

Vehicle Track Control

Debnath Bhattacharyya, and Tai-hoon Kim

Abstract— Lane Design for Optimal Traffic (LDOT) is considered as an effective tool to improve the level of traffic services. It integrates the newly emerged IT technologies with the traditional traffic engineering. By providing the traffic partners with better communications, LDOT can significantly boost the traffic managements and operations. Meanwhile, however, the deployment of the LDOT applications often involves a huge amount of investments, which may be discouraging in a challenging economy like now. Therefore how to increase the cost-effectiveness of the LDOT systems is a widely concerting issue. There has been a limited research effort on the optimization of the LDOT systems.

Lane Design for Speed Optimization (LDSO) presents a new critical lane analysis as a guide for designing speed optimization to serve rush-hour traffic demands. Physical design and speed optimization are identified, and methods for evaluation are provided. The Lane Design for Speed optimization (LDSO) analysis technique is applied to the proposed design and speed optimization plan. Lane Design for Speed Optimization can robustly boost the speed management and operations. Therefore how to increase the Speed optimization of the Lane is widely concerting issue. There has been a limited research effort on the optimization of the LDSO systems

Design of Non Accidental Lane (DNAL) presents a new optimal lane analysis as a guide for designing of non accidental lane to serve better utilization of lane. The accident factors adjust the base model estimates for individual geometric design element dimensions and for traffic control features. The Design of Non Accidental Lane (DNAL) analysis technique is applied to the proposed design and speed optimization plan. Design of Non Accidental Lane can robustly manage and operations on lane for avoiding accident. Therefore how to increase the Speed optimization with non accidental zone of the Lane is widely concerting issue. There has been a limited research effort on the optimization of the DNAL systems.

Keywords— DNAL, Lane, Buffer, Traffic, Geometric, System.

I. INTRODUCTION

THE traditional optimization methodology for the traffic systems often replies on the analytical models. It is questionable due to the facts as follows:

- a. The traditional methodology often ignores driving behaviors (e.g., car following, lane changing). However, these “trivial” driving behaviors turned out to be decisive in many cases.
- b. Many traditional optimization algorithms were designed to optimize deterministic problems and therefore they cannot tackle the inherent randomness in the traffic systems. As a result, the solutions suggested by the traditional optimization algorithms cannot answer such

questions as “how robust is the optimal solution to avoid congestion?” or “How much likelihood will the optimal solution fail if something unexpected occurs?”

The purpose of this essay is to address these two issues by introducing the retrospective approximation technique into the optimal LDOT design. We structure this paper into following parts:

- a. in the first part, we analyze the major issues residing in the latest practice of the optimization of traffic systems;
- b. in the last part, we discuss the possible applications of this new technique with probabilistic study and new algorithm.

The challenges of the non accidental lane design system are to move traffic safely and efficiently. Although highways and motor vehicles are designed to operate safely at speed. The purpose of our investigation was to create predictive models for different types of accidents on lane, based on infrastructural design and traffic intensity. In this paper, the results for all injury accidents and fatal accidents are discussed.

The first investigation was the identification of different zones on the lane. Three major zones on the lane were defined:

- a. Cross zones.
- b. Entry zones and
- c. Exit zones.

Many traditional Non accidental algorithms for lane were designed to optimize deterministic problems and therefore they cannot tackle the inherent randomness in the traffic systems.

The solutions suggested by the traditional Non accidental algorithms for lane cannot answer such questions as “how robust is the optimal solution to avoid accident?” or “How much probability will the optimal solution fail if something unexpected occurs?”

The purpose of this article is to address these three issues by introducing the showing approximation technique into the optimal DNAL design. We structure this paper into 2 parts:

- a. in the first part, we analyze the major issues residing in the latest practice of the accidental lane; and
- b. in the last part, we discuss the possible applications of this new technique with probabilistic study and new algorithm.

