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The Evaluation of Lane-Changing Behavior in Urban Traffic Stream with Fuzzy Clustering Method

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Abstract: We present a method for The Evaluation of Lane-Changing Behavior in Urban Traffic Stream with Fuzzy Clustering Method. The trends for drivers Lane-Changing with regard to remarkable effects in traffic are regarded as a major variable in traffic engineering. As a result, various algorithms have presented most models of Lane-Changing developed by means of lane information and the manner of vehicle movement mainly obtained from images process not much attention is given to the characteristics of driver. Lane change divided into two parts the first one are compulsory lane including lane change to turn left or turn right. The second type of change is optional and lane change to improve driving condition. A low speed car is a good example, in this study, through focused group discussion method, drivers information can be obtained so that driver's personality traits are taken into consideration. Then drivers are divided into four groups by means of Algorithm clusters. The four Algorithms suggest that phase typed cluster is a more suitable method for drivers classification based on Lane-Changing. Through notarization of different type of scenarios of lane change in Iran following results released. The percentage of drivers for each group is 17/5, 35, 20 and 27/ %, respectively.

Keywords: Focus group discussions, fuzzy clustering, lane-changing, urban traffic

INTRODUCTION

Traffic jam is a major problem of an urban community. Congestion has deleterious effect on transportation, security and climate quality. One of the reason ends in traffic congestion is driver's Lane-Changing attracted transport engineers, various models have been developed. These models have been widely used in traffic assimilation to raise efficiency.

Lane-Changing is classified into two general types. First type is mandatory lane and second type is discretionary Lane-Changing to improve driving condition. Low speed cars are good example. Behavioral parameters play a role in Lane-Changing. As a result regarded as important variables in micros peak assimilation models. Since scores of surveys conducted so far within the scope of drivers behaviors in Iran most deals with drivers major behaviors. As a consequence considering drivers minor behavior models provided based on Iranian drivers to apply them to assimilation software. So far little attention paid to the drivers' behavioral effects to investigate most existing models they have taken express way Lane-Changing into account or centers on ramp hook-up area with the express ways. Although existing survey about Lane-Changing is not consistent with country conditions as a result of Iranian driver's different behavior.

There is no need for naturalization in Iran. The purpose of this study is to obtain information concerning driver's personality attributes. These attributes apply to Lane-Changing in urban settings. Having obtained such information classified drivers it is time to determine the percentage of each group and the likelihood of this Lane-Changing behavior. There are renovation classifications of Iranian drivers based on aggression degree increase VIN Lane-Changing scenarios according to country conditions and comparison with the cluster methods. The hypothesis of the study is phase typed cluster method is a suitable method for drivers lane classification. We are going to have an overview of existing resources within the scope of Lane-Changing models focused on cluster method and group discussion.

Overview of lane-changing models focused group discussion and clusters: Existing Lane-Changing models are generally considered in two stages. First stage target lane selection and second gap acceptance are taken into consideration both of which turned to formula in isolation

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through gathering field information or data. It is a challenging task to develop a lane change model for traffic assimilation because there is no clear method applied by most drivers in Lane-Changing decision. It plays a role in chasing and overtaking vehicles

Lane-changing models: Lane selection is a Lane-Changing models that is one of the top parameter gained outstanding improvement among the models of Lane-Changing the single popular model developed by Gips. Similar models developed by Halaei and executed through assimilation SITAR and CORSTIM.

Main structure of this model is within the area of lane selection trend is based on mandatory stages. These stages changes based on driver position with regard to the lane and exit spot.

Guidelines overwhelmed by the Lane-Changing are classified according to the mandatory Lane-Changing. in these models parameter replacement end in motive and impact on a language due to predetermined considerations due to face problems.

No respect is paid to the drivers behavior change in such a model. Gips model looks at two factors: necessity, desirability lane change security. Driver behavior controlled in two ways attempt to reach desired speed to be in an appropriate lane for rotating maneuver. Gipps, (1986) and Ahmed (1999)

Ahmed used a breakaway selection structure including three stages decision on Lane-Changing select target passing lane in target passing lane. He used a decision tree of a driver with regard to optional or mandatory Lane-Changing.

Daniel sun argued Lane-Changing using focused group discussion method. Various reasons for Lane-Changing have been assessed. The possibility of Lane-Changing in different scenarios has been achieved. Driver have been classified based upon K means cluster Algorithm.

Effective Lane-Changing and their significance have been calculated.

Focused group discussion: The discussion is a kind of interview with an organizer run the group based upon a prearranged manual. A group of 4 to 12 participants giving their opinions about the issue. Primary application of this group touches sociology.

