Examining Perimeter Gating of Urban Traffic Networks With Locally Adaptive Traffic Signals

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Abstract

Several studies have found that Network Fundamental Diagrams (NFDs) are more well-defined (i.e., have less scatter and show better overall network performance) when adaptive traffic signals are installed that dynamically respond to local traffic conditions. A combined gating and adaptive traffic control scheme can leverage the more reproducible macroscopic traffic patterns achieved with adaptive signals to provide more robust and efficient gating control. This paper explores the benefits of combining perimeter gating with locally adaptive traffic signals through micro-simulation Two adaptive traffic signal strategies are considered with the feedback-based gating strategy. The results of the combined gating/adaptive signal control scheme are compared to gating under fixed traffic signals and the implementation of adaptive signals only.

Introduction

- The scatter and hysteresis in the NFD might be decreased slightly by applying only gating or perimeter control strategy.
- Adaptive traffic signals have shown to produce better and more reliable NFD.
- None of the existing gating strategies consider an adaptive traffic control in the protected network (PN).
- In this work, two different adaptive traffic signal strategies are considered with the feedback-based gating strategy.

Traffic Control Algorithms

1) Simple volume-based strategy:

$$g_i(t) = (C - L) \cdot \frac{v_i(t-1)}{\sum_i v_i(t-1)}$$

2) Modified version of the SCATS algorithm:

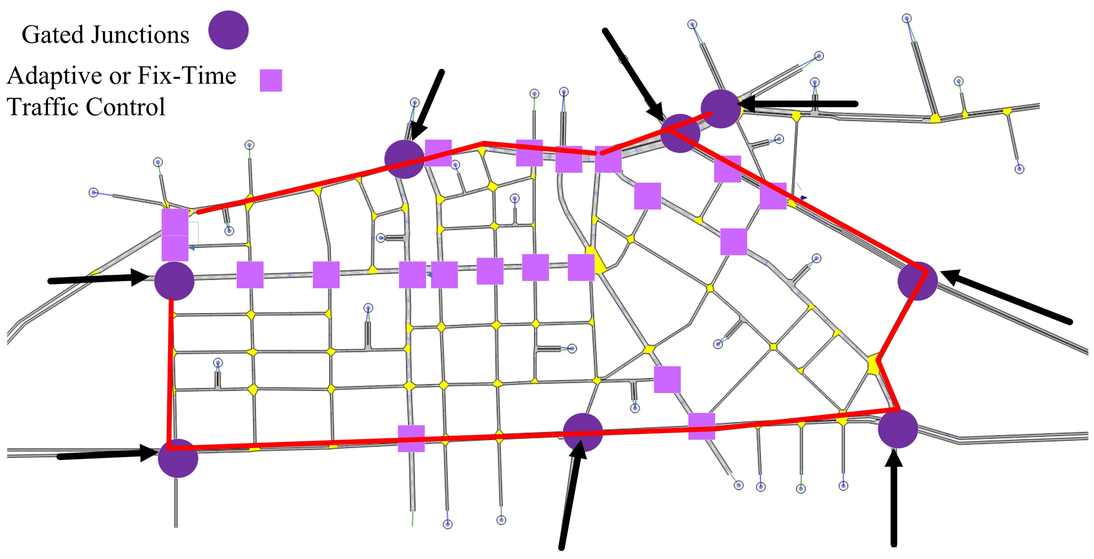
$$g_i(t) = (C(t) - L - G_{min}) \cdot \frac{d_i(t-1)}{\sum_i d_i(t-1)} + g_{i,min}$$

3) Gating Control (ordered flow will be converted to green time):

$$q_g(k) = q_g(k-1) - K_P\left[TTS(k) - TTS(k-1)\right] + K_I\left[\hat{TTS} - TTS(k)\right]$$