II. EARLIER WORKS

C.J. Messer and D.B. Fambro, 1977, proposed a new critical lane analysis as a guide for designing signalized intersections to serve rush-hour traffic demands. Physical design and signalization alternatives were identified, and methods for evaluation were provided. The procedures used to convert traffic volume data for the design year into equivalent turning movement volumes were described, and all volumes were then

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converted into equivalent through-automobile volumes. The critical lane analysis technique was applied to the proposed design and signalization plan. The resulting sum of critical lane volumes was then checked against established maximum values for each level of service (A, B, C, D, E) to determine the acceptability of the design. They provided guidelines, a sample problem, and operation performance characteristics to assist the engineer in determining satisfactory design alternatives for an intersection [1].

Airbags and roof reinforcement are passive safety devices that have helped save the lives of many crash victims. Today, leading automobile manufacturers and suppliers have added active safety features that help prevent crashes and rollovers from occurring in the first place.

According to the U.S. Department of Transportation, more than 18,000 automobile-related deaths are caused by unintended lane departures. To address this problem, several companies and academic institutions are designing video-based active safety systems. These systems monitor lane markings and send the driver an audio or tactile warning when the car is about to leave the road or deviate from its lane.

Video-based active safety systems must be evaluated and optimized under different conditions. Using text-based specification and hand coding to evaluate a set of conditions takes a lot of time, and may therefore prove impractical.

Model-based design substantially reduces development and optimization time by putting a system model at the center of the design process. The model is used to define specifications, evaluate design and system performance, automatically generate code, perform hardware-in-the-loop testing, and generate a test harness for production hardware.

David Jackson, in November 2006, have explained how model-based design has reduced the time required to develop and optimize a video system that monitors unintended lane departure.

Developing lane-departure systems are challenging. Wear patterns in the road, shadows, occlusion by other vehicles, changes in the road surface and other features make the identification of lane markers difficult. Another problem is that there are many different ways of marking roads in the world [2].

The social, environmental, and economic context in which today's highways are designed demands trade-off assessments that require more explicit and quantitative consideration of safety issues than is possible with available tools. The Federal Highway Administration's (FHWA) Interactive Highway Safety Design Model (IHSDM) is a suite of software analysis tools for evaluating safety and operational effects of geometric design decisions on two-lane rural highways. IHSDM will provide highway project planners, designers, and reviewers in State and local departments of transportation (DOTs) and engineering consulting firms with a suite of safety evaluation tools to support these assessments.

The 2003 release of IHSDM culminates a multiyear research and development effort. Highway project decision

makers now can use IHSDM to check designs for conformance with design policy, estimate their expected safety performance, and diagnose potential safety and operational issues throughout the highway design process [3].

The study on IHS has made much achievement abroad, but the research work done by RIOH here is the first experiment in China. This paper describes the design and implementation of the control system for lane-following on IHS with magnetic nails embedded in, consisting of several parts of on-board computer control system, roadway guidance establishment, on-board offset sensor, servo device for steering wheel and so on. Based on the control system designed here, the experiment results have reached and exceeded the requirements of ISO/TC204 WG14 standardization working draft for lane departure warning systems [4].

This paper proposed by Jake Kononov, Barbara Bailey, and Bryan K. Allery, first explores the relationship between safety and congestion and then examines the relationship between safety and the number of lanes on urban freeways. The relationship between safety and congestion on urban freeways was explored with the use of safety performance functions [SPF] calibrated for multilane freeways in Colorado, California, Texas. The focus of most SPF modeling efforts to date has been on the statistical technique and the underlying probability distributions. The modeling process was informed by the consideration of the traffic operations parameters described by the Highway Capacity Manual [5].

H Ludvigsen, Danish Road Directorate, DK; J Mertner, COWI A/S, DK, 2006, published, Differentiated speed limits allowing higher speed at certain road sections whilst maintaining the safety standards are presently being applied in Denmark. The typical odds that higher speed limits will increase the number of accidents must thus be beaten by the project. The Danish Road Directorate has been asked by the Ministry of Energy and Transport based on a request from parliamentarians to suggest an approach to assess the potential for introduction of differentiated speed limits on the Danish state road network.

