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附页

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发明人 4	林中盛	☐不公布姓名

【发明人外文信息】

发明人 4	

主　题:	[2019 CCDC] Result Letter of Submission 288
发件人:	2019 CCDC　　2019-1-30 16:45:04
收件人:	jsgengke
抄　送:	220170343, 220170373, ryj19940918
附　件:	Review53.txt Review54.txt Review55.txt

Dear Dr. geng keke,

Paper ID: 288
Title: A New Path Tracking Algorithm for Four-Wheel Diﬀerential Steering Vehicle
Author(s): Yan YongJun, geng keke, Shuai Peng Liu, Yanjun Ren (69827, 27750, 33741, 23768)

The review process for the 31st Chinese Control and Decision Conference (2019 CCDC) has been completed. Based on the recommendations of the reviewers and the International Program Committee, we are very pleased to inform you that your paper identified above has been accepted for presentation in 2019 CCDC. You are cordially invited to present the paper at 2019 CCDC to be held on June 3-5, 2019 in Nanchang, China.

This notification email serves as our formal acceptance of your paper as well as an invitation to present your work at 2019 CCDC.

Detailed information on the preparation of the final paper, conference registration, hotel reservation, etc., will be posted at http://www.ccdc.neu.edu.cn under the 'Information for Authors' page. You can only submit your final manuscript using the Conference Paper Management System (http://cms.amss.ac.cn) by following the instructions after you login into your personal account. Please note that the submission of your final paper should correspond to your Paper ID, i.e, xxxx.pdf. Please strictly adhere to the format given in the template for 2019 CCDC while preparing your final paper.

The reviewers' comments are attached in this notification email. Please address these comments and make necessary changes while preparing your final paper.

The acceptance of your paper is made with the understanding that at least one author will PRE-REGISTER and attend the Conference to present the paper. In order for your paper to be included in the conference proceedings, we require that:

1. your final paper in PDF format meet IEEE Xplore requirements;
2. the final PDF file and abstract in plain text are uploaded to the conference website by March 15, 2019;
3. the Copyright Transfer Form for your paper is received by March 15, 2019;
4. the Registration with payment is received by March 15, 2019.

If the above requirements are not met by the set deadlines, the paper will not be published in the conference proceedings. It is our obligation to eliminate 'no shows' if at all possible since missing presentations cause a lot of disruptions in a session and disappoint the attendees who spend a significant amount of time, money, and effort to come to your presentation. By the IEEE Conferences No Show Policy, "IEEE reserves the right to exclude a paper from distribution after the conference (e.g., removal from IEEE Xplore) if the paper is not presented at the conference."

Please indicate the language you will use during your presentation so that we can schedule our program accordingly. Nevertheless we strongly encourage you to present your paper in English as there are many non-Chinese speaking delegates. We also strongly encourage you to submit your final paper in English in order to ensure it to be included in IEEE Xplore and indexed by EI.

In addition to excellent technical sessions, we will also have stimulating and enriching keynote addresses and distinguished lectures by renowned researchers. For the most updated information on the conference, please check the conference website at http://www.ccdc.neu.edu.cn/. The Advanced Program will be available at the website around April 10, 2019.

We would like to take this opportunity to thank you for choosing 2019 CCDC to present your research results.

We look forward to seeing you in Nanchang, China!

Yours sincerely,

Changyun Wen and Zhong-Ping Jiang
Technical Program Chairs of 2019 CCDC

主　题:	Decision on IV2019 submission 493
发件人:	The IEEE Intelligent Transportation Systems Society Conference Management System　2019-4-11 8:25:21
收件人:	Jinxiang Wang
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Message from The IEEE Intelligent Transportation Systems Society Conference Management System

Message originated by Brendan Morris

From: Prof. Brendan Morris
To: Prof. Jinxiang Wang
Re: (Paper 493) Path Planning using a Kinematic Driver-Vehicle-Road Model with Consideration of Driver's Characteristics

Dear Author,

It is our pleasure to inform you that the paper identified above, for which you are listed as the corresponding author, has been accepted as a contributed paper to be presented at the 2019 IEEE Intelligent Vehicles Symposium (IV) (IV2019), June 9-12, 2019, in Paris, France. Please read this email carefully as it contains important information for the final submission of your paper.

