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Microscopic Analysis of Unsignalized Intersections in Heterogenous Traffic Conditions

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Abstract:*Unsignalized intersections in India are uncontrolled and are characterized by chaotic traffic situation and have become accident hot spots. In this study, we will collect traffic data at two uncontrolled intersections in different parts of the city. Traffic parameters such as traffic composition, speed variations, lane distribution, trajectories, conflict points, and pedestrian movements are to be analysed.*

Keywords:*Conflict points, Microscopic analysis, Uncontrolled intersections, Vehicle trajectories, Travel behaviour. Uncontrolled intersections, Vehicle trajectories, Travel behaviour.*

I. INTRODUCTION:

Road intersections are the primary bottlenecks in a given network, primarily because the intersection space needs to be shared by the vehicles moving in many different directions. An intersection has many crossing and merging conflicts points for vehicles. Additionally, many pedestrians cross-roads at intersections, resulting in pedestrian-vehicle conflicts points. The large number of vehicle to vehicle and vehicle to pedestrian conflicts is potential cause of accidents. The most vulnerable entity at intersections in India and many other developing countries is pedestrian. Drivers are aggressive, and priorities at unsignalized intersections are not followed. Consequently, the situation at unsignalized intersection is chaotic and unpredictable making maneuvering very unsafe. Such situation also makes it difficult in performance evaluation of unsignalized intersections. Unlike Highway Capacity Manual (HCM 2010), many developing countries including India do not have any standard manual for capacity analysis of unsignalized intersections. For evaluating safety and performance of unsignalized intersections, it is important to study various traffic characteristics, such as traffic volume, composition, speed, conflict points, vehicles trajectories, and pedestrian movements.

Keeping in view the type of study, authors have selected two intersections covering variety of traffic and geometrical conditions. Before selecting the listed intersections, many more were visited to assess the suitability. The intersections have been selected in such a way that they are orthogonal to each other. Other requirements include:

(a) No obstructions due to parked vehicles or any other obstruction
(b) Availability of suitable places for fixing multiple cameras so as to get view from three directions
(c) Plain terrain to avoid the impact of road gradients,
(d) Good pavement condition.

II. OBJECTIVES:

a) To study the trajectories of all classes of vehicles and determining different points of conflicts.
b) To evaluate the critical gap distribution by observing accepted and rejected gaps.
c) To assess the streamwise clearance time of all classes of vehicles.
d) To evaluate follow-up time, vehicle impedance and vehicle trajectory.

III. LITERATURE REVIEW:

Understanding traffic parameters, such as speed, traffic composition, gap acceptance, and conflict points at microscopic level, is necessary for developing performance evaluation models. These parameters also help to evaluate facilities with respect to safety. Many studies are found in the literature that focuses on microscopic traffic characteristics at various transportation facilities in developed countries. Authors have discussed a few relevant studies on urban streets, signalized intersections, and unsignalized intersections. The study carried out by *Berge and Vaa (2003)* focuses on the drivers' speed choice on a road segment and interaction with other road users. The study conducted by *Haglund and Aberg (2002)* gives a strong relation between observed speeds and speeds reported by the drivers. The study also found that a driver's behaviour is

related to the behaviour of other drivers. Even if drivers at large are aware of their own speed at a certain time and place, they appear to have a biased perception of the speed level in general. *Wolferman, Alhajyaseen and Nakamura (2011)* using empirical data of vehicle trajectories collected at signalized intersections in Japan, developed a model, which provides stochastic speed profiles of free-flowing left- and right turning vehicles. They found that the speed profiles are sensitive to intersection layout and the vehicle speed and position at the beginning and ending of the manoeuvre. *Doecke, Wolley* and *MacKenzie (2011)* studied the path of vehicles after a collision with another vehicle at a rural intersection. This information was further used to provide guidelines to transport authorities on roadside design at intersections. *Viti (2008)* studied real vehicle trajectories near and up to a few meters upstream of the stop sign. *Banerjee (2004)* collected microscopic data of turning vehicles to gap acceptance behaviour. Initial pilot observations indicated that the presence of pedestrians in intersections had an immediate and substantial impact on movement of left turning vehicles. Very few studies are found that analyze traffic behaviour at unsignalized intersections in India and other developing countries. Some relevant studies carried out mainly in India are also described here. *Chandra, Agrawal and Rajamma (2009)* introduced service delay model for uncontrolled intersections based on microscopic analysis of delay data under mixed traffic condition. The proportion of heavy vehicles was found to affect the service delay at the intersections. Recently, *Patil and Sangole (2015)* modelled gap acceptance behaviour of right turning vehicles at partially controlled T-intersection in India. *Patil and Pawar (2014)* estimated temporal and spatial gap acceptance at four-legged intersections using various methods. The critical gap values found in *Patil and Sangole (2015)* and *Patil and Pawar (2014)* were smaller than the values found in developed countries, indicating the aggressive behaviour of drivers in India. Few systematic studies are available for various other traffic parameters, such as speed, lane usage, conflict points, vehicle trajectories, pedestrian trajectories, etc. at unsignalized intersection in developing countries. These parameters are important for geometric design and evaluation of unsignalized intersection.

IV. METHODOLOGY:

A. Data collection and extraction:

Data is collected using video cameras, and the extraction is done manually by playing the videos on a screen. Because of the non-lane based movements and a large number of vehicle types, traffic data collection and extraction is very time consuming and laborious task

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B. Analysis oftraffic characteristics:

i. **Traffic Composition:** Traffic composition is the involved vehicle type and the proportions of each vehicle type in the mixed traffic flow.

ii. **Lane preference:** Different classes of vehicles prefer different lanes depending upon the type of lane i.e fast moving vehicles prefer and the slow moving and heavy vehicles prefer outer lanes.

iii. **Speed:** The primary factor at intersections that affect the safety is magnitude of speed or the variance of the speed between vehicles. The severity of accidents largely depends on the speeds of vehicles involved in the accidents. Higher variance speed between vehicles causes more number of accidents. Accident rate increases exponentially as the speed differential in the traffic stream increases.

iv. **Lane changing data:** Most of the vehicles change the lanes in the intersection influence area/zone to avoid collisions with other vehicles.

C. Analysis of Traffic Conflict Points:

Vehicles at intersections move in several directions (through, left turning, right turning from different approaches). The combination of these movements in several directions creates many conflicts points and conflict areas. A traffic conflict is an observable situation in which two or more road users approach each other in space and time to such an extent that there is a risk of collision if their movements remained unchanged. The number of conflicts for an intersection can be reduced by proper geometric design and traffic control measures. Good understanding of how and where conflicts occur is required for the proper geometric design and implementing efficient traffic control measures. The measures to reduce the conflicts will help to minimize the number and severity of accidents. Reliability of conflict point measurement is one of the problems associated with the traffic conflict technique.

V. CONCLUSIONS:

In this study, we will analyze various microscopic traffic parameters for different types of unsignalized intersections in India. This study is important as the traffic characteristics are very different in India from that in developed countries. Essentially, the unsignalized intersections in India are uncontrolled. Many observations and further evaluations will be made about the proportions of different classes of vehicles at the intersections. The lane changing analysis will help to ascertain the adoption of various lanes according to the vehicles' speed.

The conflicts of the vehicles and pedestrian will also be taken into consideration as pedestrians try to move in the shortest possible direction while crossing the intersection. This study will be of great help in developing performance evaluation and safety models for uncontrolled intersections.

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