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"Modeling Of Acceleration Behaviour Of Light Motor Vehicles"

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Abstract

Emerging as well as developed countries, traffic is characterized by a wide range of physical dimensions weights, dynamic characteristics with vehicles driving on any accessible area of the road space without regard for lane discipline. Dynamic traffic generates a variety of stains on road infrastructure, as well as affects road conditions (both structural and surface), which contributes to an increase in road accidents. Due to excessive traffic, jam density at intersection points, travel time (Time & Distance Headway) for the driver increases, which affects the overall cost of the journey because vehicles always start in place during jams that occur at Junctions. For better traffic flow, traffic simulation should be used to distribute traffic per lane.

The study and modeling of dynamic traffic having a multi-agent framework is the topic of this essay. Different keywords have been considered for the study, which can be valuable for improving traffic conditions and reducing accidents at intersections or crossings. For the distribution and analysis of traffic a vehicle characteristics and geometric design is considered. The researcher employed various types of modal such as single regime linear and dual, polynomial, and exponential modal. Intelligent transportation can be used to enhance traffic conditions by employing multi-agent systems that can be maintained or employed according to traffic conditions.

Keywords: Speed, Acceleration, Driver Behaviour, Geometric Design, Vehicle characteristics.

1. Introduction

The basic aspect which a person is used to in his daily life is traffic. There seem to be different types of trip such as (Residence, Workplace, Enjoying, Job etc.) the person use in his routing. It is crucial for him to achieve their aim. Several types of vehicles are used for transportation, depending on the driver safety and comfort. As per to their traffic intensity and movement capacity, heterogeneous and homogeneous traffic situations are frequent. These vehicles reach speeds varying from 30 to 100 kilometre per hour. Several types of vehicles possess different acceleration and deceleration attributes. Vehicles do not follow lane discipline and travel freely from across entire width of the route due to drastically varied physical dimensions, speeds, and acceleration and deceleration behaviour. Furthermore, these varied types of vehicles transiting on the same road network may receive varying levels of service. Due to their capacity to use smaller gaps with in stream, a major fraction of motor two wheelers and bicycles can go at speeds closer to their free speeds in larger traffic levels, while oversized vehicles are prone to significant speed reductions.

For realistic simulation and modelling of traffic streams, the study of regulatory systems, intersections, single intersections, and the intensity of traffic behaviour of different types of vehicles is required, as their acceleration and deceleration behaviour varies greatly depending on their power to weight ratios. Moreover, a driver's acceleration/deceleration pattern may be affected by factors such as age, driving experience, qualifications, and financial status. The impact of driver behaviour on speed, acceleration, and deceleration necessitated a better knowledge of driver attitudes and beliefs about speeding. Driver behaviour in terms of speeding, acceleration, and deceleration is also influenced by road characteristics such as lane width, number of lanes, horizontal and vertical alignment bends, and pavement performance. Driver speeding and acceleration/deceleration behaviour are also affected by higher performance vehicles equipped with advanced systems.

As a result, an effort has been made to investigate the multi-agent framework and also its behaviour for automobiles (like trucks, Bus, auto-rickshaw, cars, bike, HMV & LMV). The impact of driver attributes (such as education, age, and driving experience) on acceleration and deceleration behaviour has also been investigated.

2. Methodology

At a road junction, automobiles use their greatest acceleration potential to clear the crossroads as rapidly as feasible. The instantaneous capability of vehicles is rarely demonstrated due to the existence of vehicles with varying operating circumstances and engine capacity. To examine a vehicle's highest and normal acceleration behaviour, one must watch the vehicles in a different site where these limits are not present, but the whole acceleration spectrum of queued movers may be viewed, simulating signalized behaviour at junction.