It is commendable that your paper was among the papers selected for publication and presentation. You may log into your author workspace in the ITS Papercept website to see the reviews for your paper and the associate editor's summary. If requested, please revise your paper by following the reviews and comments.

Please convey this information and our congratulations to your co-authors, if any. The advance program for the conference will soon be available on the IV2019 website

http://iv2019.org/

Traditionally, IV2019 has been a single-track conference. All papers will be presented at the poster sessions to give all authors plenty of opportunities to engage in interactive discussions with conference participants. Additionally, about 10% of papers will be selected for oral presentation at lecture sessions and will be announced shortly.

Acceptance of your paper is made with the understanding that at least one author will attend the conference to present the paper. Earlier registration is highly recommended. If a paper is not presented during a session, it causes severe disruption to the conference program and will not be included in the conference Proceedings. To avoid such interruptions, we would greatly appreciate if you would inform us and withdraw your paper as soon as possible in the event that you or a co-author cannot attend the conference to present the paper.

Camera-ready copy of your manuscript is due by May 1, 2019 at

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All necessary forms needed for submission of your final manuscript will be created by the submission system at the time of the final submission. Please note that - as already mentioned in the submission instructions - the IEEE Intelligent Transportation Systems Society has a one-full-registration-per-paper policy. It means that at least one paper co-author must pay a full registration fee for inclusion in the proceedings, even for Workshop papers.

Also note that your final paper is limited to a total of six (6) pages including references. A maximum of two (2) supplementary pages is permitted at an extra charge. Further, due to space constraints on the proceedings of the conference, all papers are limited to 2 MB in size and should preferably be less than 500 KB.

At the time of uploading the final version of your manuscript, the manuscript submission website will require that you submit your abstract and make any modifications to the text, as requested by the reviewers, or any final changes to the author list and title of the paper before uploading the paper.

If you have any questions concerning the submission of your final paper, please check the IV2019 website where a list of contacts is provided. Also note that the Papercept website has a support section

http://its.papercept.net/conferences/support/support.php

On behalf of the IV2019 Program and Organizing Committees, we would like to thank you for your contributions and we look forward to seeing you in Paris, France.

Sincerely,

Program Chairs
Prof. Brendan Morris (Univ. of Nevada, Las Vegas)
Prof. Cristina Olaverri-Monreal (Johannes Kepler Univ.)
Prof. Fernando Garcia (Univ. Carlos III de Madrid)

http://iv2019.org/

Decision: Accepted as Contributed paper.
Final submission deadline May 1, 2019.

Submission information
Authors and title:
Yongjun Yan, Jinxiang Wang*, Kuoran Zhang, Mingcong Cao, Jiansong Chen
Path Planning using a Kinematic Driver-Vehicle-Road Model with Consideration of Driver's Characteristics
Conference: 2019 IEEE Intelligent Vehicles Symposium (IV).
Current status: Accepted.
Submission number: 493.

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A New Path Tracking Algorithm for Four-Wheel Differential Steering Vehicle

YongJun Yan, KeKe Geng, Shuaipeng Liu, YanJun Ren
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Abstract: Four-wheel differential steering vehicles are increasingly used in our lives, but there are few studies on the path tracking of four-wheel differential vehicles. According to the circular motion model of the differential steering vehicle, the pure-pursuit algorithm which was generally used in the front wheel steering vehicle is applied in this paper. In the process of experimental research, we used the integrated navigation system to record the vehicle's real-time positioning and tracking points, found that the error in the positioning process had an impact on the tracking effect. In order to reduce the impact of GPS record point data fluctuation on the tracking effect, a method to optimize the target path by minimizing lateral deviation and course deviation is proposed in this paper, which makes the target path easier to be tracked. Based on the established vehicle model and the pure tracking algorithm and the tracking curve optimization algorithm, we designed a new path tracking algorithm suitable for four-wheel differential steering vehicle, and conducted the linear and curve tracking experiments. Experimental results show proposed algorithm have extremely great tracking performance, which verifies the feasibility and effectiveness of the algorithm.

