Using Genetic Algorithms for ITS-based Advisory Systems

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1 Introduction

Predictive driving style reduces fuel consumption and tailpipe emissions of vehicles [1]. In addition, such a driving improves ride comfort, which is especially important in case of public transport vehicles [2]. Advances in Intelligent Transportation Systems (ITS) will soon allow deploying driver assistance systems that will significantly improve predictive driving. One of such systems—Green Light Optimal Speed Advisory (GLOSA) provides drivers with optimal speed advisory, which allows them to arrive at the intersection when the light is green [3]. Thanks to GLOSA, the stop-and-go driving pattern, idling at traffic signals and excessive acceleration/breaking can be avoided. Not only this improves ride comfort but also reduces fuel consumption and tailpipe emissions. When compared with idling, the average emissions during acceleration are five times greater for carbon dioxide and hydrocarbons and ten times grater for carbon monoxide and nitric oxide [4]. In order to deploy the system, vehicles need to be able to receive Signal Phase and Timing (SPaT). In the future, this information will be received by vehicles directly from traffic light controllers using wireless Dedicated Short Range Communications (DSRC).

1.1 Contribution

ITS-based advisory systems for cars and buses can be used in order to allow efficient predictive driving. The proposed approach contains single and multi-segment GLOSA. In the former speed advisory is calculated for the segment preceding the nearest signals, whereas in the latter the advisory concerns multiple traffic signals ahead of a vehicle [5]. Cars apply a single-segment GLOSA, while buses operating on dedicated lanes can also use a multi-segment GLOSA. In addition, buses can benefit from a complementary Green Light Optimal Dwell Time Advisory (GLODTA) system [2], which advices additional dwell time at near-side bus stops. In this case, if stop at traffic signals cannot be avoided using speed advisory, the GLODTA evaluates whether the stop can be avoided if extra dwell at a bus stop preceding the signals is applied. In order to receive signal timings, the systems relies on wireless communications capabilities between vehicles and road-side infrastructure. Two *ad hoc* communication patterns provided by connected vehicle technology—communication between vehicles (V2V), and between vehicles and roadway infrastructure (V2I)—are used to provide vehicles with SPaT from traffic signals.

1.2 System overview

Overview of our approach is show in Fig. 1. The output of the GLOSA system is per-segment speed advisory. For buses the advisory also contains additional (to the standard one) dwell time for near-side bus stops. A genetic algorithm (GA) is used as a search technique for the speed advisory. Complementary dwell time advisory is evaluated on the basis of a given speed advisory. The reason why a GA is used for multi-segment GLOSA is that the computational problem of finding the optimal set of speeds requires in this case searching through a huge number of possibilities for solutions.

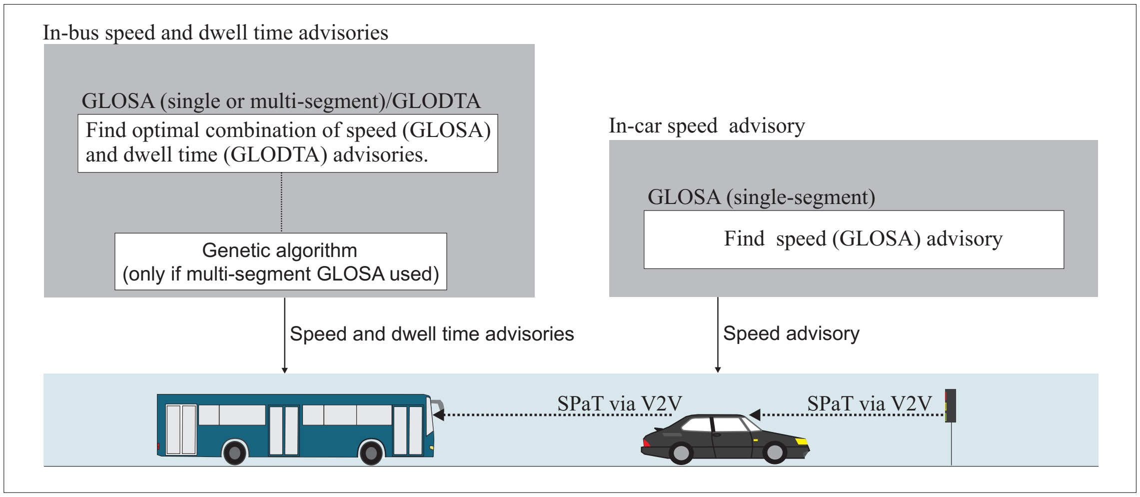

Fig. 1. Overview of GLOSA and GLODTA advisory systems. In order to avoid stopping at traffic signals vehicles calculate optimal approach speed. In addition, the bus calculates dwell time advisory for near-side bus stops. By default, single-segment GLOSA is used. Buses operating in bus-only lanes may use a multi-segment GLOSA.

In the presentation we will demonstrate benefits of using GLOSA combined with dwell time planning (for buses). Several conventional driving strategies will be compared with our approach. Using computational experiments we will show that the introduced method outperforms a conventional driving approach in terms of driving comfort and fuel consumption.

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