Effect of Intelligent Vehicle Networks On Roadways Safety

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Abstract

Most accidents happens because of lack of Visibility and not Driver's reaction on time when an accident occurs. Increasing required Time for driver's reaction caused to decreasing accidents on roadways .intelligent vehicle networks brings enough time for reaction by sending alert and alternate messages to vehicles on roadway. Main propose in this paper is around modulation on Reception interval Safety message and other effective parameters on vehicles safety at CCWS applications. Effect of alert and alternate messages will be examined and modeled with Markova chain. For verification, simulation result we will used Monte Carlo method, compare result with each other, and calculated probability of collision for those vehicles that used vehicles network on roadway.

Keywords: At least four key words or phrases in alphabetical order, separated by commas.

1- Introduction

CCWS system according to receipted message from neighbor cast[1] start to Assess environmental conditions and if some sudden happen alert driver with Warning message .calculating probability of collision is one of most important issue in intelligent vehicle networks which use CCWS system.in this networks message should send at Collective channel that some factors such as Interference and attenuation from Congestion affected Receive message at destination so if messages do not received it has negative effect on system Operation [2].it is clear that messages do not have same effect in all conditions.in this paper we model manner of safety application on connected vehicles. Relative safety between two vehicles in event of an accident modeled by Markov chain. Transitions between states will done according to receive messages and calculate probability of collision by solving recommended Markov model[3,4].to continue Markov model will be developed on vehicles chain.

2- Modeling of safety for two vehicle

Safety Application that uses at vehicles networks send messages which includes vehicle position and dynamic information. Each Reception message at the Destination with considering of packets delay, brings Awareness of transmitter position to the receiver. Relative position, Processed at receiver and give fit alert to receiver vehicle. If one or two message lost during 0.1 second it does not have Impressive Error on

calculation. But losing consecutive messages can be problematic. Getting lost some specific messages at connected vehicles have unknown probability distribution.in fact, losing each messages absolutely depends on moment conditions of sending message. Independence Messages Provides possibility of modeling with Markov rules. Predictable and unnecessary state which related to long distance from accident is not considered. For this purpose we use Awareness Range concept. Model is not use for vehicle that stated in safe and unsafe place.

3- Markov model

Markov model has two states. First state is completely safe and end state is completely unsafe.in this partition vehicles could not maneuver in close range and each middle states in chain mention to some lost messages Cholera s_i displayed. According to figure 1 Transition Between states accrues by losing one message Transition probability between states calculated by xiaomin. we use his calculation and result in this paper.

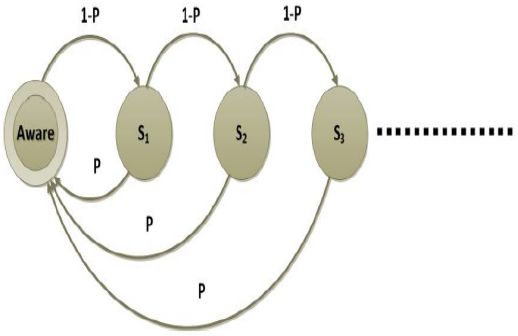

Fig.1. Effects of receive and lost messages on awareness

As shown in fig.2 when 4 packet get lost ,second vehicle goes to dangerous state and also if after 4 packet lost fifth message receive maybe it doesn't have brings enough time for appropriate reaction.so determine number of consecutive lost tolerable messages (TSML) will be effective at evaluation of vehicles condition. Determine TSML depends on many parameters such as velocity, acceleration, distance, interval messages time and etc.

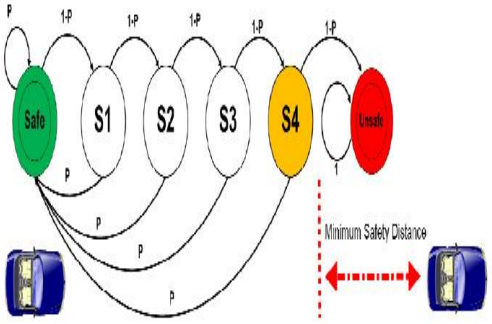

Fig.2.change vehicle states by receiving or not receiving message

First Step we should calculated is the time that vehicle need to receive alert message. Vehicle that accident has v_i velocity and d_i acceleration. We can find vehicle position by equation 1 that show blow.

