

AN OVERVIEW OF LANE CHANGING MODEL AT SIGNALISED INTERSECTION

Jezan Md Diah¹, Li-Sian Tey², Fathiyah Roslee³

MiTRANS¹ and Faculty of Civil Engineering, Universiti Teknologi MARA (UiTM)^{2,3}

¹E-mail: ce_jezan@yahoo.com

ABSTRACT

In recent years, lane changing has become a crucial issue in traffic engineering and safety aspect due to distribution of vehicles across lanes thus contributing to traffic movements. In order to keep the right route, drivers have to change their lanes. However, lane changing has a high potential of accidents, especially at signalised intersection. This may cause the traffic flow to become heavier and traffic congestion. The aims of this study are to study on lane changing issue at signalised intersection, to determine the factors contributing to lane changing at signalised intersection and to develop a model for improvement of traffic flow in lane changing behaviour at signalised intersection. Lane changing model is important because it will reduce traffic congestion and smoothen the traffic. This study will contribute in studying the changing lane issue at signalised intersection which is to control the flow of traffic in order to ensure the traffic flows smoothly and to reduce traffic congestion especially on the merging issue at signalised intersection.

Keywords: *lane changing, signalised intersection, model, traffic flow*

INTRODUCTION

Background of the Research and Problem Identification

In Malaysia, the performance of intersections is crucial to road network in term of safety and efficiency which is related to vehicles, pedestrians and other road users. A signalised intersection is a shared space used by road users coming from more than one direction at a time based on a fixed and constant cycle time. One of the conditions that drivers should be aware is when the lane is about to end and this requires the drivers to merge or change lane. Changing lane means a driver intends to move from one marked lane to another. Based on Metroland Media Toronto through InsideToronto.com as stated by a former Toronto police officer dated 19 September 2014, changing lane at signalised intersection is uncommon and present greater potential for a sideswipe accident if the lane change is not done properly and safely, particularly for other drivers and cyclists who are not expecting a vehicle to make the lane change. According to Department of Transport and Main Roads of Queensland (2010), drivers who merged onto a lane should match up the speed of the traffic that is already on the lane. In most cases, this helps drivers to find a safe gap in the traffic and can also practice and allow space for trying to enter the lane, either by changing lanes or adjusting their speed.

There are various problems that occur at signalised intersection which is related to the changing lane issue. This changing lane issue will affect the flow of traffic especially at the signalised intersection. Possibility of collisions at signalised intersection is high if a driver or road user is not familiar with the situation. According to a newspaper article from Gympie Times, The Queensland, dated 21 September 2013, many motorists unfamiliar with the merging situation find themselves in tense situation. While, based on the newspaper article from Sunshine Coast Daily, Australia, dated 7 June 2014, the biggest problem with merging is motorists driving well below the speed limit. This is because when motorists drive below the suggested speed limit, other motorists who drive from the rear may face difficulties in harmonising the speed limit and this will cause traffic congestion. In some other cases, there are drivers who are already aware of the rules of the road but they refuse to wait any longer and they come up with additional lanes that should be used for other directions. Thus, the

flow of the traffic becomes busier and this will cause traffic congestion especially during peak hours.

Objectives of the Research

In order to develop a model based on lane changing at signalised intersection, there are several objectives that need to be achieved. The objectives are as follow:

1. To study on the lane changing issue at signalised intersection.
2. To acquire and analyse field data for determining the factors contributing to lane changing at signalised intersection.
3. To develop and validate a model for improvement of traffic flow in lane changing behaviour at signalised intersection.

Scope of the Research

This research will be conducted in Northern Malaysia. Although Northern Malaysia is small area but the development in this area is growing rapidly. To achieve the goals of this research as stated in the objectives, field work data collection will be done such as through observation and questionnaire survey. The data collection is to establish the traffic volume, drivers' behaviour and also site geometry of the respective area of study. After the questionnaires are distributed and completed, the collected data will be analysed by using logistic regression method.

REVIEW OF PREVIOUS STUDIES RELATED TO THE TOPIC

Several studies have been conducted to investigate the issues related to the merging lane at signalised intersections. According to Hallmark *et. al* (2011), as cited in 'Behaviour Study of Merge Practices for Drivers at Work Zone Closure', the position or area of the merge affects the movements and capacity of traffic. They also stated that drivers merging upstream of a lane closure increases more capacity than late merging. Drivers or any road users who do not follow the expected merge regulations and skip to the

top or leading off the queue, often produce a forced merge. These lead to increase in the possibility of crash risk and turbulence, which will diminish any efficiency gained by early merges. It only requires one aggressive driver to force his/her place to be at the head of the queue and turn the free flow into a queue operating with much lower of flow queue discharge rate. Thus, this will lead to traffic congestion for that particular location.

Feldblum (2005) stated that at several signalised intersections, an extra through-lane which is approaching the intersection is required in order to multiply the capacity due to high volumes of traffic during peak hour of the day. To qualify for the criteria of the level-of-service, the extra through-lane must expand through the intersection. According to Garber and Hoel (1997), as cited in ‘Alternative Merge sign at Signalised Intersections’, level-of-service at signalised intersections does not only specify the amount of fuel consumption and loss of travel time, but it can also measure the inconvenience and frustration of motorists. At the position where the extra through-lane meets the ends, drivers must merge into one lane in order to proceed with the trip smoothly and safely. Usually, the sign “Lane Ends” is used to show that the right or left lane is about to end, but the sign does not warn the drivers to merge or guide the drivers on how they should merge. Then, the flow of traffic is disturbed repeatedly due to the merging area and this will increase drivers’ level of frustration as well as reduce the safety of drivers. For the present study, two selected locations were installed with cameras for the purpose of volume and traffic accident data collection. A questionnaire survey was established to seek views of motorists and citizens. The questionnaire survey consisted of several signs including the experimental sign and asked the participants to choose from best to worst. The experimental merge sign was successful in enhancing traffic flow and safety for merges. However, the results from this research propose the experimental merge sign at intersections with lane reductions should be taken into consideration.