A pilot project was carried in late 2006 and the entire state network will be assessed during the first half of 2007 - first of all to identify where speed limits may be raised.

The paper will present the methodology and findings of a project carried out by the Danish Road Directorate and COWI aimed at identifying potential sections where the speed limit could be increased from 80 km/h to 90 km/h without jeopardising road safety and where only minor and cheaper measures are necessary. Thus it will be described how to systematically assess the road network when the speed limit is to be increased [6].

In the Operation and Safety of Right-Turn Lane Designs's objectives of this research by the Texas Department of Transportation were to determine the variables that affect the speeds of free-flow turning vehicles in an exclusive right-turn lane and explore the safety experience of different right-turn lane designs. The evaluations found that the variables affecting

the turning speed at an exclusive right-turn lane include type of channelization present (either lane line or raised island), lane length, and corner radius. Variables that affect the turning speed at an exclusive right-turn lane with island design include: (a) radius, lane length, and island size at the beginning of the turn and (b) corner radius, lane length, and turning-roadway width near the middle of the turn. Researchers for a Georgia study concluded that treatments that had the highest number of crashes were right-turn lanes with raised islands. This type of intersection had the second highest number of crashes of the treatments evaluated in Texas. In both studies, the “shared through with right lane combination” had the lowest number of crashes. These findings need to be verified through use of a larger, more comprehensive study that includes right-turning volume [7].

Elizabeth Alicandri and Davey L. Warren, January/February 2003 – vol. 66 . No .4 , proposed a new The twin challenges of the transportation system are to move traffic safely and efficiently. Although highways and motor vehicles are designed to operate safely at speeds traveled by most motorists, almost one in every three traffic fatalities in the United States is related to speeding, either involving exceeding the posted speed limit or driving too fast for conditions. In 2000, more than 12,000 lives were lost in speeding-related crashes, and more than 700,000 people were injured. The National Highway Transportation Safety Administration (NHTSA) estimates that speeding-related crashes cost society \$28 billion annually. That's \$53,243 per minute, or almost \$900 per second. Because speeding is a complex problem involving many factors—personal behavior, vehicle performance, roadway characteristics, and enforcement strategies—the U.S. Department of Transportation (USDOT) organized a multidisciplinary, multiagency team to tackle the problem. The USDOT Speed Management Team includes personnel from the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), and NHTSA, representing backgrounds ranging from traffic engineering and enforcement to psychology and marketing [8].

III. OUR WORK

We have divided our work into following major stages:

A. Lane Design for Optimal Traffic (LDOT)

Finding methods in other literature are a family of optimization algorithms which incorporate level of traffic services in the algorithms. There are two major issues in the in the first part, we analyze the major issues residing in the latest practice of the optimization of traffic systems; in the last part, we discuss the possible applications of this new technique with probabilistic study and new algorithm.

Let $A=\{a_1, a_2, \dots, a_n\}$, $B=\{b_1, b_2, \dots, b_n\}$, $C=\{c_1, c_2, \dots, c_n\}$ be three mutually exclusive set,

The $3 \times N$ points are to be disbursed in two or more lane, such that the following:

- a. That every element $a_i, b_i, c_i, 1 \leq i \leq N$ where a_i, b_i, c_i belongs to three set A, B, C the property

speed/cost/efficiency or symbolic value say $V_a(a_i) > V_a(a_j)$ where $i > j$.

- b. This technique is applicable for all node and all lane. $1 \leq j \leq i \leq N$.
- c. The speed/cost/efficiency or symbolic value is given on the basis of probability that a(2|3) lane of n nodes having handling r nodes at any given time, p is the probability of accident and $q=1-p$, ${}^n C_r p^r q^{n-r}$.

