Praise Worthy Prize

Optimization of Delay at Isolated Signalized Intersection Using HCS2010 and SIDRA Intersection 8 Software: a Case Study

Dilveen H. Omar, Salar K. Hussein

Abstract – *Signalized intersections play a significant role in regulating the traffic stream in urban transportation networks. Extensive delay increases travel time cost and reduces Level Of Service (LOS). This study is conducted to determine delay at five isolated signalized intersections in Erbil city, Iraq using two software to improve intersection performance. The Highway Capacity Software (HCS+T7F) and Signalized and Unsignalized Intersection Design and Research Aid (SIDRA Intersection 8) software. An optimizing model following the Genetic Algorithm (GA) has been applied to optimize the signal cycle time using HCS2010(HCS+T7F) and SIDRA software in order to minimize delay at signalized intersections. The average delay value for all the intersections has been reduced after optimization using SIDRA delay model, which represents 21% reduction. On the other hand, by using HCS2010, the value has been reduced by 29% reduction, which is still higher than average field measured delay. In addition, SIDRA optimizing model has a lower optimum cycle time compared with HCS2010 optimize model. For better performance, the intersections should be optimized depending on the SIDRA. Copyright © 2022 Praise Worthy Prize S.r.l. - All rights reserved.*

Keywords: Signalized Intersection, Delay, Optimization, Software, HCS2010, SIDRA Intersection 8 Software

Nomenclature

HCS2010	Highway Capacity Software 2010
LOS	Level of Service
SIDRA	Signalized and Unsignalized Intersection Design and Research Aid
GA	Genetic Algorithm
ITE	Canadian Capacity Guide
ARRB	Australian Road Research Board
TRANSYT-7F	TRAffic Network StudY Tool, version 7F
AIMSUN	Advanced Interactive Microscopic Simulator for Urban and Nsn-Urban
SYNCHRO	Synchronous
CAV	Connected and Automated Vehicles
FCFS	First-Come-First-Service
DE	Differential Evolution

I. Introduction

The main factor in the evaluation of traffic signal is delay. Therefore, traffic engineers measure the delay to optimize the signal system in order to achieve optimum cycle time, which leads to minimum delay for existing intersections. However, for new constructed intersections, it is important to estimate the delay using proper software. For this reason, different equations and software have been developed for the estimation of delay in many developed countries in order to represent delay when calculating and designing the intersections controlled by traffic signal parameters and cycle time [1]-[29]. Reduction in delay has a significant influence to reduce fuel consumption, operation cost, improve the Level of Service (LOS), and exhaust emissions. This is shown by the results of optimization at signalized intersections [1]. Genetic Algorithm (GA) has been first used by [2] for traffic signal timing determination. For the optimization of the splits of green time and for the sequence of the phases, GA has been tested on four arm intersections in order to reduce the delay in the traffic network. The model has been extracted from the basic simulation method of traffic flow. The result of using GA has been promising in the determination of possible optimum signal timings. Later, many researchers have introduced GA into the traffic system and could perform remarkable outcomes. Average vehicle delay at a signalized intersection is an important index for signal design and intersection performance estimation [3].

Compared with other possible parameters, delay has obvious economic value and it can be understood by technical and non-technical users [4]. The important key for signal design and estimation of intersection performance is average delay at signalized intersections [3]. Much traffic software has been used for the evaluation and the optimization of isolated signalized intersection, which uses the Highway Capacity Manual (HCM) delay model. The most widely used traffic software is HCS2010 [5], Signalized and Un-Signalized Intersection Design Research Aid (SIDRA) Intersection 8 [6], OSCADY PRO, and SIGSET. HCS is the most generally utilized