同行专家业内评价意见书编号：20250858263

附件1

浙江工程师学院（浙江大学工程师学院）
同行专家业内评价意见书

姓名：唐彬彬

学号：22260076

申报工程师职称专业类别（领域）：能源动力

浙江工程师学院（浙江大学工程师学院）制

2025年05月26日

填表说明

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四、同行专家业内评价意见书编号由工程师学院填写，编号规则为：年份4位＋申报工程师职称专业类别(领域)4位+流水号3位，共11位。

一、个人申报

（一）基本情况【围绕《浙江工程师学院（浙江大学工程师学院）工程类专业学位研究生工程师职称评审参考指标》，结合该专业类别(领域)工程师职称评审相关标准，举例说明】

1.对本专业基础理论知识和专业技术知识掌握情况(不少于200字)

1）在知识掌握方面，我通过在校课程的系统学习与实际工作中的自主学习，扎实掌握了汽车智能化及自动化领域的核心理论与专业技能。我以优秀的成绩完成了汽车工程及智能化方向的各类课程学习，涵盖了车辆控制与理论技术、车辆工程专业课程设计与实践、车辆信息传感与通讯技术、优化算法、数值计算方法等重要课程内容。此外，在实际工作中，我自主学习了诸如TCP通讯、串口通讯、模型预测控制、最优控制算法、卡尔曼滤波、统计分析、机器学习、深度学习等相关理论知识，不断拓宽自己的技术视野和能力边界。

2）在研究生期间，我通过充实的工程实践和项目经验，培养了扎实的专业技术能力。参与企业工程项目不仅提升了我的专业素养，还增强了我在实际工作环境中的适应能力。我深入参与了项目的各个环节，包括项目前期的沟通对接、具体任务的实施、进度节点的汇报及项目结题等，能够从容应对任务中的各种挑战，如时间压力、项目进度滞后以及设备故障等突发情况。我的工作涉及到多种专业设备和技术工具的综合运用，能够有效利用现有的仪器设备、专业软件和数据采集工具进行项目研究和工程建设，例如：生理数据采集仪、IMU等设备开展数据采集，应用Matlab/Simulink、Carsim、Carmaker等软件进行算法开发与分析。此外，我还能够结合所学理论与实际需求，进行工程问题的综合解决与应用创新，例如：根据项目要求改造实验车辆、设计实验流程，并结合日常驾驶经验推动算法的创新与优化。我也具备较强的团队协作能力，能够在团队中发挥优势互补的作用，保持积极、及时的沟通，以确保任务顺利推进。

2.工程实践的经历(不少于200字)

1）于2023年7月至2024年8月在吉林维太科车辆技术有限公司进行专业实践训练，实践岗位为自动驾驶算法研究实习生，实践主要内容为数字孪生的学习与实践、自动驾驶规划控制算法的学习与实践等。
2）于2023年9月至2024年10月参与企业的应用性课题研究项目“汽车自动漂移控制”，开发可用于低附着、高附着路面的汽车自动漂移控制算法。
3）于2024年4月至2024年5月参与“第二届OnSite自动驾驶算法挑战赛”，设计自动驾驶算法并在虚拟仿真平台进行算法验证。
4）于2022年9月至2023年4月参与企业的应用性课题研究项目“汽车乘坐舒适度研究”，设计可用于缓解乘员晕动的方案、开展设计方案的验证实验。

3.在实际工作中综合运用所学知识解决复杂工程问题的案例（不少于1000字)

在实际工作中，通过综合运用所学的知识与技术，成功解决了多个复杂工程问题，特别是在自动驾驶技术领域的应用中。2023年7月至2024年8月期间，参与了以“舒适性的自动驾驶技术研究”为主题的专业训练项目，重点研究了自动驾驶决策规划与控制算法的开发，并将其应用于实际车辆进行验证。该项目的核心挑战在于，相比高速公路场景，城市交通环境更为复杂，主要由于高车辆密度、频繁的交通流动性以及多样化的道路形式，导致车辆间的交互更加复杂。在城市交通中，复杂的交通场景往往导致交通效率低下，频繁的加减速则对乘车舒适性产生负面影响。因此，开发高效且舒适的自动驾驶算法成为迫切需求。
1. 决策规划算法设计
在决策规划阶段，主要任务是根据实时环境信息计算车辆在即将进入交叉路口等复杂场景时