The complexity of urban issues demands continuous use of understanding methods and scientific definition. Focused group discussion is useful technique and acceptable method within the scope of urban identification (Kitzinger, 1994; Wang, 2010) 3-2 clustering .

To find out this, we should care about the definition cluster is a set of objects similar in terms of one or several traits but bears little resemblance to other clusters. Clustering is a process during which data are placed in these clusters. We see maximum and minimum degree inside a different cluster r, respectively.

Since main purpose inside a cluster is to place participants in clusters with the most similar traits. No predetermined hypothesis is determined. Statistical tests are not needed. Tango *et al*. (2010) and Laval and Daganzo 2006)

Following abovementioned reasons, in order to analyses drivers Lane-Changing benefited from focused discussion group In Iran.

Classification of drivers based upon the manner of lane change, besides FGD Quality analysis. Little need felt for analysis. To do so, cluster algorithm is taken into account.

RESEARCH METHODOLOGY

There are three key questions here. A list of Lane-Changing enclosed with respective explanation. Having justified all first question raised participant were called to evaluate the possibility of lane change in each listed scenarios. Answers weighted from 1 to 5:

- We usually don't change lanes
- We sometimes change lane because we are more likely to change lanes
- We sometimes change lanes
- We change lanes very often
- I change lanes

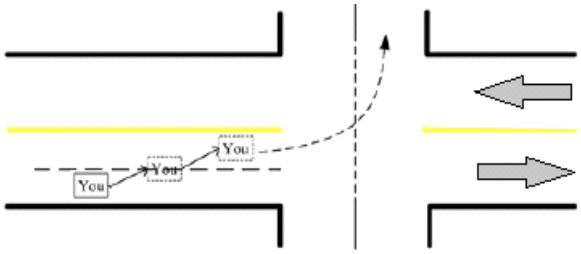
List of different lane-changing: The second question, the recognition of factors and effective factors on Lane-Changing concerned it was requested according to the list from interviews. In order to describe their behavior when changing lanes. An evaluation of three different significant was made. (Significant. very significant and less significant):

To calculate all points below relationship was used.
X_{ij} : It represents a point j participant belong to it
Si : Total points for factors from all participants

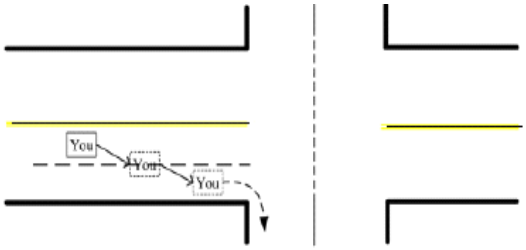
$$Si = \sum_{j=1}^{n} xij$$

X_{ij} : A very important factor
6-xij : A very important factor
3-xij : A less important factor
o-xij : No choice was made

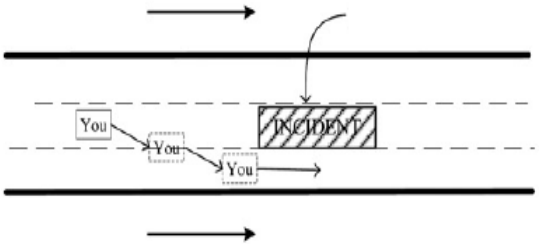
The third question concerned with the degree of drivers aggression. It plays a big role in their decision to



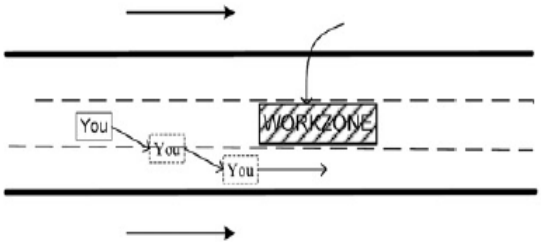
1- Lane-Changing due to turning on the left



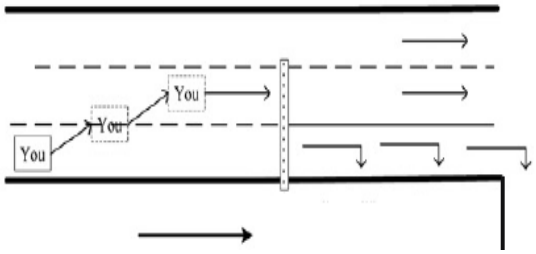
2- Lane-Changing due to turning on the right



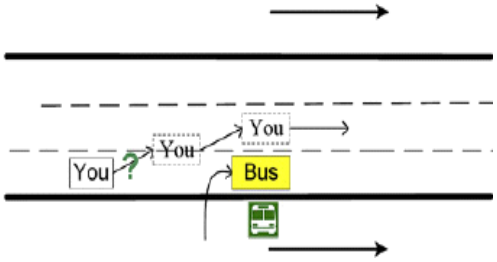
3- Lane-Changing due to collision with cars before them



