

Development of a Transit Signal Priority Algorithm for Urban Corridors

A Thesis

Submitted to Faculty of Engineering

Ain Shams University in Fulfillment of the Requirement for M. Sc. Degree
in Civil Engineering
(Transportation Planning and Traffic Engineering)

Prepared by

Nada Ahmed Ibrahim Mahmoud

B.Sc. in Civil Engineering, June 2013
Faculty of Engineering, Ain Shams University

Supervisors

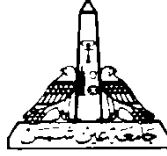
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Statement

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M. Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the Department of Public Works, Faculty of Engineering, Ain Shams University, from 2015 to 2017.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

This research developed actuated signal plans for bus priority using green split optimization and the boundary conditions for cycle lengths done through Synchro® signal optimization tool. A case study was applied on a corridor's segment that consists of four consecutive intersections on El Nahas Corridor at Nasr City, Cairo. This corridor besides being one of the most congested corridors in Cairo, has also one of the deployments of the exclusive bus lanes in an urban corridor in Cairo, Egypt. Pre-timed signal optimization was carried out using Synchro®, 8.0 for two different corridor geometric configurations: first configuration including exclusive bus lanes in the middle, and the other configuration removing the bus lanes and increasing the capacity by adding one lane in each direction (mixed traffic lanes). The optimization was carried out for split signal phasing plans, and protected signal phasing plans for peak and off-peak periods. This optimization resulted in optimized cycle lengths for each intersection in each time period as well as the optimized signal plans for the two optimized scenarios based upon protected and split phasing plans.

PTV Vissim 7.0 traffic micro-simulation tool was used in order to simulate the optimized signal plans for different exclusive bus lanes configurations for split signal phasing, protected signal phasing, and transit signal priority (TSP) scenarios. The simulation was also conducted for mixed traffic lanes configurations for split signal phasing, protected signal phasing, TSP, intermediate U-turns and left turn movements prohibited at intersections, and TSP with intermediate U-turns and left turn movements prohibited at intersections scenarios. The simulations results were used to compare the effectiveness of TSP and non-TSP scenarios on the test corridor.

Before analyzing the various TSP scenarios, a sensitivity analysis was carried out in order to decide the best cycle length for the four intersections on the corridor by using the green splits percentages from the optimized signal timings. A tailored bus priority algorithm was created using VisVAP 2.16 © simulation language. Buses were provided priority in the intersection after each red time in each other approach in the intersection not exceeding the maximum red time.

The developed TSP algorithm used mainly red truncation, green extension, phase insertion, and/or phase rotation according to bus arrival pattern. On the basis of MOEs for TSP and non-TSP scenarios, it was

found out that transit signal priority strategy with mixed traffic scenario that includes U-turns and prohibiting left turn movements at intersections was the recommended strategy to use for accommodating bus flows in congested urban corridors.

Keywords: Actuated Signal Plans, Bus Priority Measures, Exclusive bus lanes, Signal Optimization, Transit Signal Priority (TSP).

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