Research Article

Lane Changing Nature Of The Driver Amidst Busy Roads In The Country

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Abstract:
Lane changing behavior is the subject being studied since the very beginning when transportation research started. From classical transportation problem to the new era of autonomous driving, lane change behavior has helped the intelligent transportation system great heights. The basic lane change behaviors of drivers on the road has helped in modelling complex traffic situations. This paper studies how many times the driver changes lane in different situations. A number of parameters are considered and the results are analyzed in tabular format. The time of day, location, type of road, mood of driver, type of vehicle, vehicular density, etc are considered. The spatial and temporal parameters are considered. The effect of lane change on local traffic is recorded.

Keywords: Intelligent Transportation system, lane-changing, anchoring effect, spatial and temporal.

I. INTRODUCTION

This Intelligent Transportation System is a very widely discussed topic over the world these days. It is of interest to both developed and developing countries. The developed countries have a low population due to which they are in dire need of autonomous vehicles. The developing countries need to work on the existing models because of the densely populated boundary. They need to work constantly looking for innovative ways to combat their growing need in the fixed existing resources. The lane change is being studied by researchers across the world over varied terrains, different time hours, type of lane, type of road, the difference of speed, varied density range, etc. are being considered in several papers. Some of them are being described over here. Various parameters are considered and their effect on lane change is considered. These are speed difference across lanes, density difference across lanes and lane change intensity. There is a requirement for data that contains a diverse range of driving behavior with a special need for more aggressive driving behavior. Vehicular interaction are captured by lane change. The paper is structured in various subheadings: experiment, result analysis, conclusion and future scope.

II. EXPERIMENT

A. Cane Choice of cities for experiment

The data collection site is in India. India is a developing nation. It is densely populated. The cities chosen are Gurgaon and Faridabad in Haryana. Gurgaon is the fastest growing city in India. It is an NCR city close to Delhi. It is an IT hub and has also been declared a millennium city. The other city Faridabad which is also an NCR city. Faridabad is the most populous city of Haryana. Both are industrially important cities.

B. Selection of roads for experiment

The two roads chosen were well travelled roads. First is Delhi Jaipur Expressway (195.1 km): National Highway: NH-48 the other is a major district road MDR137 (total length-25.08 km) connecting Gurgaon to Faridabad (most populous city of Haryana). Delhi Jaipur Expressway is 8 lanes road. The speed limit is 120 km/hour for the car. Gurgaon to Faridabad major district is 2 lanes road. The speed limit is 80km/hour for the car. One km distance of road on both the roads were kept under observation and studied.

C. ***Methods adopted***

The method adopted was by recording of the videos in the chosen 1 km stretch of both the roads. This method was done manually with the help of mobile phones. The data collected for the experiment was done three times a day: morning, afternoon and evening. The data was then processed and results were obtained. The video was converted into sequential images. The system on which work was carried is of 8GB RAM and uses a Windows operating system. The location, alignment, velocity, number and interval of each vehicle are noted. The number of its lead and rear vehicles in all images were provided. The statistical results were obtained.

D. ***Parameters taken into consideration***

The rate of lane change is defined as the number of times the driver changes lane during a time period and place. The important feature is the frequency of the lane change.

LCh.D is the average number of times a car changes lane while moving for one km.

The direct calculation of Lane Change per unit distance is from the formula:

$$LCh.D=LCh./n \qquad (1)$$

Where, LCh.=no of lane change by vehicles in the lane,

n= no. vehicles on that lane in the particular selected area,

The major concern in about lane change per distance. Speed is a microscopic factor affecting the lane change. Traffic density is a macroscopic factor affecting the lane density.

III. DATA ANALYSIS AND INTERPRETATION

TABLE I: GURGAON TO FARIDABAD LANE CHANGE DATA

SECTION	# OF VEHICLES	AVERAGE SPEED (km/hr)	# of LCh	LCh.D (veh^{-1} km^{-1})
1	811	52.1375	374	0.46925
2	638	71.3233	226	0.36480
3	803	50.24	332	0.42847

$$LCh.D = No.\ of\ LCh./unit\ km \qquad (2)$$

TABLE II: GURGAON TO MANESAR LANE CHANGE DATA

SECTION	# OF VEHICLES	AVERAGE SPEED (km/hr)	# of LCh	LCh.D (veh^{-1} km^{-1})
1	2349	57.22	985	0.42561
2	1550	68.54	543	0.39012
3	2411	55.97	1079	0.45376