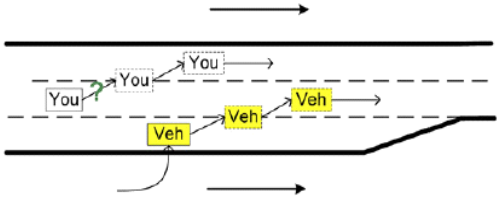
4- Lane-Changing due to road repair and workers



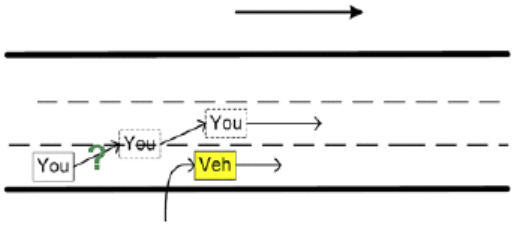
5- Lane-Changing due to the practical application of the road



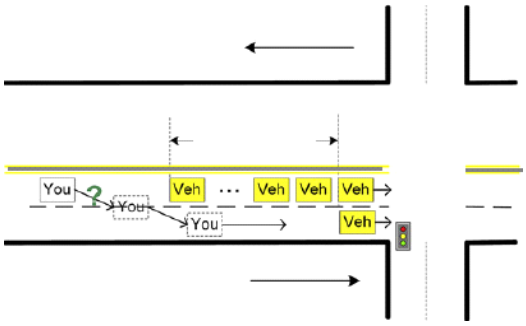
6- Lane-Changing due to a bus stops at a bus stop



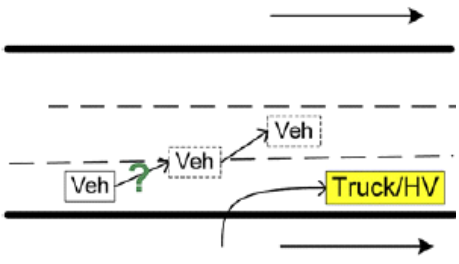
7- Lane-Changing due to a car joins your lane



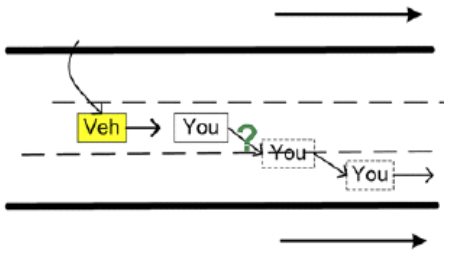
8- Lane-Changing due to a vehicle passes very slowly

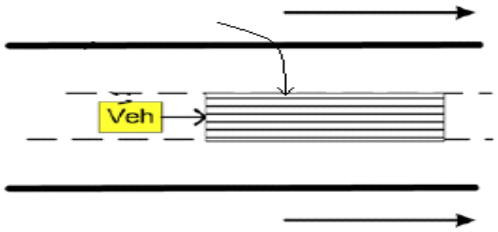


9- Lane-Changing due to a shorter queue in the neighboring lane



10- Lane-Changing to avoid driving behind a heavy car





11- Lane-Changing due to an inappropriate surface of the road

12- Lane-Changing due to a driver drives in an unusual way

13- Lane-Changing to passerby, bikers & motorcyclist
14- Lane-Changing on a lane with the U-Turn to avoid cars tending to turn a U-turn
15- Lane-Changing to avoid smog-ejecting cars
16- Lane-Changing to avoid cars reducing speed in front of you

Fig. 1: List of lane-changing

change lanes. Participant was called to evaluate their aggression based upon their record and experience. This degree is evaluated from 1-10 Fig. 1 shows the most conservative driver and the most aggressive drivers marked with 10.

Participant with of focused grouped: This research on 4 groups that one group includes 10. To make sure that the result is dependable. Participant was chosen from Karaj Government staff based on gender and driving experience and their familiarity with the lane So that the statistics include a variety of people. There were 8 women and 32 men out of 40 each possess three years driving record among whom 19 were driving more than 10 years.

Gathering information began since Ordibehesht to late Mordad in close consultation with Tehran Police based in Karaj.

The research benefits from focused group discussion 2 to 4 group opinions are obtained. Interview continues up to the level opinion is repeated. As a result, focused group discussion stopped.

