Research on Autonomous Driving Algorithm Based on Multi-Agent

Yang Cheng

Information Engineering University, Zhengzhou, Henan, 450000, China

Keywords: Autonomous driving algorithm, Multi-agent study, Calculation method

Abstract: The research of driverless cars is mainly about the interaction of the agent of a single car. However, there are few studies on the traffic congestion of multiple intelligent vehicles in ITS. Therefore, the advantages of driverless cars are used to solve specific traffic congestion problems. First of all, the state of the car driving in ITS can be divided into straight-line driving and when driving at an intersection, there are relatively few cooperative researches between car agents at the intersection. To a certain extent, the realization of driverless car technology can get rid of the traditional traffic light control technology at intersections. The control of traffic lights will cause frequent braking of the car and cause loss of car performance. At the same time, it also promotes irregular traffic post switching times and leads to serial congestion. Therefore, this article focuses on the intelligent body of the driverless car as the research object, and uses the car laser rangefinder to perceive the vehicle's position information and speed information within 200m. In order to avoid the traffic congestion problem caused by the use of traffic lights on the traditional traffic network, this paper adopts the principle of not stopping cars on the highway as much as possible, and researches the distance between the intelligent car at the intersection and the car on the straight road.

1. Introduction

With the advent of the era of human driving cars, each car is an agent, referred to as a car agent. These agents can think and interact with the environment. While obtaining information through the environment, they also provide strategies to deal with the environment through the driving actuators of the car. The arrival of driverless cars can not only solve traffic accidents caused by human factors, but also bring good news to mankind, such as solving fatigue driving and enjoying everything in the car. In the past ten years, the research on unmanned vehicles in various countries has been in a heated stage. Unmanned vehicles first began in the 1970s. Developed countries such as the United States, the United Kingdom, and Germany began to conduct research on unmanned vehicles, and breakthroughs have been made in terms of feasibility and practicality. China began to study driverless cars in the 1980s, and the National University of Defense Technology successfully developed China's first truly driverless car in 1992. Google has announced its research on driverless cars in 2010. Baidu also invested a lot of research on driverless car projects in 2012. Google self-driving cars use cameras, radar sensors and laser rangefinders to “see” other vehicles and use detailed maps for navigation. Self-driving cars collect a lot of information in their environment, and we must process and convert this information. Google data center makes all this possible, and its data processing capabilities are so powerful. As of the end of 2012, the main problem is how self-driving cars and human-driven cars coexist without causing traffic accidents. However, most of the research on driverless cars is on a single smart car agent driving on the road, and there is not much research on the problem of driverless cars completely replacing traditional cars on the road, and the current research on the road network car It is a method of coordinated control of traffic dynamics in a group of urban intersections in a manually driven car. When the driverless car technology is realized, how to avoid the problem of traffic congestion, using the current traditional technology of using traffic lights at intersections is completely unable to meet the needs of human beings. Therefore, this article focuses on the intelligent body of the driverless car as the research object, in order to meet the needs of human beings for efficiency and enjoyment. In order to avoid the traffic congestion problem caused by the use of traffic lights on the traditional traffic road network, this

  DOI: 10.25236/mmmce.2021.034

paper adopts the principle of not stopping cars on the highway, and studies the intelligent car game at the intersection. First, a state equation is established for the movement of each intelligent body car, which can express the current position and current speed information of the car. And through the sensor can perceive the surrounding car motion state estimation information, and pre-process each car through the information obtained in real time, and get the operation status of the vehicle related to the current vehicle driving at the intersection. At the same time, it is assumed that each car maintains its current operating state to predict whether there will be a conflict. The conflict here is a traffic accident. If there is a conflict, you need to evaluate the benefits of the two vehicles in conflict to obtain the revenue function, and then use the theoretical knowledge of game theory to find the Nash equilibrium solution in the current state, and control the speed of the vehicle according to the obtained Nash equilibrium solution, so as to achieve the principle of non-stop allows cars to flow unimpeded on the highway.

2. Research on Planning and Coordination of Multi-Agent Systems

Inoue described a cooperative mobile agent in an unknown environment to complete an interactive transportation task planning method. In order to achieve effective transportation, they proposed a motion planning structure: the structure consists of three parts, namely the environmental exploration phase, the path generation phase, and the strategy formulation phase. In each stage, each agent plans its own movement individually. All agents perform phase transitions at the same time. Miyata et al.

