

Swarm intelligence for urban traffic simulation: Results from an Agent-based modeling and simulation study of the Sri Lankan context

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Abstract

Traffic congestion is a crucial issue affecting the quality of life of individuals all over the world. In a country like Sri Lanka where the traffic is mostly heterogeneous and unorganized, traffic congestion could be largely influenced by the behaviors of pedestrians and drivers. Due to the significant impact of traffic congestion to economic growth, various measures have been taken to reduce the urban traffic congestion, such as widening the roads, expanding the road network and constructing overhead bridges. However, despite all these approaches, traffic congestion still remains as a serious issue. We are of the view that the traffic congestion in Sri Lanka is largely depending on the behaviors of the pedestrians and as well as the drivers, which is something that is not adequately investigated yet. Therefore, we propose the Agent-Based Modelling and Simulation (ABMS) approach, which is a popular computational research method based on swarm intelligence to study complex social and economic systems (O'Sullivan and Haklay, 2000), for researching the impact of driver and pedestrian behavior on traffic congestion and evaluating different traffic control strategies. We used the ABMS environment called NetLogo to develop our simulator and the data collected at the *Kiribathgoda* junction in Western Province, Sri Lanka was to calibrate the model with accurate parameter values. Macroscopic statistics, such as the rate of traffic flow, average speeds and queue time were used to validate the model by comparing data from real traffic situations at *Kiribathgoda* junction with model outputs. The ultimate objective of this research is to come up with a cost-effective decision support system for administrators and policy makers to understand various reasons behind congested unorganized traffic environments in Sri Lanka and, thereby to make better-informed decisions to control urban traffic congestion.

Keywords: Traffic simulation, Agent-based modelling, Heterogeneous traffic, Swarm intelligence

Introduction

When it comes to Sri Lankan urban traffic, it is mostly heterogeneous with different types of vehicles (motor cars, buses, motor bicycles and three wheelers), which differ in their static characteristic: vehicle size as well as dynamic characteristics: speed, acceleration, maneuverability, and driver behavior. In Sri Lanka, often motorcycles and three wheelers do not wait along with the other vehicles when traffic is not moving. These two types of vehicle tend to have weak lane discipline and perform dynamic virtual lane-based movements or non-lane based movements (Lee and Wong, 2016) in high-congested traffic conditions while other vehicles follow vehicle following behavior (Lansdowne, 2006). In literature, this behavior is defined as *seepage* behavior, *lane filtering*, *lane splitting*, *lane sharing* or *percolation* (Agarwal and Lämmel, 2015; Lee and Wong; 2016), which is common in all countries that have mixed traffic condition (Agarwal and Lämmel, 2015).