Analysis of data: Having summarized data clustering method was used to break down data. To benefit from this method one should possess the data related to the research. Driver aggression level plays a role in modeling. According to obtained data of field study like exceeding limited speed change lane without indicators. It plays a role in classifying drivers. Then drivers are classified with regard to this level by means of Algorithm

ANALYSIS OF RESULTS

Having held meetings of focused discussion group following information have been obtained participant characteristics, the possibilities level of a lane-changing by each driver's effective factors on different issues of aggression level. To achieve results in relation to the goals of research different analysis were conducted classification of driver types.

Types of drivers categories: To do so we benefited from drivers record to divide participant into different groups. Then the variances of Lane-Changing possibilities have been taken into account in order to choose the most appropriate group.

In Table 1, reported result by each participant represented.

Columns 2 to 13 show Lane-Changing tables in different scenarios. Columns 15 to 16 show self assessment of drivers on the degree of aggression. The average has been shown in column 17. Table 1 possibility of Lane-Changing maneuver four different methods have been used to classify drivers including FCM. MEDIAN & AGNES, K-MEANS.

K-means algorithm: The Algorithm dare to find cluster centered based on information Eq. (2) shows how to minimize variance inside clusters:

$$\min V = \sum_{xj \in si} (xj - \mu i)^2$$

Xi : >the Degree of aggression of participant
K : The number of clusters
Si : Indicators of clusters
Mi : The center for cluster i

In relation z each xi are placed in i when it includes the minimum distance up to the center according to the point. There are different types of K-means algorithm. According to the algorithm following cluster are possible.

- If the number of cluster is k = I cluster center is 4/48
- If the number of cluster is k = z cluster center is 7/35, 4/1,

Table 1: The probability of execute lane-changing maneuver

			Probability of changing (1-5)													
The rate of invasive				12	11	10	9	8	7	6	5	4	3	2	1	Number of participants
6/5	7	6	4/1	4	5	4	3	5	5	3	5	4	5	2	4	01-01
3/5	3	4	3/4	3	4	4	2	5	5	4	4	2	2	1	5	01-02
3/5	4	3	2/7	2	3	3	4	5	3	1	4	3	2	1	1	01-03
5/5	6	5	3/6	4	3	2	5	5	3	4	4	3	4	2	4	01-04
8/5	9	8	4/4	5	5	5	5	5	4	4	5	4	5	2	4	01-05
2	2	2	2/4	1	4	3	2	3	4	3	3	1	1	2	2	01-06
6/5	7	6	4/1	5	5	4	2	5	5	3	5	4	5	2	4	01-07
5/5	5	6	4/5	5	4	4	5	5	5	5	5	3	5	3	5	01-08
6	6	6	3/9	4	4	5	3	4	4	4	4	4	4	3	4	01-09
8	8	8	4/1	5	5	4	2	5	5	3	5	4	5	2	4	01-10
6/5	6	7	3/6	4	3	4	2	3	3	5	4	4	3	4	5	02-01
5/5	6	5	3/8	4	3	5	4	5	5	5	4	4	4	2	3	02-02
4	4	4	2/1	2	4	2	4	2	2	2	2	1	2	1	1	02-03
6	6	6	3/7	3	4	3	5	5	5	5	3	2	2	5	2	02-04
10	10	10	4/3	5	5	5	5	3	3	5	5	2	5	1	5	02-05
4/5	5	4	3/8	4	5	5	5	5	5	1	5	1	5	2	2	02-06
3/5	4	3	3/7	4	4	5	3	5	5	5	4	1	4	2	3	02-07
5/5	6	5	3/1	3	5	2	3	4	4	2	2	2	4	2	3	02-08
2/5	3	2	3/3	2	3	5	4	5	5	5	2	1	4	2	4	02-09
8	8	8	3/4	4	5	3	1	5	5	4	3	2	5	1	4	02-10
7	7	7	4/3	5	5	3	2	5	5	5	5	4	5	4	4	03-01
6/5	6	7	4/3	4	4	5	4	4	4	3	5	5	5	3	5	03-02
6/5	7	6	3/8	5	4	5	3	2	2	3	5	2	5	3	4	03-03
8/5	9	8	4/8	5	5	5	5	4	4	4	5	5	5	4	5	03-04
5/5	6	5	5/0	5	5	5	5	5	5	5	5	5	5	5	5	03-05
5	6	4	5/0	5	5	5	5	5	5	5	5	5	5	5	5	03-06
3	3	3	2/4	2	4	4	2	1	1	2	2	1	4	1	2	03-07
3/5	4	3	3/7	3	4	5	5	5	5	5	2	3	4	1	2	03-08
5/5	6	5	3/6	2	4	5	3	5	5	2	2	4	5	2	4	03-09
4	5	3	3/4	4	3	4	4	4	4	2	5	1	5	3	3	03-10
3/5	4	3	4/0	5	4	1	5	5	5	5	5	5	5	1	2	04-01
4	4	4	3/8	4	4	4	5	5	5	3	5	2	5	2	2	04-02
5/5	6	5	4/7	4	5	5	5	4	4	4	5	5	5	4	5	04-03
8	8	8	5/0	5	5	5	5	5	5	5	5	5	5	5	5	04-04
6	6	6	2/8	3	4	3	1	1	1	3	5	1	3	2	3	04-05
2/5	3	2	1/9	2	2	2	4	2	2	2	2	1	2	1	1	04-06
10	10	10	4/4	5	5	5	5	1	1	5	5	5	5	2	5	04-07
3	3	3	2/5	2	2	2	5	2	2	5	2	1	2	3	2	04-08
6/5	6	7	3/3	3	5	1	2	1	1	5	4	2	4	3	4	04-09
3/5	4	3	4/5	4	5	5	5	5	5	5	5	1	5	4	5	04-10
	5/70	5/25		3/8	4/2	3/9	3/7	4/0	4/2	3/8	4/1	2/9	4/1	2/5	3/6	