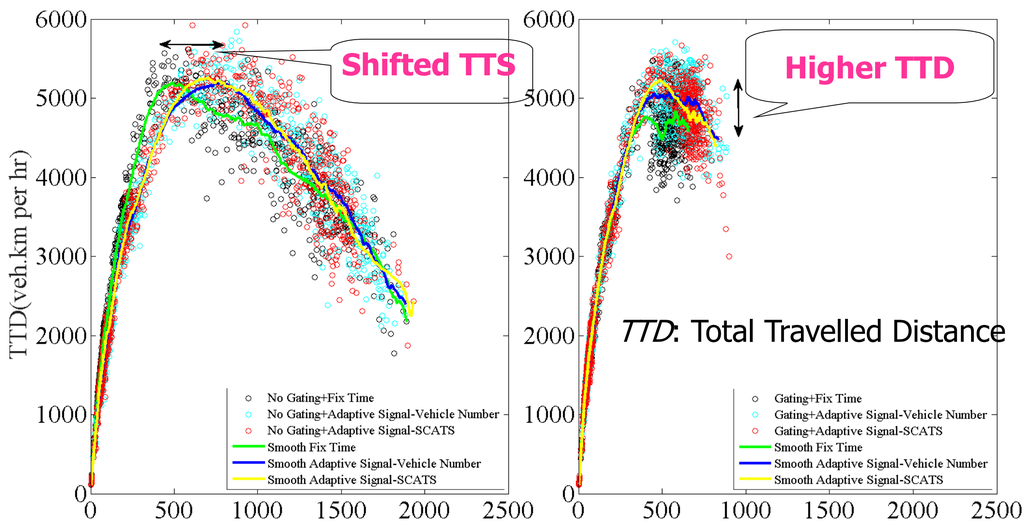
C: Cycle
L: lost time
v: approach volume
G_{min}: sum of minimum greens
d: approach demand
TTS: Total Time Spent

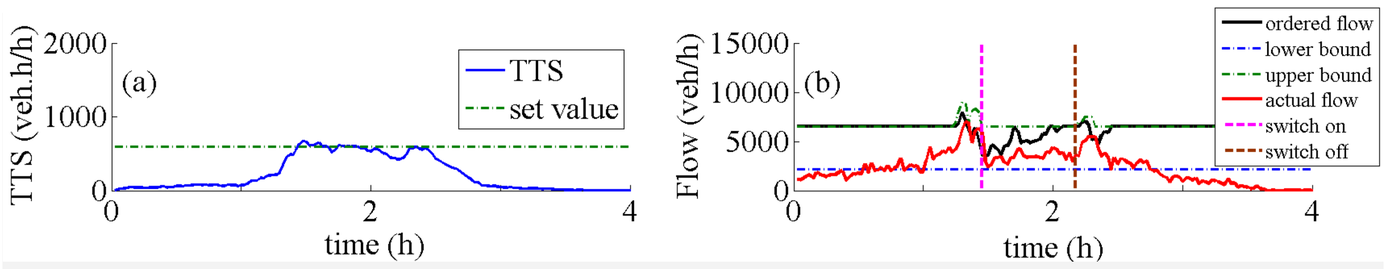
Test-Bed

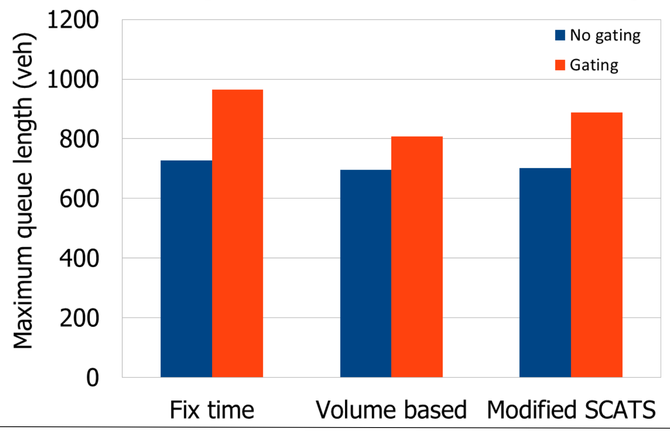


PN (red border) of a larger part of Chania

Simulation Results







- The controller maintains the *TTS* (accumulation) close to the pre-specified $\hat{TTS}$ in gating + fix-time scenario.
- Similar results have been found for the gating + adaptive traffic control strategies.
- Gating is activated within the peak hour time-window.

Conclusions

- Adaptive signal control can increase the critical accumulation in NFD to higher values.
- In over-saturated conditions, gating is more effective than adaptive traffic signals, and the combination offers shorter virtual queue and consequently less negative impact on the vicinity traffic.

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Project: There is plenty of room in the other lane

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