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Traffic Lights Management Using Optimization Tool

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Abstract

The increase of traffic is one of today's problems. Numerous cities are affected by traffic congestion and the increase of emissions from fuel use. They have a negative impact on economy, environment and overall on the quality of life. It is necessary to find intelligent solutions for road traffic management. The interest for intelligent traffic systems appeared at the beginning of the 20th century. There are various methods available for traffic management such as inductive loop detection, infrared sensors, video data analysis etc. The purpose of this paper is to present an approach of optimization tool using in order to decrease the traffic congestion and the crossing time of a road network.

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Keywords: intelligent transportation systems; optimization; traffic lights

1. Introduction

"Intelligent Transportation Systems, or ITS, can be defined as the application of computing, information, and communications technologies to the real-time management of vehicles and networks involving the movement of people, goods, and services " (Samadi, S., Rad, A.P., Kazemi, F.M., & Jafarian, H., 2012).

In order to understand the transportation system and the need to model traffic flow, we must first understand the causes of mobility and how it is achieved. People's daily activities generate the need for people and goods to move between different locations. "The transportation system provides the infrastructures and means, ensuring that both persons and freight will be at the right location at the right time to perform the activities that will result in products and services when they are required by the market " (Barceló, J., 2010).

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2. Traffic modeling and simulation

Traffic dynamics can be defined by mathematical traffic flows obtained through the interaction between drivers, vehicles and infrastructure. Thus, in these mathematical models, large amounts of information are taken into account: the behavior of drivers in terms of the degree of acceleration of the car, the agglomeration of the streets, the speed at which they travel, the pedestrian flow, the positioning of the road signs, etc. By processing these data, it is desirable to get the best possible time to cross the intersections, in order to reduce road jams.

Based on the data obtained from various traffic monitoring sensor networks, simulation models are developed. By running a simulation model, predictions of traffic evolution can be made and intersections with the highest risk of blockage can be seen.

It is noteworthy that the values for the model parameters are chosen so that the simulation will match the data obtained from the traffic. This operation is called the model's calibration, and its endpoint consists of a calibrated model that can be used to predict traffic flow. A schematic representation of all these considerations is presented in Fig. 1.

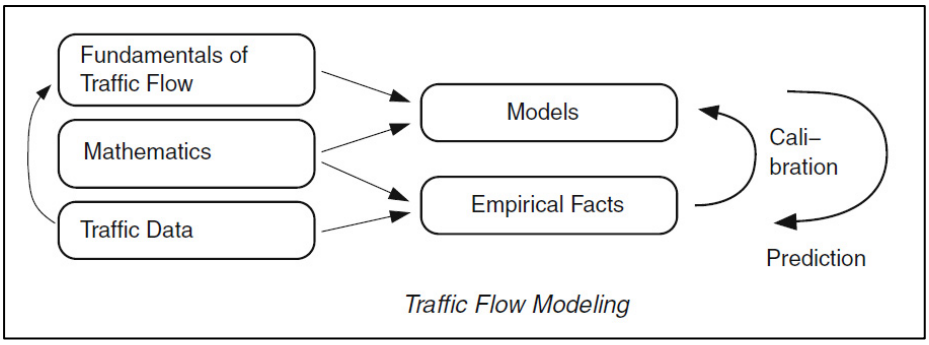

Fig. 1. Traffic Flow Modeling (Treiber, M., & Kesting, A., 2013)

A clearer relationship between simulated and real-time traffic systems is represented in Fig. 2. In order to validate a simulated traffic system, it should reproduce in a realistic manner the real system. The simulated system receives as inputs the values from the real system. Besides, there are also entries that cannot be directly observed, requiring the use of estimated values. From the category of inputs to be estimated we can specify the dynamics of origin-destination matrices.

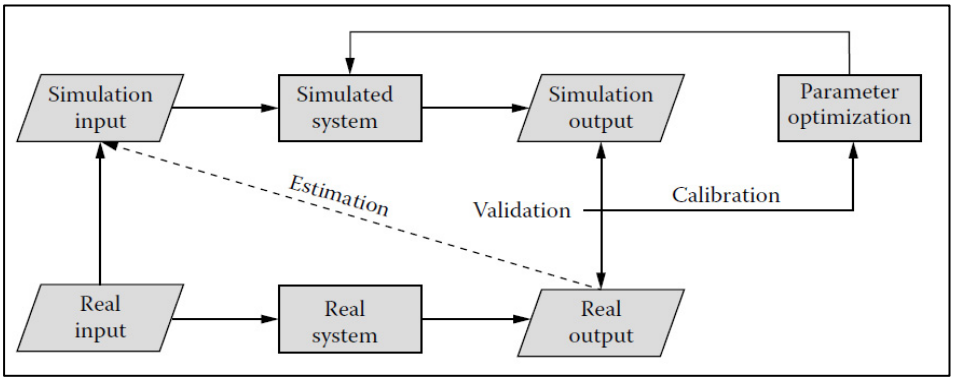

Fig. 2. Relationship of simulated and real systems and locations of calibration and validation processes (Daamen, W., Buisson, C., & Hoogendoorn, S.P., 2015)

It can be noticed that in the proposed architecture, in the calibration, the simulation output values are compared with the data corresponding to the real system. Following this comparison, an adjustment of the simulated system parameters will be made so that the differences between the two outputs are minimal or reach a minimum specified by the requirements.