- If the number of cluster is k = 3 cluster center is 8/71, 5/97, 3/37
- If the number of cluster is k = 4 cluster center is 8/71, 6/4, 5/33, 3/29
- If the number of cluster is 9/25, 7/75, 5/97, 4/3, 3/1
- If the number of cluster is 10, 8/25, 6/57, 5/59, 3/75, 2/6

To identify the most suitable cluster Table 1 is used. Lane-Changing possibility variance is calculated based on relation 3:

$$W(k) = \sum_{R1}^{R12} \sum_{i=1}^{k} \sum_{lj \in si} \left(lj - \mu i\right)^2$$

Li: Lane-Changing possibility in position I for j participant
K: Number of cluster for each cluster changing position.
Si: Indicative of I
Mi: The amount of W for

K = H(1) = 1/8, H(2) = 2/41, H(3) = 2/13, H(4) = 0/35, H(5) = 0/59

The lacks of similarity inside cluster are used to identify the number of clusters Relation 4 shows there is no similarity:

$$H(k) = (n - k - 1) \times \frac{W(k) - W(k+1)}{W(k+1)}$$

N: = The number of data to be clustered
K: = Number of clusters
W (K): = Evaluation

Equation (4) is used to calculate H for K = 1, 2, 3, 4, 5 and the amount of H (1)-1/8 H (2).

Considerable amount of loss is observed as if changing 3 clusters to four. The lack of similarity fades

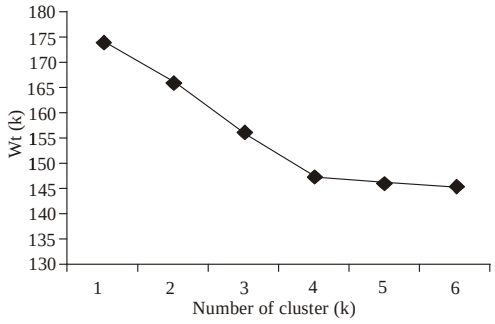


Fig. 2: Number of clusters on W (k)

Table 2: Different type of drivers based on FGD

Type of degree	Desire for high speed	Risk taking	Consequence	Selfishness
Group 1	No	No	No	No
2	Sometimes	No	Yes	No
3	Yes	Sometimes	Sometimes	Sometimes
4	Yes	Yes	No	Yes

although changing four clusters to five, similarity never goes away.

Figure 2, the results have been shown to identify the number of clusters, as it turns out, as the number of cluster exceeds 4. lack of similarity is not going to reduce tremendously. The proper number of cluster will be four, Fig. 2. The diagram for identify the number of clusters. Using the degree of driver's aggression as well as K-means. Cluster analysis participants are classified into four groups.

Classification of drivers based on FGD: Different types of Lane-Changing have been checked out in urban traffic. (Table 2).

Participant called for a full description of their perspective as to how to behave in different situation:

- Main Factors have been taken into account including willingness to take risk
- Desire for high speed
- Attention to consequences
- The degree of drivers selfishness

Group 1: It includes drivers no desire for lane change they hate risk taking

Group 2: Willing to drive fast careful about many details plays a role in Lane-Changing

Group 3: Drivers willing to reach better speed if opportunity arises they are willing to change lanes compared to previous group this group is more ambitious

Group 4: Drivers who are willing to change lanes as opportunity arises they do not pay attention to other drivers rights

Their primary goal is to drive fast. They change lanes at once willing to take risks giving no attention to others. Having classified all drivers we found out that FGP suits most participants. As shown in Table 3%6 participant are not classified in a uniform group participant 0(8-01, 05-03, 09-03, 03-04).

