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## A Decentralized Network Consensus Control Approach for Urban Traffic Signal Optimization

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## MITIGATING AUTOMOBILE CONGESTION THROUGH URBAN TRAFFIC SIGNAL CONTROL

Automobile traffic congestion in urban areas comes with significant economic and social costs. As more people move to metropolitan areas, the problem only gets worse. The latest NITC report offers a new approach to urban congestion management through traffic signal control. Traffic signals represent a significant bottleneck for congestion management. As cars queue up at a stoplight, then gradually move again once the light turns green, incremental delays are introduced and compounded by the bottleneck. There is a need to develop new traffic control strategies which exploit new developments in communication, sensing and intelligent infrastructure systems.

Led by Gerardo Lafferiere, a professor in the Fariborz Maseeh Department of Mathematics and Statistics in the College of Liberal Arts and Sciences at Portland State University, this research project uses network consensus control theory to better manage traffic at signalized intersections. The research team implemented a consensus approach in a MATLAB simulation module to explore the potential benefits to traffic flow. The model seeks to understand the evolution of the lengths of the queues at each traffic signal; that is, the number of cars waiting at the signal. It also analyzes 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.

The research team created a graphical user interface (GUI) 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 provide simple tools to analyze the simulation results offline. With the simulation tools created in this project, other researchers can explore the potential of the network consensus protocol.

This study was funded by the **National Institute for Transportation and Communities (NITC)**. NITC is one of five U.S. Department of Transportation national university transportation centers. Housed at Portland State University, NITC is a program of the Transportation Research and Education Center (TREC). This Portland State-led research partnership includes the University of Oregon, Oregon Institute of Technology, University of Utah and new partners University of Arizona and University of Texas at Arlington.

Automobile traffic congestion in urban areas is a worsening problem that comes with significant economic and social costs. This report offers a new approach to urban congestion management through traffic signal control.

**A Decentralized Network Consensus Control Approach for Urban Traffic Signal Optimization (#2019-1165)**

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