reggio Emilia that participates in the TeleFOT project. A sample of about 150 drivers was randomly selected in Reggio Emilia. Few drivers were selected in surrounding towns of Modena and Parma. This sample is further divided in two clusters. The first cluster is formed by 130 drivers provided with a smart phone that includes a navigation system application. Moreover, GPS data collected in a black box are also available. The second cluster consists of 20 drivers, the control group. Data on control group's movements were registered by an in-vehicle data logger. Moreover both groups of users had to fill in a travel diary with information regarding their departure and arrival time, approximate kilometer driven and the purpose of the trip. This set gives us information on the selected paths.

3 Work in progress

The first step of this work is based on the elaboration of the data sets in order to make the aggregate and the disaggregate traffic flows homogeneous, especially for what concerns the departure and arrival time. Secondly, the relation between the route choices, the trip purpose and the time of the day will be analyzed. This will allow us to obtain useful information on the objectives of the driver. In the second step, we will use an exact algorithm, the label setting developed by [4], in order to solve the multi-objective shortest path problem. The problem is solved for the aggregate traffic flows in order to determine the set of Pareto efficient paths under specifically identified objective functions. This set of efficient solutions

will be then compared to the real data: the travel diary and, eventually, the control group data. The comparison will allow us to determine if the behaviour of the drivers are consistent with the set of Pareto efficient solutions of the aggregate traffic flows. Moreover, it will allows us to evaluate the impact of the use of navigation system on route choice. In the third step, we will develop a heuristic algorithm in order to obtain faster solution of the multi-objective shortest path problem. Finally we also intend to consider the situation in which travel varies with time of the day and waiting time at nodes using the algorithm developed by [5]. For this purpose, three sets of traffic flows, based on Reggio Emilia Municipality aggregate data, will be created: the peak time, the intermediate and the non-peak-hour.

References

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