Key Words: Differential steering vehicle, Integrated navigation system, path optimization, Multiple conditions

1 INTRODUCTION

The wheels on both sides of the differential steering vehicle are independently driven, and the steering of different radius or even the in-situ steering is realized by changing the speed of the wheels on both sides. Comparing with the front wheel steering vehicle, the differential steering vehicle has the characteristics of compact structure, light weight, flexible maneuverability, etc. In recent years, it is more and more used in wheeled vehicles. The current research on four-wheel differential steering vehicles mostly focuses on the chassis control or single-mode path tracking issues, there are relatively few studies on multi-path condition tracking. A tracking method suitable for four-wheel differential steering vehicle is proposed in this paper, and the path tracking experiment under multiple working conditions is carried out.

A comparison of different tracking controllers for autonomous vehicles was performed in [1]. The geometry controller is designed according to the geometric model and consists of two common methods: pure-pursuit and Stanley. Pure-pursuit technology creates a virtual moving point in front of the vehicle. The tracking is achieved by tracking the moving point. The Stanley method is based on a nonlinear geometric controller that calculates the correction of the steering angle considering lateral and angular deviations [2]. The pure-pursuit algorithm selects the forward distance by speed, and the effect is relatively good, and it has strong robustness. The Stanley method is superior to the pure-pursuit method in most cases but is less robust for non-smooth paths [3]. Wit J S et al. proposed a vector tracking method that used the screw theory, which was similar to the pure-pursuit method, but this method was less sensitive to the forward distance than the pure-pursuit method [4]. Park M et al. proposed an advanced pure-pursuit algorithm that can reduce the cutting angle and make up for the shortcomings of the pure-pursuit method. At the same time, a dead band compensator was developed to overcome the dead band [5].Park S et al. proposed a target point pure-pursuit algorithm based on the lateral acceleration of the aircraft, which added adaptive capability to the change of vehicle speed due to external disturbances, such as wind, and it can realize a tight tracking when following curved paths [6].

Dynamic state feedback (linear and non-linear) control method shows better performance when the dynamics of vehicles and tires is considered. The Linear Quadratic Regulator (LQR) control law is easy to design, but when tracking trajectories with different curvature feedforward control, error-free tracking are required, however, adding feedforward control makes the tracking controller sensitive to discontinuities in the reference trajectory, which requires additional tuning to attenuate [3]. On the other hand, the method based on optimal control can provide accurate trajectory tracking, even at high speeds, but only in certain assumptions (for example, in the optimized field of view, the speed of the subject vehicle remains constant) .

Neural networks and fuzzy logic based on methods are also proposed in the literature which shows tracking performance similar to LQR controllers. However, in the absence of formal proof of stability and exception handling,

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Path Planning using a Kinematic Driver-Vehicle-Road Model with Consideration of Driver's Characteristics