的最优行驶轨迹。为了实现这一目标，采用了基于优化的方法，综合考虑了安全性约束、舒适性需求及通行效率，计算出车辆的最优运动轨迹。

首先，基于车辆与周围其他车辆的相对位置、速度以及可能的交通行为，使用了模型预测控制（MPC）算法生成车辆的行驶轨迹。此过程确保轨迹不仅能够避免与其他车辆的碰撞，还能够最大化驾驶舒适性，避免频繁的加减速和剧烈转向，从而提高乘客的舒适体验。

2. 控制算法设计

在决策规划阶段生成的目标轨迹和目标速度之后，下一步是将这些决策转化为实际控制命令，确保车辆按照预定路径行驶。为此，采用了纯跟踪算法（Pure Pursuit）来控制车辆的转向行为，同时使用PID控制算法对规划的速度进行跟踪。该过程通过实时计算目标轨迹的当前状态，确定车辆所需的转向角度和加速度，确保车辆能够平稳地沿着预定轨迹前进。

3. 实车部署与调试流程

为了验证算法在实际环境中的表现，选择了基于在线控车辆的实验平台进行调试与测试。在实车部署前，首先对车辆进行了硬件配置。车辆底盘安装了GPS/IMU组合惯导系统，确保能够精准获取车辆的位置信息和动态状态。同时，利用CAN总线协议将车辆底盘、传感器和控制计算机连接起来，确保各个模块之间能够实时通讯并协同工作。在硬件配置完成后，重点进行了传感器的校准工作，确保GPS和IMU数据的精度。通过虚拟环境注入周围车辆信息和交通规则数据，实时构建了一个动态的交通背景。这些数据为决策规划算法提供了必要的环境信息，包括周围车辆的位置信息、速度、行驶方向以及道路上的交通信号等。在完成初步调试后，控制系统被部署到实际车辆上，开始进行实车测试。测试环境主要模拟了各种交通场景，重点验证算法在交叉路口、交通拥堵区域等场景下的表现。在测试过程中，发现了几个问题，例如在某些特定场景下，车辆的反应时间较慢，导致出现轻微的跟车距离过近等问题。为了解决这些问题，针对性地调整了控制算法的参数，并对决策规划算法进行了进一步优化。通过改进控制算法，使得车辆能够更精准地响应周围环境的变化，尤其是在遇到复杂交通状况时，能够保持较高的反应速度和舒适性。在对算法进行优化后，测试结果显示，车辆能够在城市交通环境中平稳行驶，且乘车体验得到显著改善。

（二）取得的业绩（代表作）【限填3项，须提交证明原件（包括发表的论文、出版的著作、专利证书、获奖证书、科技项目立项文件或合同、企业证明等）供核实，并提供复印件一份】					
1. 公开成果代表作【论文发表、专利成果、软件著作权、标准规范与行业工法制定、著作编写、科技成果获奖、学位论文等】					
成果名称	成果类别 [含论文、授权专利（含发明专利申请）、软件著作权、标准、工法、著作、获奖、学位论文等]	发表时间/授权或申请时间等	刊物名称/专利授权或申请号等	本人排名/总人数	备注
Can we Use Smart Phone on a Moving Vehicle Without Worrying About Carsickness? Developing an Effective Motion Cue APP with Driving Simulator and Real Vehicle Experiments	核心期刊	2024年06月03日	International Journal of Human - Computer Interaction	2/9	
Personalized Trajectory Planning Algorithm Considering Passenger Motion Sickness Level	会议论文	2023年09月23日	2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC)	1/6	

2.其他代表作【主持或参与的课题研究项目、科技成果应用转化推广、企业技术难题解决方案、自主研发设计的产品或样机、技术报告、设计图纸、软课题研究报告、可行性研究报告、规划设计方案、施工或调试报告、工程实验、技术培训教材、推动行业发展中发挥的作用及取得的经济社会效益等】

（三）在校期间课程、专业实践训练及学位论文相关情况	
课程成绩情况	按课程学分核算的平均成绩： 86 分
专业实践训练时间及考核情况(具有三年及以上工作经历的不作要求)	累计时间： 1.1 年（要求1年及以上） 考核成绩： 89 分
本人承诺	
个人声明：本人上述所填资料均为真实有效，如有虚假，愿承担一切责任，特此声明！ 申报人签名： 唐树彬	