Are grouped in the place of group 2 instead of group 3 because they said they are ambitious to drive fast and would let one driver pass by.

Participant 07-02, 02-04 grouped in group 2 instead of one because they said they sometimes would like to drive fast but they are also careful about consequences. The differences in 6, above cases are because of the fact that groups are rather similar. Since they didn't follow K-Mean clustering the classification of drivers into group of four is accepted. To reduce the number of difference FGP, AGNES & MEDIAN will be in use.

Agnes clustering: In this Algorithm data is placed later combined step by step it is based on a predefined criterion it is to be continued as the number of reach the favorite number. The number of cluster is 4. Clustering is possible according to using Agnes algorithm.
The following result is released:

- The first cluster drivers whose aggression level $_1 \leq$ 3/5 C2 $\leq$
- The second cluster drivers whose aggression level $_2 \leq$ 5/5C4 $\leq$
- The third cluster drivers whose aggression level $_3 \leq$ 8/5 C6 $\leq$
- The fourth cluster drivers whose aggression level $_4 \leq$ 10 C9 $\leq$

Median distance clustering: It is called exclusive clustering if a cluster is mixed with big one average point is the bigger cluster average. It is not favorable in a few applications. Two types of clustering lack above mentioned problem Result of clustering in Median Distance Method:

- The first cluster drivers whose aggression level is $_1 \leq$ 3/5 C2 $\leq$
- The second cluster drivers whose aggression level is $_2 \leq$ 5/5C4 $\leq$
- The third cluster drivers whose aggression level is $_3 \leq$ 8/5 C6 $\leq$
- The fourth cluster drivers whose aggression level is $_4 \leq$ 10 C9 $\leq$

As it turns out, Agnes clustering and Median are similar.

It is vivid that cluster result of Agnes and Median look alike. It is because of distribution of analyzed data

Table 3: Results from the four-way clustering) K-mean, Agnes, Median, FCM

	Agnes			The rate of invasive					
FCM	Median	K-mean	FGD	-	-	-	Number of participants	Experience certificate	Row
3	3	3	3	6/5	7	6	01-01	7	1
1	1	1	1	3/5	3	4	01-02	4	2
1	1	1	1	3/5	4	3	01-03	3	3
2	2	2	2	5/5	6	5	01-04	10	4
4	*3	4	4	8/5	9	8	01-05	15	5
1	1	1	1	2	2	2	01-06	3	6
3	3	3	3	6/5	7	6	01-07	11	7
3	*2	*2	3	5/5	5	6	01-08	8	8
3	3	3	3	6	6	6	01-09	5	9
4	*3	4	4	8	8	8	01-10	17	10
3	3	3	3	6/5	6	7	02-01	18	11
2	2	2	2	5/5	6	5	02-02	7	12
*2	*2	1	1	4	4	4	02-03	5	13
3	3	3	3	6	6	6	02-04	11	14
4	4	4	4	10	10	10	02-05	15	15
2	2	2	2	4/5	5	4	02-06	8	16
2	*1	*1	2	3/5	4	3	02-07	25	17
2	2	2	2	5/5	6	5	02-08	4	18
1	1	1	1	2/5	3	2	02-09	17	19
4	*3	4	4	8	8	8	02-10	19	20
3	3	3	3	7	7	7	03-01	12	21
3	3	3	3	6/5	6	7	03-02	3	22
3	3	3	3	6/5	7	6	03-03	12	23
4	*3	4	4	8/5	9	8	03-04	8	24
3	*2	*2	3	5/5	6	5	03-05	6	25
2	2	2	2	5	6	4	03-06	10	26
1	1	1	1	3	3	3	03-07	3	27
1	1	1	1	3/5	4	3	03-08	5	28
3	*2	*2	3	5/5	6	5	03-09	15	29
*2	*2	1	1	4	5	3	03-10	6	30
1	1	1	1	3/5	4	3	04-01	15	31
2	2	*1	2	4	4	4	04-02	3	32
3	*2	*2	3	5/5	6	5	04-03	11	33
4	*3	4	4	8	8	8	04-04	9	34
3	3	3	3	6	6	6	04-05	14	35
1	1	1	1	2/5	3	2	04-06	3	36
4	4	4	4	10	10	10	04-07	17	37
1	1	1	1	3	3	3	04-08	11	38
3	3	3	3	6/5	6	7	04-09	18	39
1	1	1	1	3/5	4	3	04-10	18	40
5%	30%	15%	the difference		5/70	5/25	Avg		

are similar. Since drivers behavior are alike the result is reasonable.