Algorithm:

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Step 1: Insert a node say  $a_i, b_i, c_i, 1 \leq i \leq N$ .
Step 2: Repeat step 3 to step 5 for  $i=1, 2, 3, \dots, N$ 
Step 3: if  $V_a(a_i) < V_a(a_j)$  then
    step 3.1 if  $V_a(a_j) < V_b(b_i)$  then
        step 3.1.1 if  $V_a(a_j) < V_c(c_i)$  then
            PUSH(Transition1, $a_j$ );
        endif
    endif
endif
Step 4: if  $V_b(b_j) > V_b(b_i)$  then
    4.1 if  $V_b(b_j) > V_c(c_i)$  then
        PUSH(Transition2, $b_j$ );
    else
        if  $V_b(b_j) > V_a(a_i)$  then
            PUSH(Transition1, $b_j$ );
        endif
    endif
endif
Step 5: if  $V_c(c_j) > V_c(c_i)$  then
    5.1 if  $V_c(c_j) > V_b(b_i)$  then
        PUSH(Transition2, $c_j$ );
    else
        5.1.1 if  $V_c(c_j) > V_a(a_i)$  then
            PUSH(Transition1, $c_j$ );
        endif
    endif
endif
[End of loop]
Step 6: Exit
    
```

Analysis:

- a. The above algorithm is a 3 lane design implemented on open unplanned area.
- b. The objects will follow linear queue as long as speed/value/cost of proceeding is greater than the immediate next.
- c. Transition/Cross over are used and they again follow appropriate data structure in order to maintain the preceding step rule.
- d. Here we assume the lanes are narrow enough to limit the bidirectional approach.

B. Lane Design for Speed Optimization (LDSO)

We analyze the major issues residing in the latest practice of the speed optimization of traffic systems; in the last part, we discuss the possible applications of this new technique with probabilistic study and new algorithm.

Let $A = \{a_1, a_2, \dots, a_n\}$, $B = \{b_1, b_2, \dots, b_n\}$, $C = \{c_1, c_2, \dots, c_n\}$ be three mutually exclusive set, The $3 \times N$ points are to be disbursed in two or more lane, such that the following : --

- That every element a_i, b_i, c_i , $1 \leq i \leq N$ where a_i, b_i, c_i belongs to three set A, B, C the property speed/cost/efficiency or symbolic value say $Va(a_i) > Va(a_j)$ where $i > j$.
- This technique is applicable for all node and all lane. $1 \leq j \leq i \leq N$.
- The speed/cost/efficiency or symbolic value is given on the basis of probability that a(2|3) lane of n nodes having r nodes at any given time, p is the probability of accident and $q=1-p$, ${}^n C_r p^r q^{n-r}$.

C. Design of Non Accidental Lane (DNAL)

