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On Road Automobile Management System

[1]S.Sujila, [2]A.M.Reshma, [3]T.K.Vishnu Manjari, [4]M.Abishek
Department of Computer Science and Engineering, Nandha Engineering College, Erode
[5] **Ms. B.Deepa,** Department of Computer Science and Engineering, Nandha Engineering College, Erode
[1-4]UG Scholar, [5]Assisstant Professor

[1]E-Mail: sujilasuseelan@gmail.com
[5]E-mail: deepacse.b@gmail.com

A*BSTRACT*- A path planning and tracking framework is presented in order to maintain a collision free path for autonomous vehicles. For path planning approaches, a 3D virtual dangerous potential field is constructed as a superposition of trigonometric functions of the road and the exponential function of obstacles, which can generate a desired trajectory for collision avoidance when a vehicle collision with obstacles is likely to happen. Next, in order to track the planned trajectory for collision avoidance maneuvers, the path tracking controller formulates the tracking task as a Multi-constrained Model Predictive Control (MMPC) problem, and calculated the front steering angle to prevent the vehicle from colliding with a moving obstacle vehicle. Simulink and Car Sim simulations are conducted in the case where moving obstacles exist. The simulation results show that the proposed path planning approach is effective for many driving scenarios and the MMPC-based path-tracking controller provides dynamic tracking performance and maintains good maneuverability.

Keywords— Autonomous vehicle, collision avoidance, model predictive control, multi-constraints, path planning, path tracking.

I. INTRODUCTION

Owing to the rapid increase in traffic density, vehicle safety has become a crucial factor in modern intelligent transportation systems. While passive safety systems, in combination with ever-increasing active safety systems in motor vehicles have been developed to avoid vehicle crashes and minimize the impact of accidents [1], the need for further reduction in traffic accident incidences using modern control and sensing technologies remains of great interest. In recent years, autonomous vehicles have attracted strong attention from the automotive industry due to their potential applications in collision avoidance. However, fully autonomous driving for the objective of having 'zero accidents on the road' remains a complex task. Further work, such as planning the path upon

Because of its capability to systematically handle input is adopted to track the planned trajectory for collision avoidance in this work. Here, the path tracking problem is formulated as a MPC problem with multi-constraints. At each sampling time instant, a future input sequence of

front steering angle for collision detecting obstacles, and controlling the actuators so that the vehicle follows the planned path, is often required before the collision avoidance system is road-ready. Although there has been substantial research on path planning and tracking in collision avoidance systems for unmanned aerial vehicles (UAV) and other robots [2]-[5], It is not easy to apply these approaches directly to vehicle collision scenarios, since the vehicle can only move at the limits of its stability and handling capability in a constrained environment. Furthermore, to solve the collision avoidance problems on the road, it is also necessary to consider other moving vehicles that have these own motion properties.

The path planning for a vehicle collision avoidance system is to generate a collision-free trajectory which takes into consideration geometric characteristics of obstacles and the kinematic constraints of the autonomous vehicle [6]. Early works on path planning for autonomous vehicles date back to the 1980s and were primarily focused on computing a time-optimal and collision-free trajectory going from a given point to another [7] and [8]. Since then, many different computational methods and various successful implementations have been reported in research literature.

The common path planning methods include A* heuristic search, visibility graph method, generalized Voronoi diagram and artificial potential field [6]. The artificial potential field (APF) method was inspired by classical mechanics; it formulates a relationship between the motion of the autonomous vehicle and the sum of the applied forces [9]. This method has been used to generate repulsive potential fields to obstacles and attractive potential fields to the goal, which enables the vehicle to avoid collisions with obstacle boundaries while proceeding towards its goal. The APF-based method is very different from previously mentioned approaches, which have all future path information known after the planner's execution and before the vehicle's motion [10]. However, traditional APF-based path planning approaches possess an inherent problem, which is the formation of local minimum that

constraints, and admissible states, model predictive control with avoidance can be calculated in a defined horizon. This is accomplished by solving a finite-time optimal control problem, considering a set of constraints in both the control actions and the plant outputs [16]. An additional feature of a MPC-based approach for collision avoidance is that it continuously optimizes the performance index by receiving information about vehicle position, heading angle and obstacles as the vehicle moves [17].

A. Vehicle dynamic model for path tracking

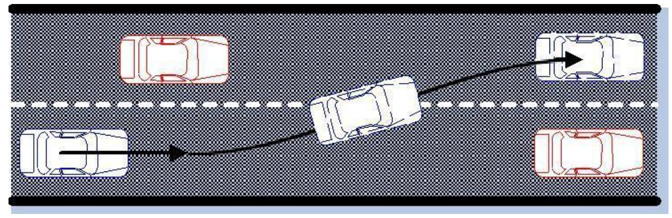

Fig. 2 Accident zone

II.DESCRIPTION OF COLLISION AVOIDANCE SYSTEM

2.1. Problem description

The majority of traffic accidents on roads are caused by vehicle collision. The objective of any collision avoidance system is to design a vehicle control algorithm to avoid an imminent accident. Longitudinal control (i.e., emergency braking only), and lateral control, (i.e., active steering only), are possible choices of actuation configuration for collision avoidance maneuver.