$$x_H(t) = \begin{cases} \frac{1}{2}d_l + v_l + d & breaking \\ d & accident \end{cases} \qquad (1)$$

Trailing vehicle close to accident vehicle with v_H velocity and a_H acceleration. Question 2 show vehicle position.

$$x_H(t) = \begin{cases} \frac{1}{2}a_H t^2 + v_H - d & t \le t_r + t_{latancy} \\ \frac{1}{2}d_H t^2 + v_{tr}t - d_{tr} & t > t_{tr} + t_{latancy} \end{cases} \qquad (2)$$

Value of $t_{latancy}$ is time delivery delay message and t_{tr} is PR time. Velocity and distance of vehicle at breaking time describe as v_{tr} and d_{tr} .now for calculating number of message we need value of $t_{latancy}$ .for this reach this purpose we should solve $x_H(t) = x_l(t)$ then find $t_{latancy}$ .now can find TSML value from equation 3.

$$\text{TSML}= [t_{latancy} / (1/\lambda)] \quad (3)$$

With TSML value, we can calculate middle states. More middle states increase safety of vehicle on roadway. Another parameter use in this paper is uncertainty, which consider with Markov model .fig .3 show this scenario. As it fig.2 shown red and yellow states refers to beginning and end of the CoARB. Our purpose is calculate safety so we need to calculate probability of set in states. For this goal use Transition matrix and Balance equation as it follow in equation 4.

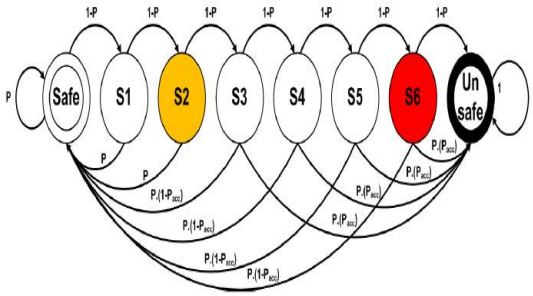

Fig.3.Markov model relative to our scenario

$$TM_{5,5} = \begin{bmatrix} p & 1-p & 0 & 0 & 0 \\ 1-p & 0 & 1-p & 0 & 0 \\ p*(1-p_{acc}) & 0 & 0 & 1-p & p*(p_{acc}) \\ p*(1-p_{acc}) & 0 & 0 & 0 & p*(p_{acc}) \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \quad (4)$$

For the general cases the transition matrix is produced by 5.

$$TM_{k,k} = \begin{cases} p & \\ 1-p & i = j+1 \,\&\, j \neq k \,\&\, j \neq k-1 \\ p*(p_{acc}) & R_{cv} \leq i, j < R_{cvs} \\ p*(1-p_{acc}) & R_{cv} \leq i < R_{cvs}, j = k \\ p*(p_{acc})+1-p & i = k-1 \,\&\, j = k \\ 1 & i = j \,\&\, i = k \\ 0 & otherwise \end{cases} \quad (5)$$

R_v and R_{ca} and R_{cab} mention to required package for passing each awareness board .probability of each state is equal $p_k = (1-p)^k$ .probability of sate in safe and unsafe state calculate by equation 6 and 7.

$$p_{safe} = \frac{\left(\sum_{i=1}^{m} p_i\right)}{1-p} p + \frac{p*(1-p_{acc})(\sum_{i=m+1}^{n} p_i)p}{1-p} \quad (6)$$

$$p_{unsafe} = p_n*(p*(p_{acc})+1-p)+p*(p_{acc})(\sum_{i=m+1}^{n} p_i) \quad (7)$$

n is TSML value and m consider for needed message for passing CoARB.

4- Simulation parameters

Simulation parameters includes two part.one of them is network Specifications another is Moving Vehicle Specifications. Network Specifications consider constant at MAC layer shown in Table 1. Moving Vehicle Specifications is include PR time, velocity, acceleration and vehicle distance all of these variable will taken completely random samples that is shown in table 2. For Measurement accuracy of different models,

we consider 10000 repetition between two vehicle and 1000 repetition in vehicle chain.