Finding methods in other literature are a family of optimization algorithms which incorporate level of traffic services in the algorithms. There are two major issues, in the first part, we analyze the major issues residing in the latest practice of the accidental lane; in the last part, and we discuss the possible applications of this new technique with probabilistic study and new algorithm.

Let $A = \{a_1, a_2, \dots, a_n\}$, $B = \{b_1, b_2, \dots, b_n\}$, $C = \{c_1, c_2, \dots, c_n\}$ be three mutually exclusive set, The $3 \times N$ points are to be disbursed in two or more lane, such that the following : --

- That every element a_i, b_i, c_i , $1 \leq i \leq N$ where a_i, b_i, c_i belongs to three set A, B, C the property speed/cost/efficiency or symbolic value say $Va(a_i) > Va(a_j)$ where $i > j$.
- This technique is applicable for all nodes and all lanes. $1 \leq j \leq i \leq N$.
- In this work, used B(i) for all lane as buffer, which contain node and used for garbage collection; means if any node value like a_i, b_i or c_i value is ≤ 0 then this node collect by B (i) buffer for avoiding accident.
- The speed/cost/efficiency or symbolic value is given on the basis of probability that a(2|3) lane of n nodes having r nodes at any given time, p is the probability of accident and $q=1-p$, ${}^n C_r p^r q^{n-r}$.

Algorithm:

- Step 1: Insert time_interval
 Step 2: Repeat step 3 to 7 for time_interval > 0
 Step 3: Insert a node say a_i, b_i, c_i $1 \leq i \leq N$.
 Step 3.1: if $Va(a_i) = 0$ then
 PUSH_BUFFER(Transition1,i).
 Record accident position.
 Increment count of accident by 1.

- Step 3.2: if $Vb(b_i) = 0$ then
 PUSH_BUFFER(Transition2,i).
 Record accident position.
 Increment count of accident by 1.
 Step 3.3: if $Vc(c_i) = 0$ then
 PUSH_BUFFER(Transition3,i).
 Record accident position.
 Increment count of accident by 1.
 Step 4: Repeat step 3 to step 5
 for $j=1, 2, 3 \dots N$.
 Step 4.1: if $Va(a_j) = 0$ then
 PUSH_BUFFER(Transition1,j).
 Record accident position.
 Increment count of accident by 1.
 Step 4.2: if $Vb(b_j) = 0$ then
 PUSH_BUFFER(Transition2,j).
 Record accident position.
 Increment count of accident by 1.
 Step 4.3: if $Vc(c_j) = 0$ then
 PUSH_BUFFER(Transition3,j).
 Record accident position.
 Increment count of accident by 1.
 Step 5: if $Va(a_i) < Va(a_j)$ then
 Step 5.1 if $Va(a_j) < Vb(b_i)$ then
 5.1.1 if $Va(a_j) < Vc(c_i)$ then PUSH(Transition1,a_j);
 Endif
 Endif
 Endif
 Step 6: if $Vb(b_j) > Vb(b_i)$ then
 6.1 if $Vb(b_j) > Vc(c_i)$ then PUSH(Transition2,b_j);