There are twelve differences between driver's classification and FGD method. So Agnes and Median do not suit drivers cluster according to Lane-Changing behavior. Having considered three clustering methods and their comparison with the FGD data. It was supposed to employ phase typed cluster to measure credibility. Since the three method are exclusive each cluster devoted to data like Agnes, K-Means, Median. Data belong to several clusters is a sample of fast drivers.

FCM clustering: In this method the degree of any cluster is identified $U = [u_{ij}]_c = [\bar{u}_1, \bar{u}_2, ..., \bar{u}_n]$ c equals the number of cluster and n equals the number of stuff. There are two main limitations First no cluster should be empty. The second is normalization. Total number of membership degree should correspond to one.

FCM is attached. Then 14 stages are repeated. The result of cluster is summed up in 4 ways. Table 3 the result of cluster in 4 methods as shown in Table 3. We have reached a desired result using FCM because there are two methods in these methods whereas K-Means include six differences Agnes sand Median enjoy 12 differences. The FGD difference with K-Means is 15% and there are 30% differences with Agnes Median the difference result of FGD with FCM is only 5%. Therefor FCM is a suitable method because it is more accurate and more exact.

The likelihood of variance maneuver: The possibility of different maneuver in cluster C1, C2, C3 and C4, 14-7

Table 4: The possibility of change for different groups of drivers

The difference	Frequency probability level 5	4	3	2	1	Number of drivers	Ci	Types of changes	Percent chance of changing the line	Frequency probability level 1	2	3	4	5	Number of drivers	Ci	Types of changes
3/8	4	2	2	2	0	10	C1	R7	2/6	2	1	0	5	2	10	C1	
3/8	3	2	3	1	0	9	C2		2/9	1	1	4	2	1	9	C2	
4/5	9	4	0	1	0	14	C3		4/1	5	7	1	1	0	14	C3	
4/7	5	2	0	0	0	7	C4		4/6	4	3	0	0	0	7	C4	
3/8	6	0	1	2	1	10	C1	R8	1/7	0	1	1	2	6	10	C1	
4/0	5	2	0	1	1	9	C2		2/9	2	1	1	4	1	9	C2	
3/9	7	3	1	1	2	14	C3		3/2	2	3	5	4	0	14	C3	
4/1	4	1	1	1	0	7	C4		2/4	1	1	0	3	2	7	C4	
3/8	4	3	0	3	0	10	C1	R9	3/1	2	3	0	4	1	10	C1	
4/2	4	3	2	0	0	9	C2		4/2	4	4	0	1	0	9	C2	
3/5	5	1	4	4	0	14	C3		4/4	9	2	2	1	0	14	C3	
4/0	5	0	0	1	1	7	C4		5/0	7	0	0	0	0	7	C4	
3/4	3	2	2	2	1	10	C1	R10	1/9	1	0	2	1	6	10	C1	
3/8	4	2	0	3	0	9	C2		2/2	1	1	1	2	4	9	C2	
4/0	6	4	3	0	1	14	C3		3/5	3	6	1	3	1	14	C3	
4/6	5	1	1	0	0	7	C4		3/9	3	2	0	2	0	7	C4	
3/5	1	5	2	2	0	10	C1	R11	3/1	2	2	1	5	0	10	C1	
4/0	3	3	3	0	0	9	C2		4/0	4	3	0	2	0	9	C2	
4/4	6	7	1	0	0	14	C3		4/4	9	3	1	1	0	14	C3	
5/0	7	0	0	0	0	7	C4		4/7	6	0	1	0	0	7	C4	
2/6	1	1	2	5	1	10	C1	R12	3/7	5	1	1	2	1	10	C1	
3/8	1	6	1	1	0	9	C2		3/7	4	1	1	3	0	9	C2	
4/0	5	5	3	1	0	14	C3		3/9	6	2	5	1	0	14	C3	
4/9	6	1	0	0	0	7	C4		3/9	3	2	1	0	1	7	C4	

