A study of Feedback-based Traffic Flow Control Using Estimated Traffic Congestion

Hideyuki Kobayashi†, Shweta Jain‡, Theodore Brown††

†National Institute of Technology, Sendai
‡York College and Graduate Center, CUNY
††Queens College and Graduate Center, CUNY
Background

Loss from traffic congestion (Japan, 2003\cite{1})

- $116\text{ billion / year}$

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[VICS (Vehicle Information and Communication System)]

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VICS (Vehicle Information and Communication System)

Existing method

1. Stop

2. Send Request

3. Receive IDs

ID: 1
Existing method

Calculate ID

ID

ID

ID
Problems

• Driver decide to re-route
  ➢ Independently and manually

• Partitioned communication graph
Purpose

• Self organized
  ➢ V2V, V2I, I2I
• Traffic congestion control without driver intervention i.e., rerouting
Proposed Method

TSP (Traffic Signal Priority) for improved traffic movement
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Avoid traffic congestion
(User insensible)
Time-Varying Graphs

Castegits’ [2]

Birand’s [3]

Each edge represents available time

changed relation by Time

G_0

G_1

Applied Proposed Method

\[
\begin{align*}
G_0 & = \begin{bmatrix}
-1 & 1 & 0 & \ldots & 0 \\
1 & -1 & 0 & \ldots & 0 \\
0 & 0 & -1 & \ldots & 0 \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
0 & 0 & 0 & \ldots & -1 \\
\end{bmatrix}
\end{align*}
\begin{align*}
G_1 & = \begin{bmatrix}
-1 & 1 & 1 & \ldots & 0 \\
1 & -1 & 1 & \ldots & 0 \\
0 & 0 & -1 & \ldots & 1 \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
0 & 0 & 1 & \ldots & -1 \\
\end{bmatrix}
\end{align*}
\]

\[
\begin{align*}
t_0 & = \begin{bmatrix}
-1 & 1 & 0 & \ldots & 0 \\
1 & -1 & 0 & \ldots & 0 \\
0 & 0 & -1 & \ldots & 0 \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
0 & 0 & 0 & \ldots & -1 \\
\end{bmatrix}
\end{align*}
\begin{align*}
t_1 & = \begin{bmatrix}
0 & 1 & -1 & \ldots & 0 \\
0 & 0 & -1 & \ldots & 0 \\
1 & 1 & -1 & \ldots & 0 \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
0 & 0 & 0 & \ldots & -1 \\
\end{bmatrix}
\end{align*}
\]
Summary

- Communication between Traffic lights and cars (T2T, C2C and C2T)
- TSP (Traffic Signal Priority), Congestion control and Surface Mass Transit
- Time-Varying Graphs

Future work

- Simulation
  - (Mobility model <-> Communication feedback loop)
- Verification