 Else
 If $Vb(b_j) > Va(a_i)$ then PUSH(Transition1,b_j);
 Endif
 Endif
 Endif
 Step 7: if $Vc(c_j) > Vc(c_i)$ then
 7.1 if $Vc(c_j) > Vb(b_i)$ then PUSH(Transition2,c_j);
 Else
 7.1.1 if $Vc(c_j) > Va(a_i)$ then PUSH(Transition1,c_j);
 Endif
 Endif
 Endif
 [End of Loop]
 [End of Loop]
 [End of Loop]
 Step 8: Show statistics of accident points and number of accidents in 3 lanes.
 Step 9: Exit

IV. RESULT AND ANALYSIS

The output of LDOT Algorithm stated in Fig. 1. The simulated output of LDSO stated clearly in Fig. 2 to Fig. 6.

“Design of Non Accidental Lane” in an open unplanned area, so as to increase traffic movement in rush hours and to minimize accident using the concept of Cross Over between adjacent Lanes and also implementing buffering system on each lane.

Fig. 1, States three vertical lanes that are unidirectional, and $A = \{a_1, a_2, \dots, a_n\}$, $B = \{b_1, b_2, \dots, b_n\}$, $C = \{c_1, c_2, \dots, c_n\}$, with the property of the three lanes. $B[i]$ used for buffering management over each set A,B and C. Here we assume that each and every lane's car speed not less than 30 kmph. If any car's speed less than 30 kmph then we assume that there may be problem. This is why we explicitly push into Buffer which exists in every lane. Fig. 7 and Fig. 8 explain the output clearly.

The random distribution of entities in an open area to lanes is taken care as far as possible.

Analysis:

- a. The above algorithm is a 3 lane design with 3 buffer implemented on open unplanned area.
- b. The objective will follow linear queue as long as speed/value/cost of proceeding to greater than the immediate next.
- c. Transition/Cross over are used and they again follow appropriate data structure in order to maintain the preceding step rule.
- d. Here we assume the lanes are narrow enough to limit the bidirectional approach.
- e. Here we maintain optimize speed for each lane.
- f. Here we also maintain a buffer transition (three in number) if speed/value/cost of a car is found zero to maintain the normal movement and transition in all the three lanes.
- g. Accident/Break down is recorded with their position and number and it follows appropriate data structure in order to maintain the buffer storage rule.

V.CONCLUSION

The main limitation of the approach is that vertical Bi-Directional movements are not taken care off. Our future effort

will certainly be on that direction. In future we maintain both side buffering system for an internal lane.

