

Generalized effects of on-street parking maneuvers on the performance of nearby signalized intersections

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Problem Statement

On-street parking affects intersection service rate

An on-street parking maneuver can often start a temporary bottleneck, leading to additional delay endured by the following vehicles. When the maneuver occurs at a close distance upstream a signalized intersection, the scope of the impact can be magnified.

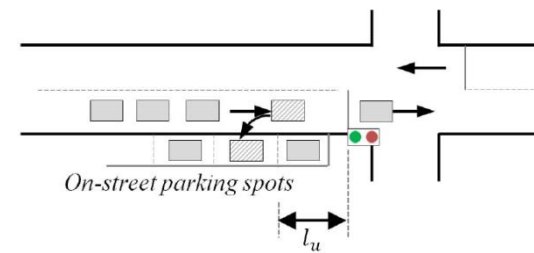


Figure 1. Illustration of the general situation.

Research idea and tools

In this paper, we estimate the service rate reduction due to the delay caused by a parking maneuver at different locations and provide suggestions to avoid such reduction. Based on the hydrodynamic theory of traffic flow, the perturbation caused by the parking maneuver is calculated. Using dimensional analysis, we analyze the relation between the background conditions (i.e, traffic volume, traffic saturation condition, signal control settings, etc.), the time/location of the parking maneuver, and the service rate reduction at the intersection.

The results show that, generally, for an undersaturated intersection, parking downstream of the intersection causes less negative effects on service rate than parking upstream. However, for an oversaturated intersection, parking at a close distance downstream of the intersection might reduce the service rate significantly.

Solution

Steps

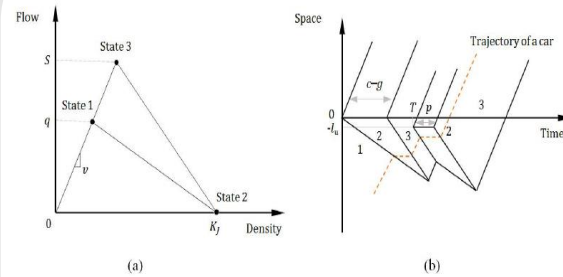


Figure 2. (a) Illustrative triangular fundamental diagram for the link. (b) Illustrative time-space diagram.

- i. Define the parking maneuver (duration, location in reference to the intersection).
- ii. Define the saturation conditions.
- iii. Find the service rate reduction of the intersection due to the parking maneuver based on the hydrodynamic theory of traffic flow.

Results

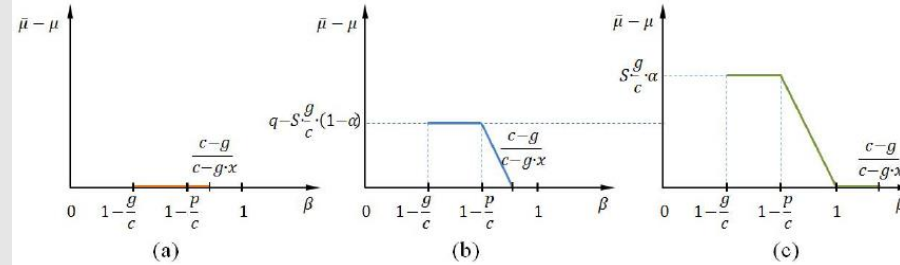


Figure 3. Relation between the service rate reduction and the value of β based on different saturation conditions. (a) very unsaturated; (b) nearly saturated; (c) oversaturated.

Validation

The accuracy refers to the service rate (instead of the reduction). The survey was conducted on a section of Dreikönigstrasse in the city of Zurich, Switzerland. During the survey, more than 90 maneuvers were recorded, but only 32 were used.

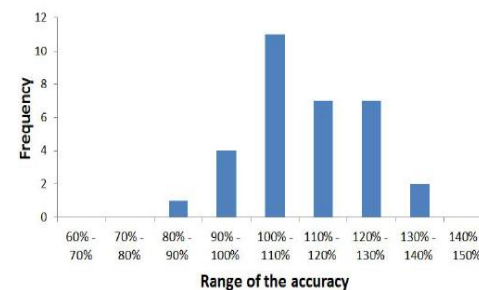


Figure 4. validation

Solutions/ Conclusions

1. According to our analysis, the amount of the service rate reduction depends very much on the saturation conditions (i.e., volume-to-capacity ratio) and the virtual arrival time of the parking vehicle to the intersection (i.e., β).
2. Based on the comparison between upstream and downstream parking maneuvers and their influence on the intersection, we do not suggest to provide downstream parking spaces close to the intersection unless the intersection is often very undersaturated, as parking at those locations always cause a relatively high service rate reduction.

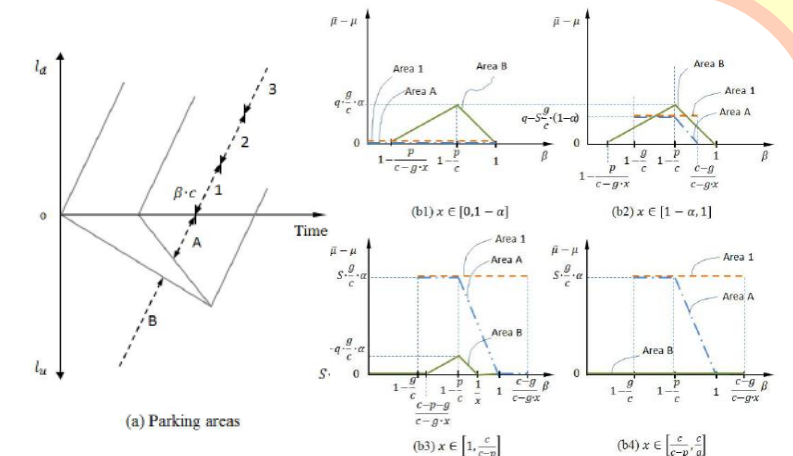


Figure 5. Comparison of the service rate reduction between an upstream parking maneuver and a downstream parking maneuver.

3. If the intersection is often oversaturated, the best choice is to place the parking area far downstream (areas 2 and 3), the second is to place the parking area far upstream (area B), the third is to place the parking area upstream and close to the intersection (area A), and the last one is to place the parking area downstream and close to the intersection (area 1).