While, according to Dixon *et al.* (1999), the optimal design and operation of signalised intersections is a challenging issue for the design of urban roads, this paper studied on right-turn treatment which was located in Cobb Country, Georgia. This previous research aimed to identify the application of various right-turn strategies based on condition for the observed field operation. The right-turn vehicles often used shared lanes

where the vehicles can occupy the same lane as vehicles which progressing straight through the intersection and also the vehicles turning left. When the lane is shared, this will cause disruption to the right-turn-on-red movement. Channelization or traffic islands are usually used for delineation of right-turn movements. A right-turn at signalised intersection is considered as a combination of entrance and exit treatments. Entrance treatments occur commonly for conventional right-turn movements in Cobb Country while exit treatments are merges with the cross street through traffic. The intersections ranged from minor to major arterial roads. Based on the observation, approximately 50% of crashes happened were the right angle crashes. This type of crashes are more severe than the rear-end and sideswipe crashes. Thus, according to the study, further information is needed before transportation engineers fully understand the impact of various right-turn treatments. Future research should evaluate particular treatments in depth using types of road, traffic volume and conflict, and limited right-turn treatments.

Based on Kumara and Chin (2003), they stated that according to annual accident statistics, more than 30% of vehicles collision in Singapore happens at signalised intersections. In order to plan for suitable actions that need to be taken, firstly it is necessary to identify several factors that may affect the occurrence of accident at these locations. This can be done by establishing a statistical model that relate to the accident frequencies with traffic control measures, traffic characteristics and also design elements of the intersection. The problem that occurs in developing the statistical models is the number of cases when zero accidents are recorded at particular intersection. When zero accident is recorded over a period of time, it shows either the site is almost safe, or that the chances of occurrence of accidents are not reported. Hence, the presence of zero record in the accident count data may be mistakenly regarded because of incorrect specified model. According to Kulmala (1995) as cited in 'Modelling Accident Occurrence at Signalised Tee Intersections with Special Emphasis on Excess Zeros' by Kumara and Chin (2003), short sight distances might raise the accident occurrence. Over the years, many engineering advances such as advanced driver training and also advanced vehicle checking systems have been proposed in Singapore which may reduce the possibility of accident occurrence at intersection as indicated by negative model parameter based on time trend. The model shows that the more phases per cycle, the higher accident occurrence. Generally, the

number of phases is higher for occupied intersections with more conflict demands stated by Poch and Mannering (1996) as cited in ‘Modelling Accident Occurrence at Signalised Tee Intersections with Special Emphasis on Excess Zeros’ by Kumara and Chin (2003).

METHODOLOGY

At this stage of research, the information that is related to the study, the literature review from previous studies is done to strengthen this study. For the preparation of this study, the problems that usually occur while changing lane at signalised intersection will be analysed. Next, is identifying the objectives and suitable locations of the study. Then, the data is prepared through field work based on the pilot study, site observations and also the questionnaire survey. The data analysis and model development is evaluated using logistic regression method. Finally, conclusion and relevant recommendation are determined. Figure 1 below shows the flowchart for the methodology of the research.

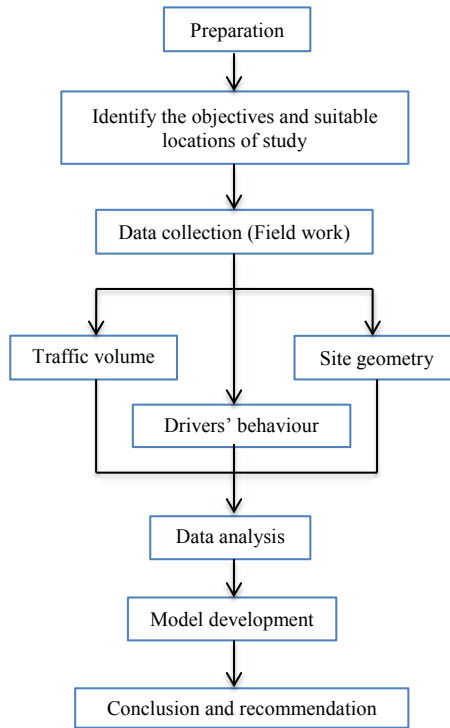


Figure 1: Flowchart of research methodology

EXPECTED SIGNIFICANT CONTRIBUTION TO NEW KNOWLEDGE

The contribution of this research lies in studying the changing lane issue at signalised intersection. The importance of signalised intersection is to control the flow of traffic in order to make sure the traffic flows smoothly and to reduce traffic congestion especially on the merging issue at signalised intersection. The work carried out in this research is to reduce and then ultimately to prevent negative issue in changing lane at signalised intersection. Besides that, it can avoid factors that lead to changing lane issue at signalised intersection which will inevitably lead to traffic congestion. This study also will develop and validate a model to improve the traffic flow in lane changing behaviour at signalised intersection based on the area

of study. The results of this study indicate that drivers' parameters such as giving ways to other road users, using signals while changing lanes, years of driving experience and also following the present speed limit are the components of lane changing models.

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