To this end, a task distribution structure has been developed. They considered the three needs of the planning module: and processing various tasks in time and space; processing a large number of tasks; and determining behavior in real time. The following method is proposed.

(1) Based on the sensing information, a task template is used to dynamically generate tasks.

(2) The generation of tasks can be further precisely adjusted by feeding back the execution results.

(3) The main part of the structure consists of two real-time planning modules: one is based on priority-based linear programming for task allocation, and the other is based on short-term estimation. Donald et al. used different numbers of agents and different numbers of prior knowledge of the objects to be moved to test the coordinated operation of the motion planning algorithm. For example, in the box pushing exercise, in terms of theory, their work focuses on the computational information requirements of performing specific agent tasks. Botelho and Alam proposed a general structure for the realization of M+ collaborative characters. This structure is to integrate the implementation of multiple agent tasks. The collaborative and cooperative behavior it produces is based on the online combination of local individual agent planning and multi-agent planning verification. The agent regards the planning and social rules of other agents as a constraint on the planning or adjustment, and plans or adjusts their respective tasks according to the constraints, thereby generating a multi-agent plan that effectively includes coordinated and cooperative actions.

3. The Game Needed to Solve the Traffic Congestion Model

The three elements of game theory are participants, strategies or actions and benefits. The two most basic assumptions of game theory are that the participants are rational and intelligent. Without these two assumptions, then all the arguments of game theory cannot continue. When applied to transportation, we can assume that there is nothing The agent of a person driving a car is rational.

Participants in the game are also called players or players in the play. The players here are not limited to individuals, but can be a single agent or a whole. The “single player game” and “multiplayer game” in any competition or game are determined based on the number of players in the game 1,2,,n.

Strategy is actually all the response methods that game participants can take. These methods constitute a set. The finiteness of this set determines whether the game is a finite game or an infinite game. It should be noted that strategy is the rule of action rather than the action itself. Simply put, strategy is the choice that game participants can take, and action is the choice made by game participants at a certain moment.

Profit refers to the benefits brought to different game participants under different game strategies. This benefit can be understood as the players' gains and losses in this game. The final result of the game is the participants' win or lose, that is, Profit and loss of resources. Profit is what the game participants care most about, and is also the most important basis for their actions and judgments, because the goal of each game participant is to maximize their own interests and minimize their losses.

4. Intersection Mas Model Algorithm to Solve Traffic Congestion

(1) The sensor obtains the location of the surrounding vehicles. Since the data is obtained at any time, there is no termination condition for the flow chart. Since the intersection is at an intersection, the time t can be set within two minutes. Where i 1 represents the current vehicle; N represents the total number of vehicle agents around the vehicle sensor; xi, t represents the abscissa of the ith vehicle agent at time t; xi, t represents the ith vehicle agent at time t means the vehicle agent obtains the sensor feedback of the distance data of the two vehicles; t means the deviation angle between the direction of the vehicle agent and the test vehicle agent and the abscissa of the entire coordinate system; t means the sampling time.

(2) The passed data should know the current state of motion at the intersection. Where viTx, represents the abscissa component of the average velocity of the i-th vehicle agent at time T; viTy, represents the ordinate component of the average velocity of the i-th vehicle agent at time T; a represents the slope of the straight line, the center of the circle The abscissa; b represents the intercept of the line and the ordinate of the circle center; r represents the radius of the circle; w represents the array, and each row stores the values of a, b and r.

(3) Convert the general equation of a straight line or curve into a parametric equation, the parametric equation is about time t, and save the parametric equation in the array L.

(4) Determine whether there is a solution for t according to the motion parameter equation of any two cars in the game. If there is a solution, it means that the two cars will conflict at time t in the future, and the corresponding game needs to be given according to traffic rules. Income A, B.

The following figure shows a snapshot of the movement of the two cars in the direction of El and Ws with a time interval t of 0.3s. The red represents the position of the car in the Ws phase, and the initial position of the movement speed is -28m and 27km, respectively /h, and blue represents the state of the car in the El phase, and its initial position and moving speed are 28m and 27km/h, respectively.