Yongjun Yan, Jinxiang Wang, Kuoran Zhang, Mingcong Cao, and Jiansong Chen

Abstract— **A driver-vehicle-road (DVR) model based on kinematic vehicle model is proposed in this paper. In this DVR model, the kinematics vehicle-road model is adopted, and the driver model considering the human driver's characteristics is also included. Thus the behaviors of human driver's preview and neuromuscular delay can be considered in design of path planner and controller by using this DVR model. The repulsive force field based on the artificial potential field (APF) and the circle decomposition of vehicle shape are used to describe the constraints of obstacle avoidance and the road departure avoidance. Based on the proposed DVR model, a trajectory planer using model predictive control (MPC) is designed with consideration of collision and lane-departure avoidance, driver's intention, and vehicle occupant comfort. Simulation results show that with the proposed planner, the vehicle can successfully avoid static/moving obstacles and return to the original lane without lane departure. Simulation results indicate that the proposed kinematic vehicle model based DVR model can be used to design the path planner in normal driving and some typical driving scenarios. And the proposed path planner can provide the vehicle driven by different human drivers with individually safe trajectories in typical scenarios of obstacle avoidance.**

I. Introduction

Road traffic death is the ninth leading cause of death worldwide, and is expected to become the seventh leading cause by 2030 [1]. One solution to reduce road deaths effectively is using fully autonomous vehicles, but compared with the autonomous vehicles, it is more practical to use semi-autonomous vehicles currently. In semi-automated driving, drivers still play an important role. So the driving characteristics of different drivers were taken into consideration in model construction [2], [3].

Dynamic and kinematic vehicle model are generally used to design the vehicle lateral motion controllers [4]. Dynamic model is more widely used than the kinematic one, because the former can reflect the lateral motion of vehicles more precisely. However, the dynamic model requires many vehicle parameters, and most of these parameters have nonlinear characteristics such as side slip angle, cornering stiffness, tire parameters, etc. This will increase the computational complexity and reduce the real-time performance of the vehicle motion control [5]. In [6], [7], the effectiveness of the kinematic model in both path planning and path tracking at different vehicle speeds was verified. Kang et al [8] found that the change of front tire steering angle in highway autonomous driving was small, they expected that the kinematic vehicle model was enough for vehicle lateral motion control in highway autonomous driving.

In the maneuvers of path planning and path tracking, many researchers considered the combination of driver and vehicle dynamic model [9]. Parameters of the driver's steering characteristics such as delay time, preview time, and steering gain were used to represent drivers with different driving behaviors [10]. By considering these characteristics of drivers in controller design, the performance of the vehicle controller can be more human-like. When the drivers do not operate, the control behavior of the controller is closer to the operation behavior of the drivers, which can make the drivers feel comfortable. On the other hand, with consideration of the computational complexity by using the vehicle dynamic model, the kinematic vehicle model is more efficient to be applied for build the driver-vehicle-road (DVR) model for path planning.

The methods to realize real-time path planning is important for collision avoidance. The artificial potential field (APF) has been used to make collision-avoidance decisions [11]–[13]. The APF method was implemented in generating safety-oriented trajectory considering of both vehicle stability and environmental constraints [11], [12]. In [13], imaginary mountains of repulsive force fields were introduced to detect collision threat and lane boundaries. In order to describe the relationship between the ego vehicle and the obstacle vehicle better, the method of circle decomposition was adopted to describe the shape of vehicles. In [14], the collision-avoidance constraints between vehicles and obstacles were transformed into limit of the distance between center of the circles and the constraint polygons of obstacle. The APF method and the circle decomposition method were combined to solve the collision-avoidance problem under extreme driving conditions in [13].

In recent years, Model predictive control (MPC) has been used in local trajectory planning due to its ability to better deal with system constraints and nonlinearities [15]. In [16], a nonlinear MPC was utilized for obstacle avoidance of high-speed autonomous ground vehicles in unstructured environments. In [17], a MPC method was adopted to realize the trajectory planning algorithms by dealing with the interactions between different driver-vehicle systems. However, the computational burden of solving MPC problems in real time increased [15]. So the linear kinematic vehicle model and point mass vehicle model were used to reduce the computational burden in MPC [18], [19].

*This work is supported by National Natural Science Foundation of China (NSFC) under Grant 51675099, and U1664258, and National Key R&D Program of China under Grant 2018YFB1201602-08. All correspondence should be sent to J. Wang (Email: wangjx@seu.edu.cn).

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