Here in this work, we have tried to optimize the speed of the vehicles, in a secured collision manner.

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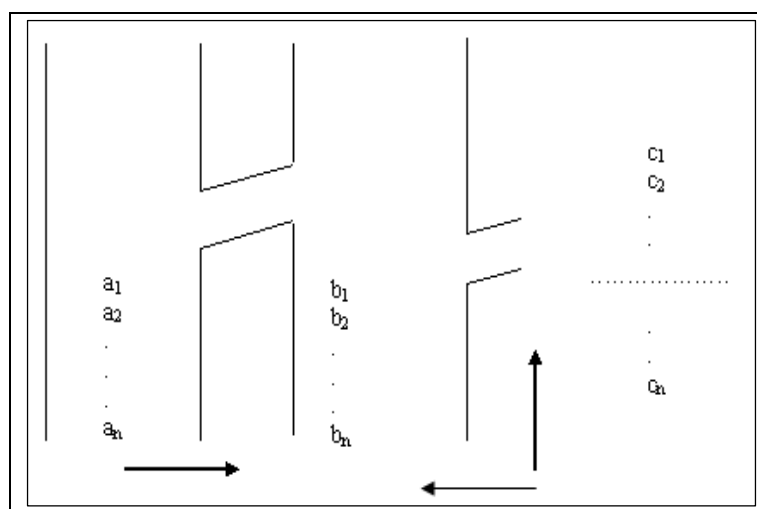


Fig. 1. LDOT.

Car no.	Lane a	Lane b	Lane c
1	46	30	82
2	90	56	17
3	95	15	48
4	26	4	58
5	71	79	92
6	60	12	21
7	63	47	19
8	41	90	85
9	14	9	52
10	71	79	16
Transition1	-> Lane ->b	Car Position ->2	Car speed ->56
Transition1	-> Lane ->b	Car Position ->5	Car speed ->79
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition1	-> Lane ->b	Car Position ->7	Car speed ->47
Transition2	-> Lane ->b	Car Position ->8	Car speed ->90
Transition2	-> Lane ->c	Car Position ->8	Car speed ->85
Transition1	-> Lane ->b	Car Position ->10	Car speed ->79
Transition2	-> Lane ->c	Car Position ->1	Car speed ->82
Transition2	-> Lane ->c	Car Position ->4	Car speed ->58
Transition2	-> Lane ->b	Car Position ->5	Car speed ->79
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition2	-> Lane ->b	Car Position ->8	Car speed ->90
Transition2	-> Lane ->c	Car Position ->8	Car speed ->85
Transition2	-> Lane ->b	Car Position ->10	Car speed ->79
Transition2	-> Lane ->c	Car Position ->1	Car speed ->82_

Fig. 2. Result state 1, LDSO.

Car no.	Lane a	Lane b	Lane c
1	46	30	82
2	90	56	17
3	95	15	48
4	26	4	58
5	71	79	92
6	60	12	21
7	63	47	19
8	41	90	85
9	14	9	52
10	71	79	16
Transition2	-> Lane ->b	Car Position ->2	Car speed ->56
Transition2	-> Lane ->c	Car Position ->4	Car speed ->58
Transition2	-> Lane ->b	Car Position ->5	Car speed ->79
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition2	-> Lane ->b	Car Position ->8	Car speed ->90
Transition2	-> Lane ->c	Car Position ->8	Car speed ->85
Transition2	-> Lane ->c	Car Position ->9	Car speed ->52
Transition2	-> Lane ->b	Car Position ->10	Car speed ->79
Transition1	-> Lane ->b	Car Position ->1	Car speed ->30
Transition2	-> Lane ->c	Car Position ->1	Car speed ->82
Transition1	-> Lane ->b	Car Position ->2	Car speed ->56
Transition2	-> Lane ->b	Car Position ->5	Car speed ->79
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition1	-> Lane ->b	Car Position ->7	Car speed ->47
Transition2	-> Lane ->b	Car Position ->8	Car speed ->90

Fig. 3. Result state 2 LDSO.

Car no.	Lane a	Lane b	Lane c
1	46	30	82
2	90	56	17
3	95	15	48
4	26	4	58
5	71	79	92
6	60	12	21
7	63	47	19
8	41	90	85
9	14	9	52
10	71	79	16

Transition2	-> Lane ->c	Car Position ->8	Car speed ->85