As a result, the current investigation is likewise done under controlled conditions along a designated stretch of road, simulating queue leaders at signalized Junction. This study used an access controlled stretch of road with free flowing traffic, straight geometry, and a smooth road surface to maintain a constant impact of geometry and friction force. The research site was a two km long two lane Nagpur Katol Naka Highway on the outskirts of Kalmeshwar Town, roughly 15 km from Nagpur (India) that met the above criteria. On this section of road, light motor vehicles are utilized to travel short distances of 15-20 kilometers. Motorized vehicles' speed and position data are collected using a GPS system with 1 Hz data acquisition (data recorded once in every second).

Speed data is computed and acceleration data calculated for the analysis,

$a_2 = (v_2-v_1)/(t_2-t_1)$ -------- (1)

(Where 'a' is the acceleration, 'v' is the velocity, 't' is the time taken)

3. Data Collection & Analysis

A speed trajectory is collected at different interaction point (Junction) for light motor vehicle line Auto, Bike, Car & other etc.)

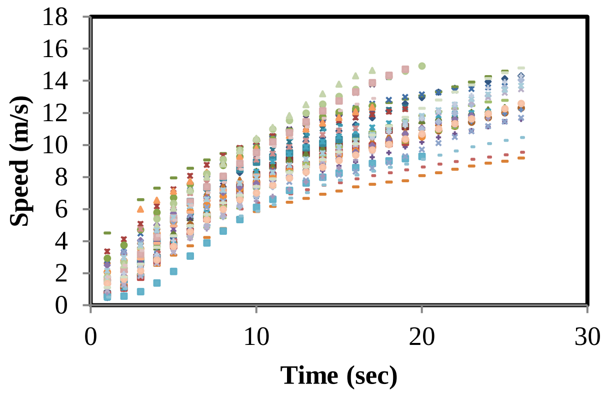

Figure 1(a): Speed versus time plot for all speed trajectories of bike

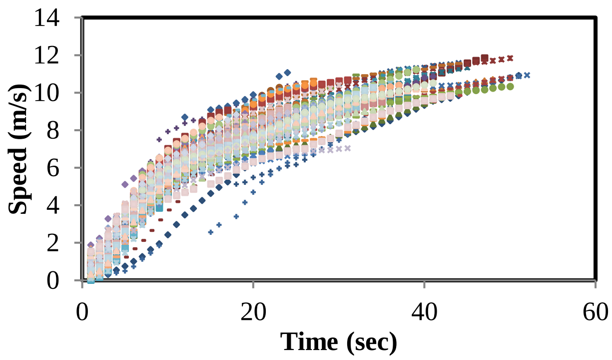

Figure 1(b): Speed versus time plot for all speed trajectories of auto-rickshaw

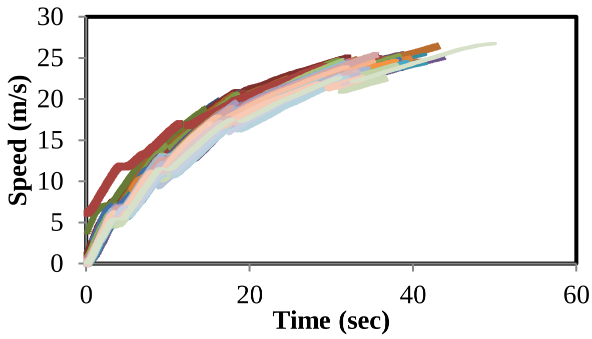

Figure 1(c): Speed versus time plot for all speed trajectories of petrol cars

Figure 1(a), 1(b), 1(c) shows a scatter plot of speed-time for all recorded light motor vehicles.

Further this raw data is analyzed by considering the speed-time connection.

Following Figure 2(a), 2(b), 2(c) shows the idealized speed-time connection, which is obtained by averaging additional speed measurements over every second.

