East Liberty in its Heyday
Commercial
Residential
Investment
Adaptive Traffic Signals

Objective

– Demonstrate adaptive signals in a grid configuration

Benefits

– Improve traffic flow and reduce air pollutants

Current Status

– Simulation results are promising:

<table>
<thead>
<tr>
<th>% Reduction</th>
<th>Travel Time</th>
<th>Wait Time</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM rush</td>
<td>37%</td>
<td>63%</td>
<td>32%</td>
</tr>
<tr>
<td>PM rush</td>
<td>23%</td>
<td>42%</td>
<td>20%</td>
</tr>
</tbody>
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Pittsburgh’s East Liberty Neighborhood
Virtual Traffic Lights using V2V

Main Concept

Principle of Operation
Benefits

• Increased safety
• Reduced congestion
• Building block for autonomous driving

Increase in traffic flow during rush hours: 60%

Expected benefit when compared to 16% TL in Porto

Vehicle density (veh/km²)

% benefit

24 (Low)  120 (Medium-low)  251 (Medium-high)  333 (High)
Automated Recognition of Traffic Intent

Goals

• Detect position and velocity
• Predict future motion

Outcomes

• Intelligent monitoring
• Early driver warning
• Input for automated crash avoidance

Examples of vehicles to be detected & tracked from vehicle-mounted sensors.
Embedded Diagnostics

- Embedded sensors and communications to monitor and diagnose vehicle dynamics in real-time

Vehicle Controls  Virtual Dashboard  Online Diagnostics  Trip Analyzer

Carnegie Mellon University
University of Pennsylvania
Automatic Recognition and Understanding
Communicating driver intentions

- V2V communications to anticipate and avoid dangerous scenarios

Simple Case: Negotiation of right-of-way at intersections

More Advanced Case: Interstate shape space management
Automatic Recognition and Understanding of the Driving Environment for Driver Feedback

External sources
- Maps
- Traffic
- Weather

Scene Understanding
- Images
- 3D point clouds
- Motion prediction

Constraints
- Rules of the road, patterns of behavior
- Combination of statistical and symbolic data
- Driver preferences

Make recommendations
- Sound alarm
- Take emergency action
Security and formal verification

- Vehicle-to-Vehicle (V2V) Networks are temporary, ad-hoc wireless networks formed between vehicles, when they are in the vicinity of each other.

- How to guarantee computational and communication systems performance in the presence of potentially malicious users?
• How to define trustworthiness of information?

Trust management

1. Trust Bootstrap
2. Get Context information
3. Obtain Behavior History
4. Compute Reputation
5. Policy Application
6. Make Decision

Off-line Behavior Evaluation

Decision

(1) Trust Bootstrap

(2) Get Context information

(3) Obtain Behavior History

(4) Compute Reputation

(5) Policy Application

(6) Make Decision
Objective: Use the acceleration data that comes from many vehicles passing over a bridge to determine if changes to bridge have occurred.
Laboratory-Scale and Full-Scale

Laboratory set-up:

- Linear Bearing
- Sensor Mount
- Spring Suspension

8 inch (20.3 cm)
18 inch (45.7 cm)

Full-scale set-up
Continuous Road Surface Distress Detection

Light sensor on vehicles that regularly traverse the road network.

(A) Road image
(B) One cross-section
(C) Several cross sections combined - 3D map.
(D) Map with road distress.
Detailed assessments of road surfaces
Reducing Road Congestion via Parking Management
Tiramisu: Community-Driven Transit Information

Crowd-source real-time data
- Riders report on bus location & fullness
- Real-time arrival predictions using machine learning