NITC
NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

Exploring New Solutions to Urban Congestion Through a Network of Traffic Signal Controls

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Automobile traffic congestion in urban areas comes with significant economic and social costs for everyone. According to the 2015 Urban Mobility Report, the total additional cost of congestion was $160 billion. As more people move to metropolitan areas, the problems only intensify. The latest NITC report offers a new approach to urban traffic signal control based on network consensus control theory which is computationally efficient, responsive to local congestion, and at the same time has the potential for congestion management at the network level.

Traffic signals represent a significant bottleneck. As cars queue up at a stoplight, then gradually move again once the light turns green, incremental delays are introduced and compounded by this bottleneck. Exploiting new developments in communication, sensing and intelligent infrastructure systems, our opportunities for new traffic control strategies expand.

Led by Gerardo Lafferriere, a professor in the Fariborz Maseeh Department of Mathematics and Statistics at Portland State University, this research applies a common concept in computer science that redistributes burdens across a system in order to even the playing field. The research team implemented this network consensus approach in a MATLAB simulation module to explore the potential benefits to traffic flow.

AN EXPLORATORY MODEL

This exploratory model seeks to understand the dynamic shifts in the number of cars waiting at each traffic signal, including the impact of sudden changes in traffic flow patterns on overall congestion in the grid.

The consensus approach was able to distribute traffic more efficiently and kept the load on all streets at a comparable level. In short, with a “smart city” technology approach we can be more responsive to change.

The research team created a graphical user interface (accessible on GitHub) that lets the user visualize the simulation runs in an easy-to-understand environment and provides direct access to a number of simulation parameters. Some can even be modified “on the fly” while the simulation is running.

Researchers also provided simple tools to analyze the simulation results offline. The main contribution of this project is the simulation platform that allows for comparison between the proposed consensus approach and a standard traffic signal control protocol. The main features of the mathematical model and the simulation tools are explained and illustrated in the report.

With the simulation tools created in this project, other researchers in traffic management can explore the potential of the network consensus protocol. The complete open source for the code is available in the online depository (see reverse for URL). The code is in the form of MATLAB files with extensive comments explaining the various parts of the model.

ABOUT THE AUTHORS

The research was conducted by Gerardo Lafferriere of the Fariborz Maseeh Department of Mathematics and Statistics at Portland State University.

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THE FULL REPORT and ONLINE RESOURCES

For more details about the study **A Decentralized Network Consensus Control Approach for Urban Traffic Signal Optimization**, download the full report at **https://nitc.trec.pdx.edu/research/project/1165**

Access the graphical user interface on GitHub: **https://github.com/gerardolf/Traffic_Light_Code**

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