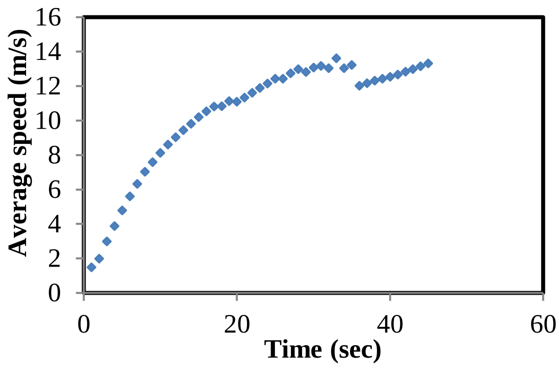

Figure 2(a): Average speed versus time plot for all accelerating phase trips of bikes

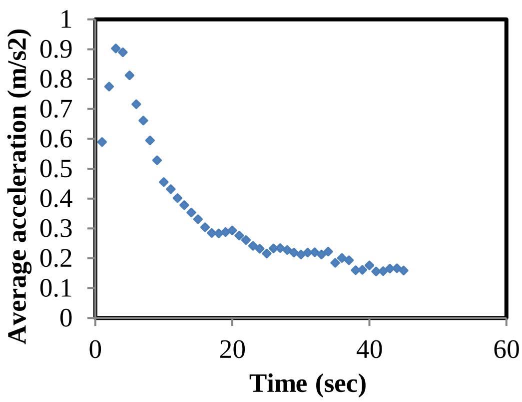

Figure 3(a): Average acceleration versus time plot for all accelerating phase trips of bikes

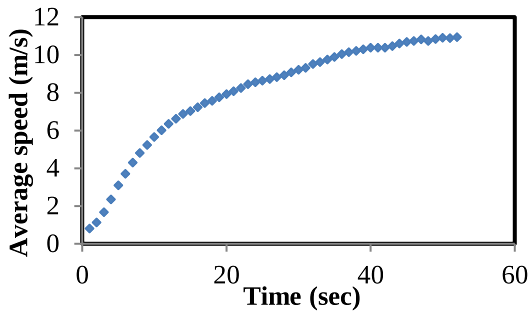

Figure 2(b): Average speed versus time plot for all accelerating phase trips of auto-rickshaw.

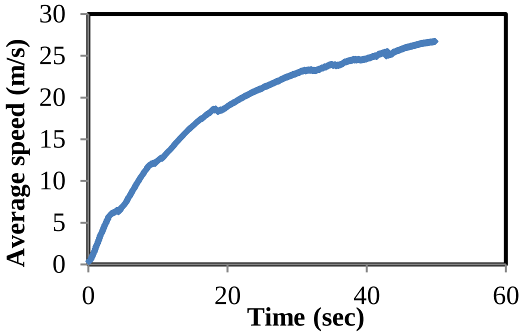

Figure 2(c): Average speed versus time plot for all accelerating phase trips of petrol car

It is observed that form the raw data collected, few trips is not started for the starting point and the initial value of speed seems to vary or start for one. This phenomena is occur due to the instrument is used is not able to capture the reading due to overlapping of readings.

Figure 3(a), 3(b), 3(c) shows the idealized acceleration-time connection, which is obtained by averaging additional acceleration measurements over every second.

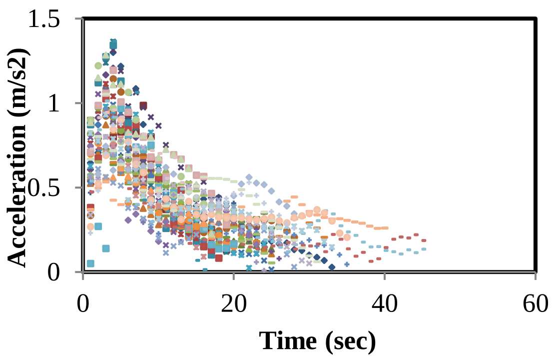

Figure 3(a): Acceleration versus time plot for all accelerating phase trips of bikes