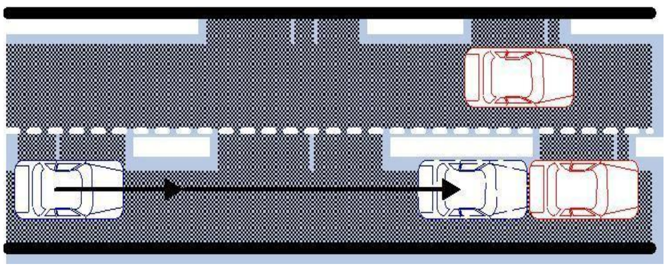

Fig. 1 represents the aforementioned two maneuvers.

control of an autonomous vehicle to track the planned trajectory and to perform an emergency.

Virtual dangerous potential field. Many researchers have studied path planning for autonomous vehicle and a number of rule-based methods have been proposed, such as virtual desired trajectory and elastic band theory, etc. However, driving is a complex task, and even highway subtleties make the implementation of a rule-based planning algorithm cumbersome. Therefore, utilizing an artificial potential field for local trajectory planning offers an elegant alternative. This method can modify the collision free trajectory in real time. So, potential function approaches have already seen considerable use for path planning of autonomous vehicle. In order to simplify the derivation of the collision-free trajectory using the potential field approach, this paper assumes the following conditions, as illustrated in Fig. 1. The road is straight with road boundaries on both sides. Only a single obstacle appears in front of the host vehicle When it is in motion.

Regardless of vehicle avoidance action, the obstacle continues moving along the road. The path planning block in this architecture generates a collision free trajectory during runtime. In the case of a vehicle traveling on the road, it can be planned based on occurrence of certain events such as: a stationary obstacle or moving vehicle is

used for control design. For the path-tracking problem, the following assumptions are made in the vehicle model:

It is becoming increasingly common for luxury cars to be fitted with Emergency Brake Assist (EBA) or Brake Assist System (BAS) .However, longitudinal collision avoidance controllers are of limited benefit for preventing head -on collisions between roads vehicles travelling at high speed or for rear end collisions when there is insufficient separation between the vehicles. In these circumstances, aggressive lateral vehicle maneuvers are more appropriate, as is altering the path of the vehicle to move it out of danger. The maneuvers in this case can be completed in a shorter distance than that required to stop the vehicle.

detected in the path. Moreover, the referenced signals of lateral position, yaw rate, and sideslip angle of the simplified model are the state variables for MMPC that can be calculated from the planned trajectory in this block.

The path-tracking module is based on a receding horizon control design [19]. The tracking problem is formulated as a constrained optimization problem. The cost function penalizes lateral tracking errors between the predicted position of vehicle and the planned trajectory derived of the 3D potential field. Furthermore, the penalty of the yaw rate tracking errors will play a main role in cost function when the yaw rate error. Exceeds its threshold. Regarding the vehicle sideslip regulation, the desired sideslip is simply defined via a tolerance band.

IV. VEHICLE MATHEMATICAL MODEL

The path tracking problem is very dependent on the vehicle modeling since it is a requirement for multi-constraints model predictive control law design. The model used in this paper should take into account the kinematic and dynamic aspects of the vehicle [16]. Here, we present an augmented mathematical model of a vehicle used for the development of collision avoidance system. Section A develops a vehicle dynamic model along with its lateral and yaw dynamics, and Section B introduces a discrete state-space vehicle model used for the development of multi-constrained model predictive controller.

This section describes the vehicle and tire models we

1) the longitudinal velocity of vehicle is constant, 2) at the front and rear axles, the left and right wheels are lumped in a single wheel, and 3) suspension movements, slip phenomena, and aerodynamic influences are neglected. This set of

simulations represents a collision avoidance emergency maneuver in which the vehicle is following the planned trajectory with a given initial forward speed. The In the second scenario, the initial velocity of the host vehicle is taken as 20 m/s and the leading vehicle is placed.

VII. CONCLUSION

In this paper, we presented a framework for path planning and path tracking for a collision avoidance system of autonomous vehicles. The path planning framework built a 3D dangerous potential field based on the information of road and obstacles. A real-time collision free trajectory was then generated for path tracking. As for the path tracking framework, an optimal problem was formulated in terms of cost minimization under constraints in the MMPC method. The state constraints on lateral position, yaw rate, sideslip angle and input constraint on the steering wheel angle were proposed in order to stabilize the vehicle at high speeds.

