Optimizing Road Traffic with Intelligent Traffic Lights

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Introduction

Air quality degradation, stress, and noise pollution are all problems caused by frequently congested and poorly regulated road traffic. An effective solution could be the optimization of traffic lights. However, one question remains: how can this optimization be implemented, and by what means?

Thematic Positioning

ENGINEERING SCIENCES (Automation), COMPUTER SCIENCE (Applied Computing), ENGINEERING SCIENCES (Electronics).

Keywords

Road traffic congestion, data analysis, peak speed, free-flow speed.

Annotated Bibliography

Traffic congestion cost the French economy 17 billion in 2013 and is expected to reach 22 billion by 2030 [1]. However, significant progress has been made in transportation, notably through autonomous vehicles, the growth of electric vehicles, and the increased use of data to reduce congestion.

The report from Cédric Villani's mission on artificial intelligence in 2018 [2] highlights the importance of developing and interconnecting transportation modes (carpooling, shared vehicles, urban logistics, etc.) to reduce traffic density.

Some cities have already implemented solutions to streamline traffic. For example, the city of Milton Keynes (United Kingdom) uses cameras to adjust traffic lights in real-time [3]. Similarly, in Pittsburgh (United States), an AI-based traffic control system has reduced intersection wait times by 50%.

In this study, we will focus on optimizing traffic lights, particularly at simple crossroad intersections. By simplifying our reasoning, such an intersection can be modeled with two crossing lanes, which facilitates optimizing sensor placement and traffic light management. A first approach involves applying a fixed cycle (e.g., red 10s, yellow 3s, green 10s). However, this system has a major drawback: its lack of adaptability. Some cities, such

as Strasbourg, have implemented predefined modes (day, night, high traffic) to improve traffic flow. However, these solutions remain limited. Therefore, the objective of this study is to design a traffic light structure capable of dynamically adapting to traffic conditions.

Research Question

Why improve traffic flow? How can an adaptive traffic light system be implemented? How can these so-called intelligent lights adjust in real time?

TIPE Objectives

1. Study different traffic models [4].

2. Design a model simulating a simple road intersection.

3. Model the efficiency of an intelligent traffic light system.

4. Engage with stakeholders in the field, such as the Eurometropole of Strasbourg, which faces traffic management challenges.

References

References

[1] Inrix. *Traffic congestion: A cumulative bill of over 350 billion for France over the next 16 years.*

[2] Cédric Villani et al. *Giving meaning to artificial intelligence: Towards a national and European strategy.* National Digital Council, 2018.

[3] Francesca Baker. *The technology that could end traffic jams.* BBC.com, December 12, 2018.

[4] Emmanuel Bourrel. *Dynamic modeling of road traffic flow: From macroscopic to microscopic.* INSA Lyon, 2004.