Table .1.parameter for network specification

Parameter	Value
Channel data rate	6 Mbit/s
DIFS for 802.11a	64 μs
transmitter domain	500 m
packet size of sending message	200 byte
Header MAC layer	192+271 bit
Contention Window	15

Table .2.parameter for vehicle moving specification

Parameter	Value
Velocity	Uniform distribution (20-33 m/s)
acceleration	Uniform distribution ($2\,m/s^2$)
PR time	Uniform distribution (0.3-0.7)
Distance between vehicle	Exponential distribution with average(50-100)

5- Measurement Accuracy Model with simulation

5 .1 -Effect of distance.

Markov Model and Monte Carlo result will be calculated and then checking manner of them in simulation. First simulation is about effect of distance on probability of collision. Near distance is an important parameter in most accident.as shown in fig.4 increasing distance it cause increase TSML parameter. This means middle states will increased too and it can proof from equation (3) . also as shown in fig.4 Markov Model and Monte Carlo has almost same manner in simulation of distance effect.

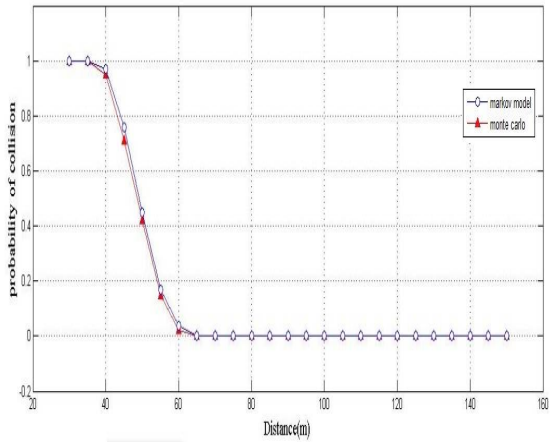

Fig.4. effect of distance on probability Of collision

5.2.-Effect of packet interval

Packet interval is one of Adjustable parameter on connected network. This variable effect on Congestion and probability of reception. more research recommend matching data rate for solving collision avoidance.as shown in fig.5 decreasing data rate and increasing packet interval probability of collision Will increased. According to simulations Pattern they both have same manner that it can proof our recommended model accuracy.

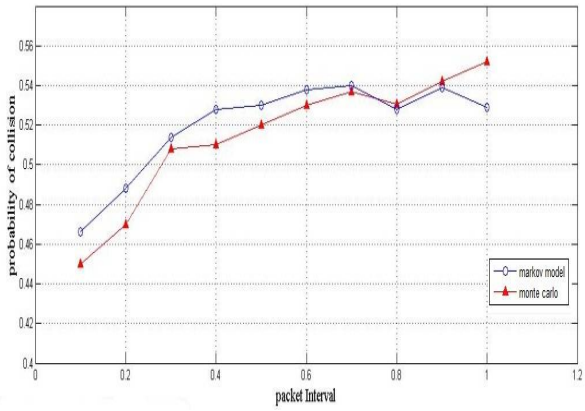

Fig.5.effecet of packet interval on probability of collision

5.3- Effect of velocity

Velocity has undeniable effect on accident most damageable accident happens at high velocity .we simulate velocity at range 15-33 (m/s).as shown in fig.6 increasing velocity cause increase probability of accident and two simulation has same manner .Average distance in this scenario is 100 meter and interval time between sequence message transitions consider 0.1 second.

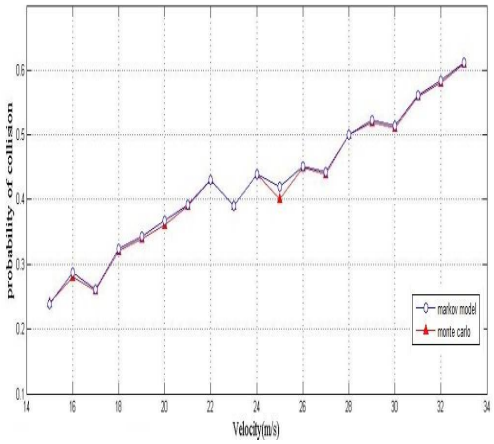

Fig.6.effect of velocity on probability of collision .velocity is between 15-33 (m/s)

5.4- Effect of PRR

Reliability in connected networks is necessary at safety application .in fact operation of awareness layer in CCWS depends on communication operator layer. Increasing PR time will caused decreasing transfer probability of states with factor 1-p .as shown in fig.7 increase PR time decrease probability of collision.