Table 5: Factors lane-changing

The total weight Si	Frequency Very important: 6	Important: 6	Low importance: 3	Effective factors	Changing scenario
225	16	11	5	Traffic congestion in the left lane	Turn left
219	14	12	7	Distance to the local circulation of pedestrian crossing	
210	15	12	1	Permissible speed / slow motion	
189	10	15	3	Traffic lights	
237	21	6	4	Distance to the local circulation of pedestrian crossing	Turn to right
231	15	12	8	Permissible speed / slow motion	
228	16	12	4	Familiar with the route	
207	14	13	1	Traffic congestion	
198	10	16	4	Pedestrian	
279	26	7	1	Change the vehicle in front	Accident
240	17	10	9	Traffic congestion	
228	16	12	4	Distance to the crash site	
213	17	10	0	Road to rescue vehicles	
201	15	11	0	Effects of surviving a crash	
240	18	12	2	Traffic congestion and queues ahead	Bus stop
234	15	13	7	The next station status	
210	15	12	1	Distance to bus stop	
189	10	15	3	State (state) where the moment	
180	11	10	7	The number of passengers at the station	
171	13	8	2	Distance to next turn	
249	23	7	0	Density at the target line	Join other vehicle
240	17	10	9	Permissible speed / slow motion	
228	16	12	4	How to join	
216	18	9	0	Distance to next turn	
210	15	11	3	Type of vehicle	
297	25	12	0	Distance to next turn	Tardigrade auto
288	23	13	1	Control by the police	
240	17	10	9	Density at the target line	
237	19	11	0	Mode at the moment and the rush	
195	16	8	1	Permissible speed / slow motion	

Table 5: (continue)

The total weight Si	Frequency Very important: 6	Important: 6	Low importance: 3	Effective factors	Changing scenario
300	26	11	0	The queue length in the other lines	Queue length
294	24	13	0	Distance to next turn	
267	19	14	4	Number of crossing lines	
252	18	12	6	Weather conditions / night and day	
270	21	12	3	Permissible speed / slow motion	Heavy vehicle
255	17	15	4	Traffic congestion in all lines	
225	18	9	3	Weather conditions / night and day	
264	23	9	1	Permissible speed / slow motion	The car chase
258	22	10	0	Distance to next turn	
237	17	12	4	Traffic congestion in all lines	
225	16	12	3	Mode (status) at the moment	
252	18	15	0	Distance to next turn	Pavement conditions
246	18	14	0	Along with poor pavement	
243	21	7	4	Differences in other lines of pavement	
237	15	13	8	Traffic congestion on other lines	
222	16	11	4	Weather conditions / night and day	

based on FCM, respectively shown in the third column of Table 4 that shows the frequency of possibility level according to the type of drivers. For example the percentage of possibility to handle change for each four group C1, C2, C3 and C4 is 6/2، 9/2، 1/4 , 6/4, respectively. These figures mean c 4 drivers aggression level is the highest they are likely to change lanes to pass by a stopped bus. It is expected for such result s and that is right. R, 4R, 5R, 7R, 10R, 11R, 12R3 will be observed.

For R2 reasons The possibility level for group C1, C2, C3 and C4 are 1/7, 2/9, 3/2 and 2/4, respectively.

When driver's aggression level is at the highest level they are unwilling to let other drivers pass. If they do so they sometimes reduce speed to prevent vehicles to join their lanes. On the other hand, more conservative drivers reduce speed since they do not take risk but C2 and C3 drivers are likely to change lane a lot.

R6 and r 8 have got similar interests. The result of such analysis is that possibility level for Lane-Changing is low depends on drivers and scenario. It is more likely to change lanes. Drivers with high aggression spirit. While other scenarios such f = drivers are not willing to change lane. Lane-Changing modeling, both types of drivers and Lane-Changing scenarios should be taken into account.

Effective factors on lane-changing scenarios: Other important goal is to gain important factors have been evaluated by participants. Table 5 presents impressive factors on driver's Lane-Changing. Such factors derive from FGD if a factor is not selected from n participant total frequency is reduced to 40-n.

For example in Lane-Changing scenarios four important factors have been identified Distance to subsequent rotating movement, unduly pavement lane, pavement quality in other lanes.

CONCLUSION

Following comes the result of the research:

- There are four factors willing to drive fast, take a risk, driver's selfishness, consequence.
- According to personal information, behavior trait, the manner of performance
- Difference percentage of FGD, K-Means, Agnes, Median and FCM is 15, 30, 30 and 5%, respectively. As a result the research is approved and phase clustering is a suitable way for drivers classification based on Lane-Changing.
- Effective factors on each lane change scenarios is achieved through FGD. Few factors like traffic congestion & speed for each scenario while other factors confined to specific scenarios.
- Drivers percentage for each type: first, second, third, fourth is 20, 27/5, 17/5, 35%, respectively.

The result of the research in traffic microscope assimilation software is used to better assimilation driver's behaviors. The classification of drivers into four types according to the manner of behavior bring about accuracy of lane change models. For example software is valid for 7 violating drivers but it is likely to describe 4 drivers in traffic as a result of the percentage of participant of any type of drivers is according to four groups the percentage of each group is defined for software.

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