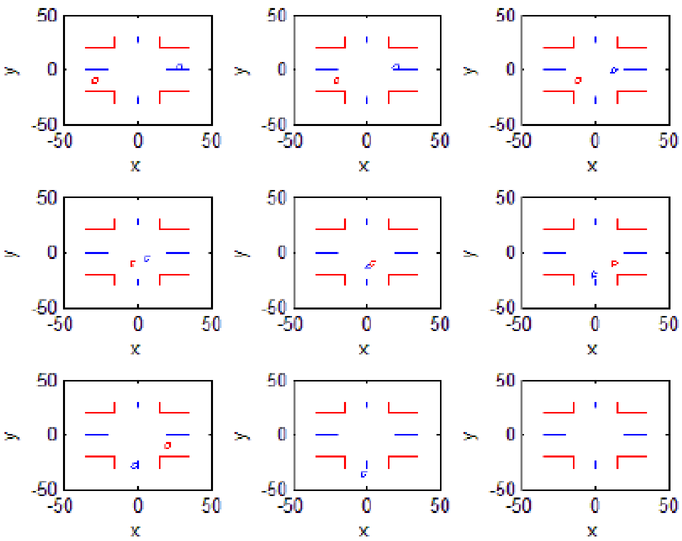

Fig.1 El Vehicles and Ws Vehicles Location Map in the 0.3s Sampling Interval

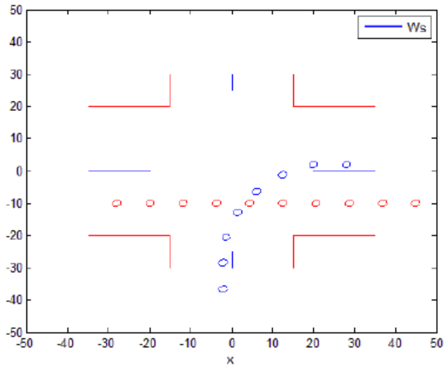

Fig.2 Overall Trajectory about El and Ws Vehicle

It should be noted that the coincidence points of different colors here are not conflict points, because the coincidence points are not necessarily the same time for each car. The overall timing diagram of the movement of the two vehicles in the El and Ws directions shown in Figure 1 can be shown in Figure 2. In the figure, blue represents the movement timing diagram of the vehicle in the EL direction, and red represents the movement timing diagram in the Ws direction.

5. Conclusion

With the help of the agent of the driverless car to perceive the surrounding environment and control the running state of the vehicle, this article uses the algorithm of the car game to solve the problem of underutilized road network resources caused by the traffic light control of the traditional intersection through the traffic post. Vehicles at intersections with no traffic lights pass. To a certain extent, it can maximize the use of the time and efficiency of the intersection. On the one hand, it can reduce vehicle resources, energy consumption and the number of stops; on the other hand, humans do not need to be congested due to ignorance of traffic conditions. Solve the relationship between traffic and people. At every moment, the agent of each vehicle can perceive the movement state of the surrounding environment. The intersection does not need to be controlled by traffic lights. The agent of the car can dynamically distribute the sequence of movement according to the current resource distribution, so that the passing efficiency is higher. The control speed is more reliable and efficient. Protect the security and privacy of users. Avoid the aggravation of resources, time, energy and pollution caused by traffic stop start. Do your best to ensure that the system does not stop, and the overall running time is shorter. At home and abroad, the research on traffic light traffic lights and the solution to congestion are becoming mature, but they still cannot meet the increasing demand of human beings. Therefore, this article saves time from the perspective of automatic control without stopping, and the entire system is in circulation.

References

[1] Wu Hua. Self-driving cars: an industry disruptive innovation. Qi Luzhou. 2014, 32:24-25.

[2] Qiao Weigao, Xu Xuejin. The development status and direction of unmanned vehicles. Shanghai Automotive, 2007, 7(40): 13.

[3] Weng Yuexuan. Road to Intelligent Vehicles: Research on the Safety Supervision of Intelligent Vehicles and Self-driving Vehicles. Science Technology and Law, 2014 (4): 632-655.

[4] A. Daligro, Li Lu. How will Google's driverless cars change everything. China Science and Technology Translator, 2015, 28(002): 61-64.

[5] Ji Jie, Li Yinong, Zheng Ling, et al. Comprehensive control of longitudinal and lateral motion of vehicle automatic driving system. China Journal of Highway and Transport, 2010, 23(5): 119-126.