TABLE III: LANE SPECIFIC LANE CHANGE DATA GURGAON TO FARIDABAD

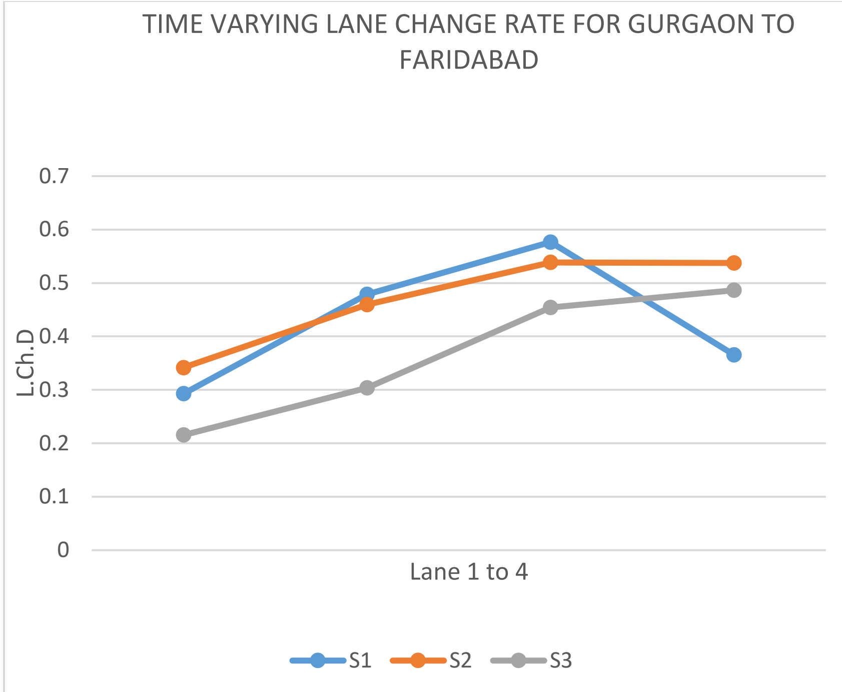
SECTION	# OF VEHICLES	AVERAGE SPEED (km/hr)	# of LCh	LCh.D (veh^{-1} km^{-1})
S1.Lane1	234	60.30	80	0.3418
S1.Lane2	209	58.07	96	0.4593
S1.Lane3	195	50.13	105	0.5384
S1.Lane4	173	40.05	93	0.5375
S2.Lane1	181	75.52	39	0.2154
S2.Lane2	168	70.42	51	0.3035
S2.Lane3	141	68.03	64	0.4539
S2.Lane4	148	50..1	72	0.4864
S3.Lane1	280	59.81	82	0.2928
S3.Lane2	215	53.07	103	0.4790
S3.Lane3	163	49.02	94	0.5766
S3.Lane4	145	39.06	53	0.3655