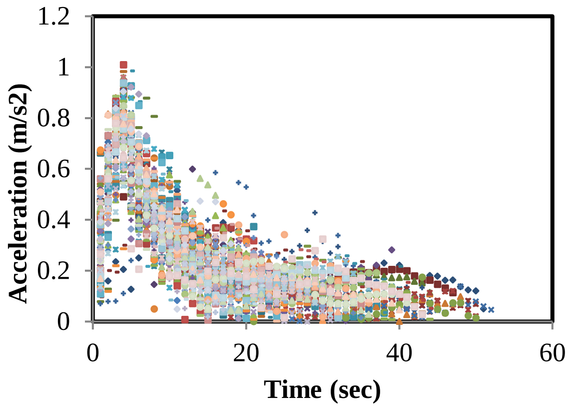

Figure 3(b): Acceleration versus time plot for all accelerating phase trips of auto-rickshaw

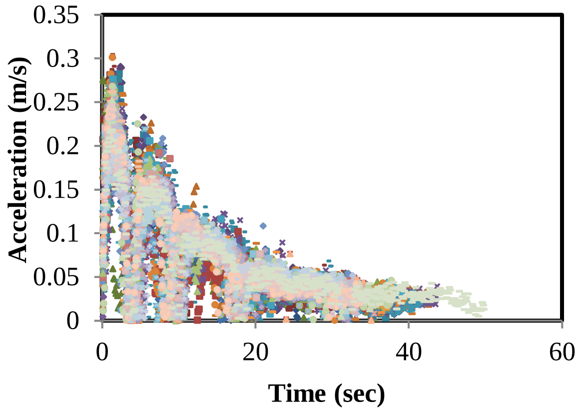

Figure 3(c): Acceleration versus time plot for all accelerating phase trips of petrol car

Figure 4(a), 4(b), 4(c) shows the average acceleration plot with respect to time which is obtained by averaging additional acceleration measurements over every second.

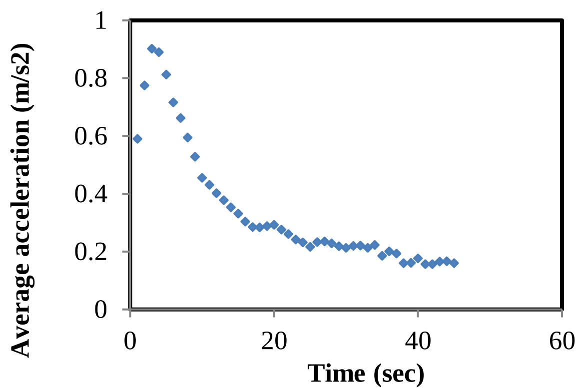

Figure 4(a): Average acceleration versus time plot for all accelerating phase trips of bikes

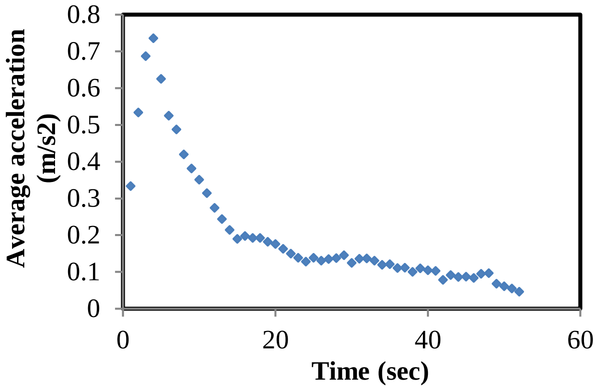

Figure 4(b): Average acceleration versus time plot for all accelerating phase trips of auto-rickshaw

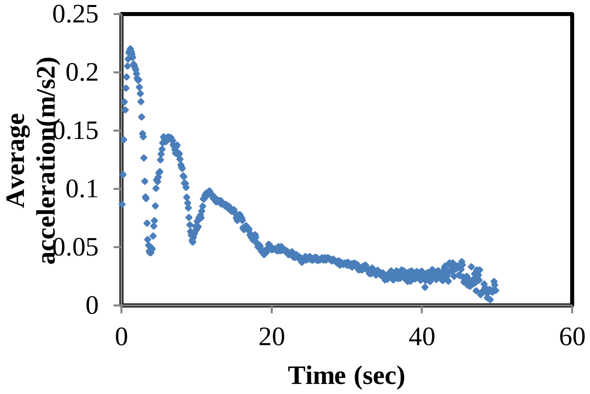

Figure 4(c): Average acceleration versus time plot for all accelerating phase trips of petrol car