It is solved with Hildreth's quadratic programming procedure and the constraints were incorporated in an augmented vehicle model. The proposed path tracking framework tracking framework was implemented and tested in simulations. The MMPC approach was developed in MATLAB/SIMULINK and the actual plant used in the simulations was a Car Sim vehicle model. Simulation results demonstrate satisfactory tracking performance in terms of collision avoidance in both static and dynamic environments. The proposed controller was able to stabilize the vehicle on a low friction coefficient road and in the presence of a moving obstacle. The promising results from the simulations motivated an effort to implement the proposed active safety system. Integration of collision avoidance control with environment information devices such as radar and vision systems are topics of future research.

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I hope this survey will help to understand various methods which can be done to prevent collision. control input is the steering angle of front wheels and the goal is to follow the trajectory as close as possible by minimizing the vehicle deviation from the target path. In this context, we assume that future vehicles would be able to identify obstacles on the road such as an animal, rock, or fallen tree/branch, and follow the desired trajectory automatically with a fully autonomous steering system.

REFERENCES

[1] S. Chang, and T. J. Gordon, "A flexible hierarchical model-based control methodology for vehicle active safety systems," Vehicle Syst Dyn, vol. 46, pp. 63-75, Sep, 2008.

[2] K. J. Yang, S. K. Gan, and S. Sukkarieh, "An Efficient Path Planning and Control Algorithm for RUAV's in Unknown and Cluttered Environments," J Intell Robot Syst, vol. 57, no. 1-4, pp. 101-122, Jan, 2010.

[3] M. P. Aghababa, "3D path planning for underwater vehicles using five evolutionary optimization algorithms avoiding static and energetic obstacles," Appl Ocean Res, vol. 38, pp. 48-62, Oct, 2012.

[4] J. Courbon, Y. Mezouar, N. Guenard, and P. Martinet, "Vision-based navigation of unmanned aerial vehicles," Control Eng Pract, vol. 18, no. 7, pp. 789-799, Jul, 2010.

[5] S. Saravanakumar, and T. Asokan, "Multipoint potential field method for path planning of autonomous underwater vehicles in 3D space," Intel Serv Robot, vol. 6, no. 4, pp. 211-224, Oct, 2013.

[6] V. Kunchev, L. Jain, V. Ivancevic, and A. Finn, "Path planning and obstacle avoidance for autonomous mobile robots: A review," Lect Notes Artif Int, vol. 4252, pp. 537-544, 2006.

[7] Y. Kanayama, and B. I. Hartman, "Smooth Local Path Planning for Autonomous Vehicles," Proceedings - 1989 IEEE International Conference on Robotics And Automation, Vol 1-3, pp. 1265-1270, 1989.

[8] Z. Shiller, and Y. R. Gwo, "Dynamic Motion Planning Of Autonomous Vehicles," IEEE T Robotic Autom, vol. 7, no. 2, pp. 241-249, Apr, 1991.

[9] A. K. Pamosoaji, and K. S. Hong, "A Path-Planning Algorithm Using Vector Potential Functions in Triangular Regions," IEEE T Syst Man Cy-S, vol. 43, no. 4, pp. 832-842, Jul.

[10] A. Shum, K. Morris, and A. Khajepour, "Direction-dependent optimal path planning for autonomous vehicles," Robot Auton Syst, vol. 70, pp. 202-214, Aug,

[11] P. Shi, and Y. W. Zhao, "An Efficient Path Planning Algorithm for Mobile Robot Using Improved Potential

Field," 2009 IEEE International Conference on Robotics And Biomimetics (Robio 2009), Vols 1-4, pp. 1704-1708, 2009.

[12] T. Shim, G. Adireddy, and H. L. Yuan, "Autonomous vehicle collision avoidance system using path planning and model-predictive-control-based active front steering and wheel torque control," P I Mech Eng D-J Aut, vol. 226, no. D6, pp. 767-778, 2012.

[16] steering control through a steer-by-wire system," Int.J Automot. Technol, vol. 13, no. 7, pp. 1169-1176, Dec, 2012.

[17] G. V. Raffo, G. K. Gomes, J. E. Normey-Rico, C. R. Kelber, and L. B. Becker, "A Predictive Controller for Autonomous Vehicle Path Tracking," IEEE T Intell Transp, vol. 10, no. 1, pp. 92-102, Mar, 2009.

F. Rovira-Más, and Q. Zhang, "Fuzzy logic control of an electrohydraulic valve for auto-steering off-road vehicles," P I Mech Eng D-J Aut, vol. 222, no. 6, pp. 917-934, Jun, 2008.

[13] S. H. Tabatabaei Oreh, R. Kazemi, and S. Azadi, "A sliding-mode controller for directional control of articulated heavy vehicles," P I Mech Eng D-J Aut, vol. 228, no. 3, pp. 245-262, Feb, 2014.

[14] K. Nam, S. Oh, H. Fujimoto, and Y. Hori, "Robust yaw stability control for electric vehicles based on active front

[18] W. Kim, D. Kim, K. Yi, and H. J. Kim, "Development of a path-tracking control system based on model predictive control using infrastructure sensors," Vehicle Syst Dyn, vol. 50, no. 6, pp. 1001-1023, Jul, 2012.