5. 5- Effect of uncertainty.

in this paper, uncertainty means to Lack of driver's reliability from any accident that happen included and add as p_{acc} to model. For instance if vehicle fall in situation that cannot know what happen in road driver cannot have suitable react in right time. However, if vehicle has additional time and distance for reaction, uncertainty do not effect on result.in fact predict probability of collision with considering p_{acc} has an error. Because p_{acc} depends on several variables and we do not have enough information about p_{acc} .anyway this variable effects results comes in fig.8.

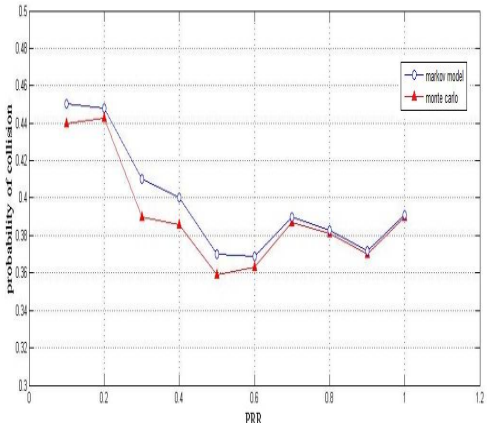

Fig.7.effect of PRR on probability of collision

5.6- Effect of connected vehicle on accidents chains

In this part, we consider 10 vehicles with different message generation rate for our simulation. Average distance between vehicles are 70 meter.as shown in fig.9 increasing interval message generation average probability of collision in vehicle chain will increased. Vehicle show with V1 to V10.vehicles that located at end of chain have less effect and be safer from collision. And also vehicles located at first of chain have more effect from collision that can see as follows.

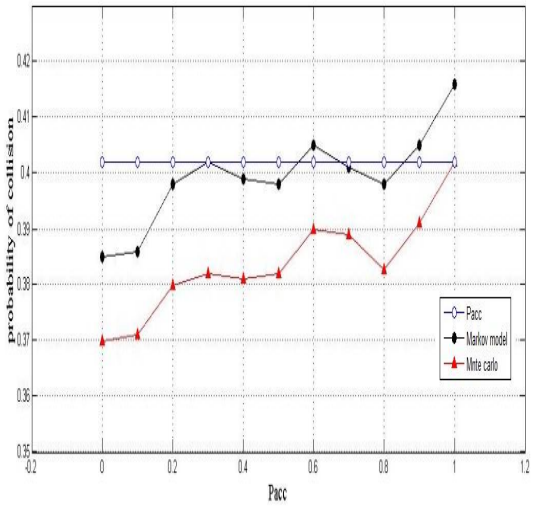

Fig.8.effect of PRR on probability of collision

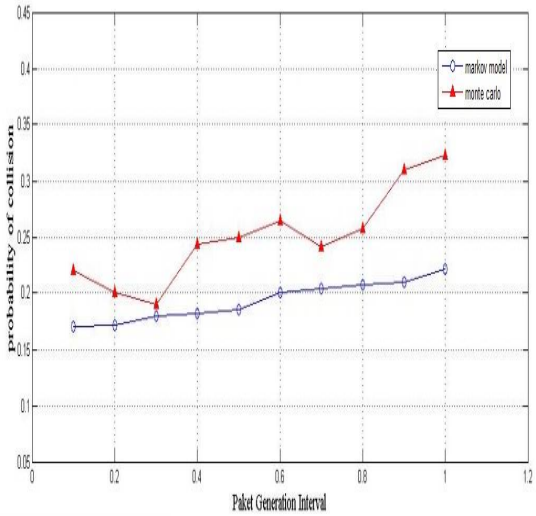

Fig.9.effect of message generation on average probability of collision at 10 vehicles chain.

5. Conclusion

in this paper we try to calculate Markov model on safety of roadway for vehicle which use network for connected with together and proof our model with Monte Carlo as shown in simulation result both result have same manner so this tell Markov model is useful model for simulation in connected wireless network. We simulate our variable parameter in this paper like as distance, velocity and etc. For future work simulation can done at high velocity and crowded roads. And also add vehicle communication protocol in simulation like as an RNP[1] and FSBP.

References

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