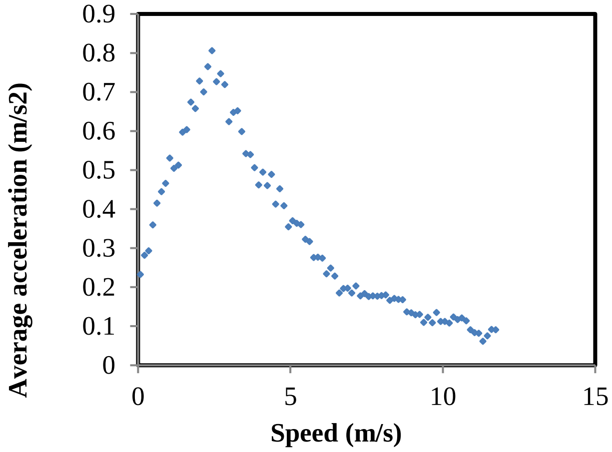

Figure 4(c): Average acceleration versus speed plot for all accelerating phase trips of auto-rickshaw

Figure 5(a), 5(b), 5(c) shows a plot containing speed versus acceleration plot.

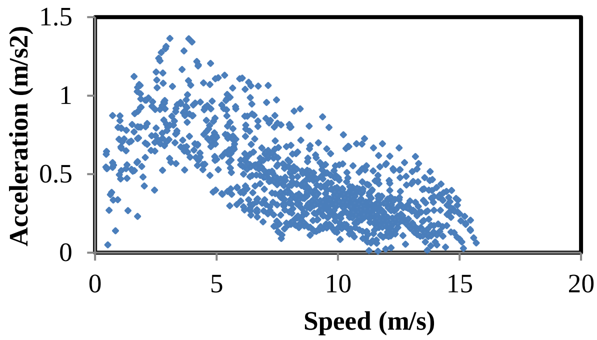

Figure 5(a): Acceleration versus speed plot for all accelerating phase trips of bikes

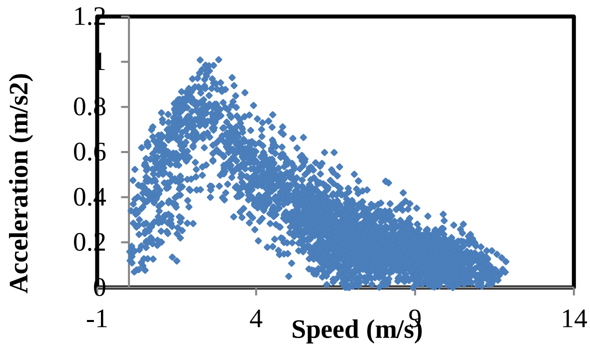

Figure 5(b): Acceleration versus speed plot for all accelerating phase trips of auto-rickshaw

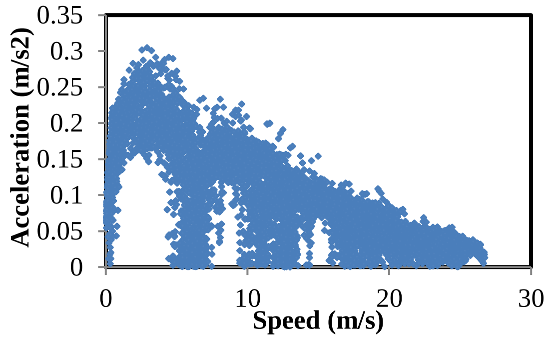

Figure 5(c): Acceleration versus speed plot for all accelerating phase trips of petrol car

4. Results

In this section study of acceleration behaviour of different type of LMV vehicles (Bike, Auto-rickshaw, Cars (petrol & diesel) has been explained. To explain the acceleration behaviour of these vehicles certain number of trips has been collected and used for analysis purpose. A single regime linear model is attempted to explain the traffic behaviour at intersection. The equation for linearly decaying model is y=ax+b and the coefficient of regression is specified in graph.