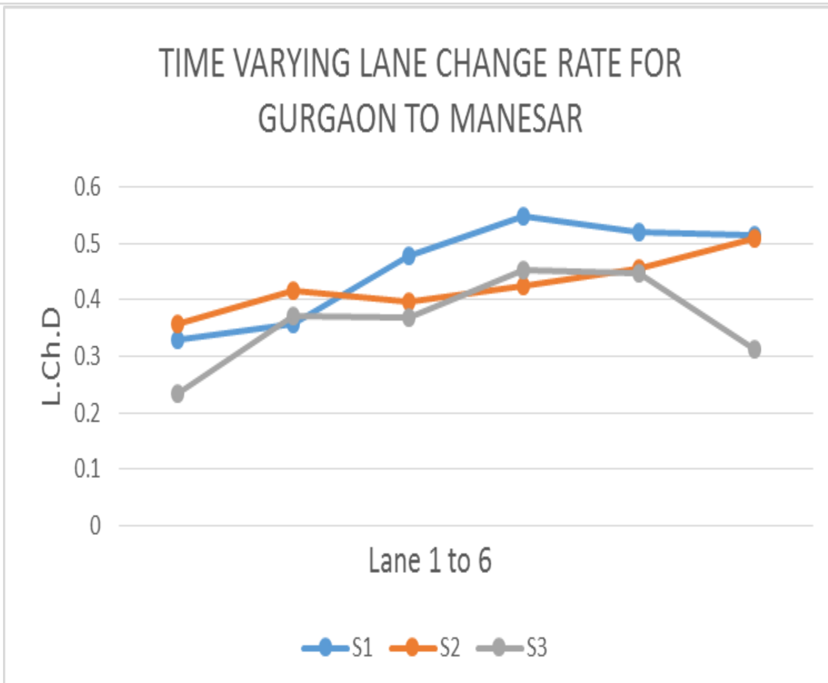
TABLE IV: LANE SPECIFIC LANE CHANGE DATA GURGAON TO MANESAR

SECTION	# OF VEHICLES	AVERAGE SPEED (km/hr)	# of LCh	LCh.D (veh^{-1} km^{-1})
S1.Lane1	456	68.03	163	0.3574
S1.Lane2	414	64.03	172	0.4154
S1.Lane3	458	60.15	181	0.3951
S1.Lane4	382	57.03	162	0.4240

S1.Lane5	326	52.06	148	0.4539
S1.Lane6	313	42.02	159	0.5079
S2.Lane1	356	79.09	83	0.2331
S2.Lane2	302	75.43	112	0.3708
S2.Lane3	258	70.42	95	0.3682
S2.Lane4	205	67.03	93	0.4536
S2.Lane5	195	60.95	87	0.4461
S2.Lane6	234	58.32	73	0.3119
S3.Lane1	480	67.01	158	0.3291
S3.Lane2	451	63.91	161	0.3569
S3.Lane3	423	59.35	202	0.4775.
S3.Lane4	362	55.05	198	0.5469
S3.Lane5	342	49.60	178	0.5204
S3.Lane6	353	40.91	182	0.5155

Table definition:
The lane number parameters used in both the tables specifies as follows: L1 represents the rightmost lane and L4 represents the leftmost lane.
Sections try to study the temporal relation of lane change.
S1: Morning time
S2: Afternoon time
S3: Evening time





III. CONCLUSION

The study involves the centrifugation of cane juice. The juice is subjected to centrifugation directly after milling of the cane. This treatment has been thought of particularly to clarify juices by removing the suspended particles, viz. silica, organic salts, etc. along with mud. In this paper the design pattern of the centrifuge has been shown. The effective factors such as removal of suspended particles, clarity and ICUMSA colour of the centrifuged juice has shown by the table and graph.

IV. RESULT AND ANALYSIS

Many inferences can be drawn from the table.

- For all sections lane change rate increases from left to right.
- Lane change rate at L1 is below average for all sections indicating anchoring effect by high-speed lane.
- The temporal effect of lane change can be seen by comparing the lane change of the sections which are nothing but the time of the day. The lane change is smaller in Section 2 as compared to lane change Section 1 and Section 3. This can be attributed to a lesser number of vehicles in Section 2 as compared to Section 1 and Section 3. Section 1 and 3 comprises of peak hours and section 2 is non-peak hours. The lane change in peak hours is higher which could be attributed to the rush of office going people.
- An increase in traffic density increases the lane change rate.
- Lane change is complicated and a result of non-linear interaction among these factors: speed and speed difference, acceleration, orientation, spacing between vehicles, density difference, adjacent lanes and their
- When the speed of the front car is very less than the speed of the subject car then it changes lane from a large distance. When speed difference is smaller than it changes lane as it is close.
- There are two lanes a target lane in which it enters or an alternate lane which was also available as an option. After lane change, speed in the original lane increases while speed in target lane decreases. The effect of lane change can be seen for 15-20 minutes on other vehicles. Lane change results in much more loss in speed for slow-moving lane than speedy lane.
- The major contributing factors are speed difference and traffic density.

V. CONCLUSION

The paper explored lane change behavior at different times of the day. The aggressive or rush driving results in an increased lane change rate. Lane change occurs for better ambient conditions. Aggressive drivers change lane regardless of speed. The effects of attracting, anchoring effect of the speedy lane i.e. rightmost lane. The spatial parameter shows a linear relationship with lane change. The temporal aspect highlights the traffic density effect on lane change. The speed of lane is a microscopic factor affecting lane change behavior between lanes. While density is a macroscopic factor that substantially affects the lane change numbers.

VI. FUTURE SCOPE

A traffic management model can be defined keeping in mind the lane change rate, its effect on local traffic. The study and analysis of lane change in manual driving helps in strategic planning for designing of autonomous driving. More microscopic and macroscopic factors could be considered and accuracy could be increased. This can be used to model a better traffic management and traffic modeling system for the future.

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