J. Cent. South Univ. (2019) 26: 893−904
DOI: https://doi.org/10.1007/s11771-019-4058-y

Springer

Dynamic signal control for at-grade intersections under preliminary autonomous vehicle environment

LUO Si-da(罗斯达)[1], ZHANG Shuai(张帅)[2]

1. Department of Civil and Environmental Engineering, Northwestern University, Evanston, Illinois 60208, United States;
2. Department of Strategy and Policy, Beijing Transport Institute, Beijing 100073, China

Abstract: Autonomous vehicle technology will transform fundamentally urban traffic systems. To better enhance the coming era of connected and autonomous vehicles, effective control strategies that interact wisely with these intelligent vehicles for signalized at-grade intersections are indispensable. Vehicle-to-infrastructure communication technology offers unprecedented clues to reduce the delay at signalized intersections by innovative information-based control strategies. This paper proposes a new dynamic control strategy for signalized intersections with vehicle-to-signal information. The proposed strategy is called periodic vehicle holding (PVH) strategy while the traffic signal can provide information for the vehicles that are approaching an intersection. Under preliminary autonomous vehicle (PAV) environment, left-turning and through-moving vehicles will be sorted based on different information they receive. The paper shows how PVH reorganizes traffic to increase the capacity of an intersection without causing severe spillback to the upstream intersection. Results show that PVH can reduce the delay by approximately 15% at a signalized intersection under relatively high traffic demand.

Key words: dynamic traffic control; vehicle-to-signal; signalized intersection; preliminary autonomous vehicle environment

Cite this article as: LUO Si-da, ZHANG Shuai. Dynamic signal control for at-grade intersections under preliminary autonomous vehicle environment [J]. Journal of Central South University, 2019, 26(4): 893–904. DOI: https://doi.org/10.1007/s11771-019-4058-y.

1 Introduction

Intelligent transportation systems (ITS) have attracted the attention from transportation researchers and practitioners since 1980s. This advanced application is expected to meet the ever-increasing need for mobility in both developed and developing countries. Even in the developing world, cities have witnessed many ITS implementations that vary in technologies (e.g., car navigation, variable message signs, automatic plate recognition, etc). With the ongoing technological revolution, applications including vehicle-to-infrastructure communications (V2I) and vehicle-to-vehicle communications (V2V) are being on the horizon. In fact, vehicle-to-signal communication (V2S), one simplest instance of V2I, has been commercially deployed in the United States (https://apnews.com/34c22c1071434616a44653b042d9e869/carcompany-offering-red-light-readingvehicles-las-vegas).

V2S provides great opportunities to enhance the efficiency of signalized intersections. As acknowledged, it is the isolated signalized intersection that is a typical bottleneck in road networks and demands wise control strategies [1]. Efficiency improvement at signalized intersections

Received date: 2017-12-13; **Accepted date:** 2018-09-20
Corresponding author: LUO Si-da, Research Assistant; Tel: +1-847-8684981; E-mail: Sidaluo2015@u.northwestern.edu; ORCID: 0000-0002-2803-956X