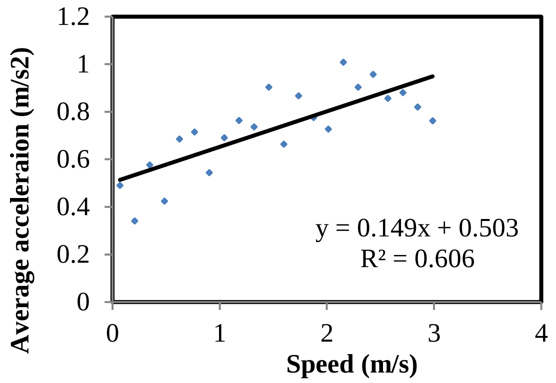

Figure 6(a): Plot of single regime linear model for average acceleration versus speed plot of all accelerating phase trips of bikes

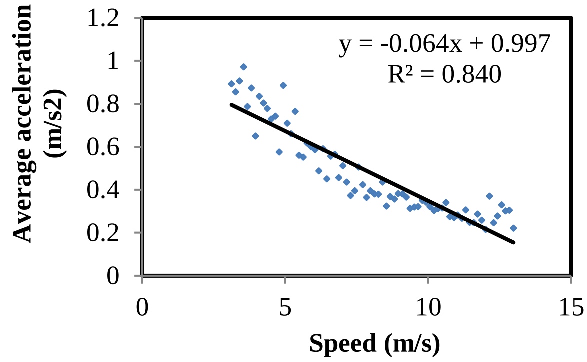

Figure 6(b): Plot of single regime linear model for average acceleration versus speed plot of all accelerating phase trips of bikes

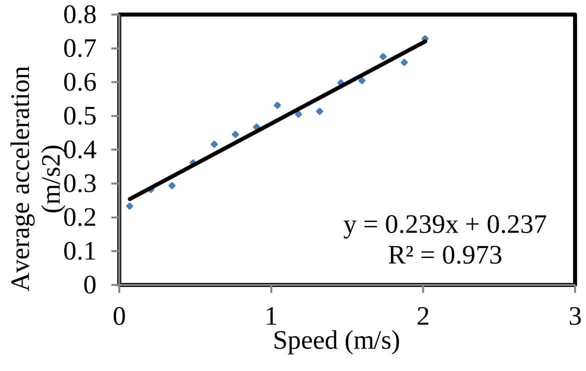

Figure 6(c): Plot of single regime linear model for average acceleration versus speed plot of all accelerating phase trips of auto-rickshaw

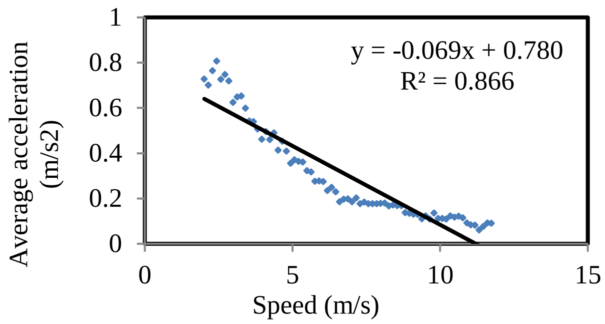

Figure 6(d): Plot of single regime linear model for average acceleration versus speed plot of all accelerating phase trips of auto-rickshaw

5. Conclusion

Acceleration values initially increases to maximum value at lower speed range and later on acceleration value decreases with the further increase in speed.

Present study evaluates single regime linear model explain the acceleration behaviour of vehicle satisfactory.

The models attempted for the analysis are found satisfactory and fairly accurate in predicting acceleration behaviour for the designing purpose.

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