Transition2	-> Lane ->b	Car Position ->10	Car speed ->79
Transition1	-> Lane ->b	Car Position ->8	Car speed ->90
Transition2	-> Lane ->b	Car Position ->1	Car speed ->30
Transition2	-> Lane ->c	Car Position ->1	Car speed ->82
Transition2	-> Lane ->b	Car Position ->2	Car speed ->56
Transition2	-> Lane ->c	Car Position ->3	Car speed ->48
Transition2	-> Lane ->c	Car Position ->4	Car speed ->58
Transition2	-> Lane ->b	Car Position ->5	Car speed ->79
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition2	-> Lane ->b	Car Position ->7	Car speed ->47
Transition2	-> Lane ->b	Car Position ->8	Car speed ->90
Transition2	-> Lane ->c	Car Position ->8	Car speed ->85
Transition2	-> Lane ->c	Car Position ->9	Car speed ->52
Transition2	-> Lane ->b	Car Position ->10	Car speed ->79

Fig. 4. Result state 3, LDSO.

Car no.	Lane a	Lane b	Lane c
1	46	30	82
2	90	56	17
3	95	15	48
4	26	4	58
5	71	79	92
6	60	12	21
7	63	47	19
8	41	90	85
9	14	9	52
10	71	79	16

Transition2	-> Lane ->c	Car Position ->1	Car speed ->82
Transition2	-> Lane ->b	Car Position ->2	Car speed ->56
Transition2	-> Lane ->c	Car Position ->3	Car speed ->48
Transition2	-> Lane ->c	Car Position ->4	Car speed ->58
Transition2	-> Lane ->b	Car Position ->5	Car speed ->79
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition2	-> Lane ->b	Car Position ->8	Car speed ->90
Transition2	-> Lane ->c	Car Position ->8	Car speed ->85
Transition2	-> Lane ->c	Car Position ->9	Car speed ->52
Transition2	-> Lane ->b	Car Position ->10	Car speed ->79
Transition1	-> Lane ->a	Car Position ->1	Car speed ->46
Transition1	-> Lane ->a	Car Position ->5	Car speed ->71
Transition2	-> Lane ->c	Car Position ->5	Car speed ->92
Transition1	-> Lane ->a	Car Position ->6	Car speed ->60
Transition1	-> Lane ->a	Car Position ->7	Car speed ->63

Fig. 5. Result state 4, LDSO.

Car no.	Lane a	Lane b	Lane c
1	46	30	82
2	90	56	17
3	95	15	48
4	26	4	58
5	71	79	92
6	60	12	21
7	63	47	19
8	41	90	85
9	14	9	52
10	71	79	16

Transition2 -> Lane ->c Car Position ->8 Car speed ->85

Total transition=76_

Fig. 6. Result state 5, LDSO.

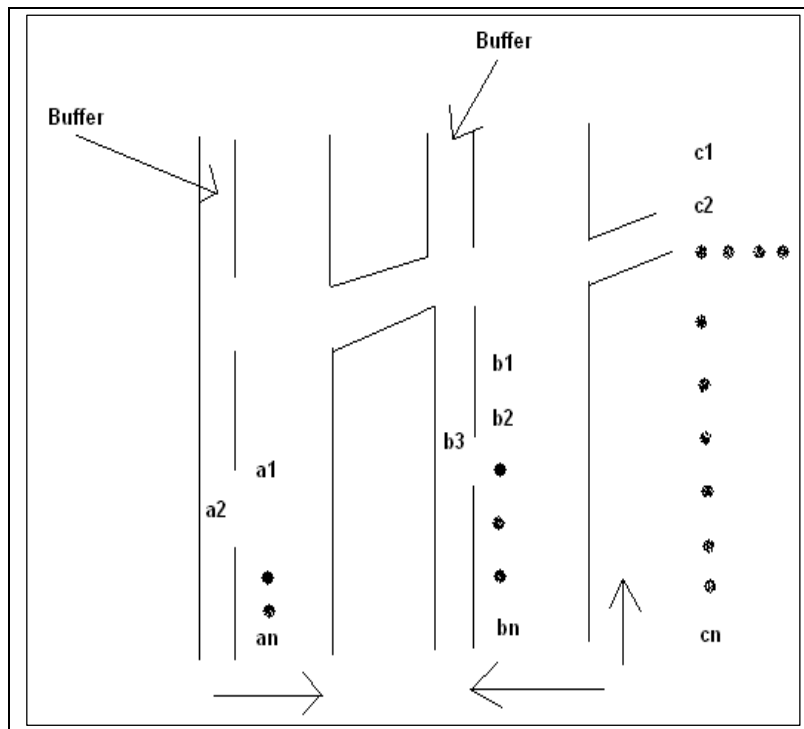


Fig. 7. Vertical lanes that are unidirectional and with the property of the three lane with buffering system.

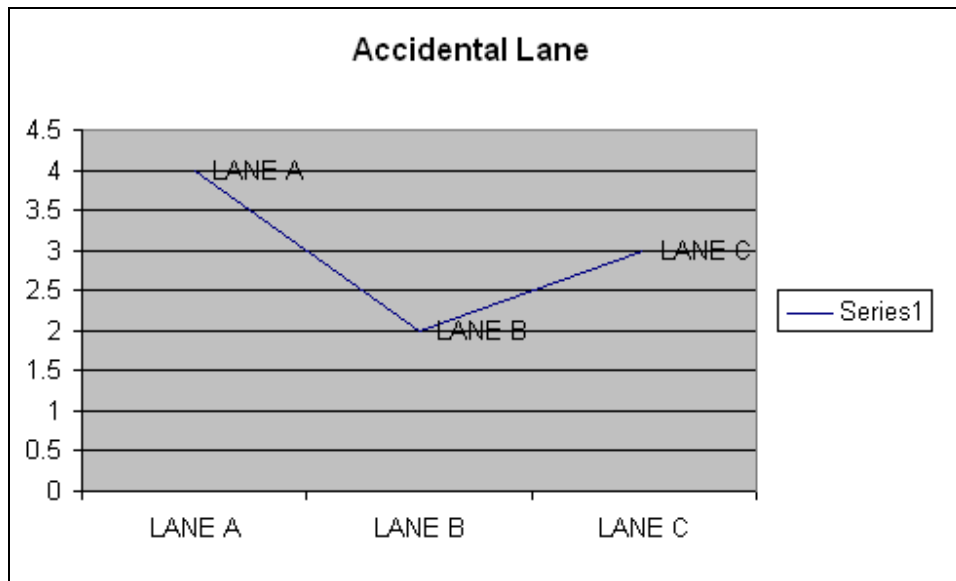


Fig. 8. In the above graphical chart describe, each lane with accidental point, which assume with time and number of car of each lane.



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