22260076

二、日常表现考核评价及申报材料审核公示结果

日常表现考核评价	非定向生由德育导师考核评价、定向生由所在工作单位考核评价： ☑优秀　☐良好　☐合格　☐不合格 德育导师/定向生所在工作单位分管领导签字（公章）：周昌 2025年5月26日
申报材料审核公示	根据评审条件，工程师学院已对申报人员进行材料审核（学位课程成绩、专业实践训练时间及考核、学位论文、代表作等情况），并将符合要求的申报材料在学院网站公示不少于5个工作日，具体公示结果如下： ☐通过　☐不通过（具体原因：　） 工程师学院教学管理办公室审核签字（公章）：　年　月　日

浙 江 大 学 研 究 生 院

攻读硕士学位研究生成绩表

学号：22260076	姓名：唐彬彬	性别：男	学院：工程师学院	专业：能源动力	学制：2.5年
毕业时最低应获：26.0学分		已获得：29.0学分		入学年月：2022-09	毕业年月：
学位证书号：			毕业证书号：		授予学位：

学习时间	课程名称	备注	学分	成绩	课程性质	学习时间	课程名称	备注	学分	成绩	课程性质
2022-2023学年秋季学期	研究生英语		2.0	免修	公共学位课	2022-2023学年冬季学期	车辆信息传感与通信技术		3.0	90	专业学位课
2022-2023学年秋季学期	工程技术创新前沿		1.5	90	专业学位课	2022-2023学年冬季学期	产业技术发展前沿		1.5	82	专业学位课
2022-2023学年秋季学期	数值计算方法		2.0	87	专业选修课	2022-2023学年春季学期	自然辩证法概论		1.0	83	公共学位课
2022-2023学年秋季学期	研究生英语能力提升		1.0	免修	跨专业课	2022-2023学年春夏学期	工程伦理		2.0	91	公共学位课
2022-2023学年秋季学期	研究生英语基础技能		1.0	免修	公共学位课	2022-2023学年春夏学期	优化算法		3.0	84	专业选修课
2022-2023学年冬季学期	车辆控制理论与技术		3.0	90	专业学位课	2022-2023学年夏季学期	研究生论文写作指导		1.0	94	专业学位课
2022-2023学年秋冬学期	高阶工程认知实践		3.0	88	专业学位课		硕士生读书报告		2.0	通过	
2022-2023学年冬季学期	新时代中国特色社会主义理论与实践		2.0	91	公共学位课						

说明：1.研究生课程按三种方法计分：百分制，两级制（通过、不通过），五级制（优、良、中、及格、不及格）。

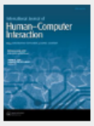
2.备注中“*”表示重修课程。

学院成绩校核章：

成绩校核人：张梦依

打印日期：2025-06-03

浙江大学研究生（60）成绩校核章



International Journal of Human–Computer Interaction ›
Volume 41, 2025 - Issue 9

Research Articles

Can we Use Smart Phone on a Moving Vehicle Without Worrying About Carsickness? Developing an Effective Motion Cue APP with Driving Simulator and Real Vehicle Experiments

Daofei Li, Binbin Tang, Tingzhe Yu, Linhui Chen, Keyuan Zhou, Nan Qie, ...show all

Pages 5245-5259 | Received 11 Jan 2024, Accepted 20 May 2024, Published online: 03 Jun 2024

Cite this article https://doi.org/10.1080/10447318.2024.2359204 Check for updates

Abstract

Formulae display: MathJax ?

The prevalence of motion sickness among passengers using personal electronic devices, such as smartphones, during vehicle journeys has become a growing concern. This issue is expected to intensify with the increasing adoption of assistant or automated driving functions, which may lead to non-driving tasks (NDT) being performed by all on-board passengers, including the user in the "driver" seat during conditionally or fully automated driving modes. This trend presents challenges related to motion sickness, particularly in terms of specific performance requirements for non-driving tasks. In response to the need to alleviate passenger motion sickness, we have developed an easy-to-understand animation cue app that can be conveniently implemented on smartphones. The motion cue conveys information about vehicle accelerations, including their directions and magnitudes, using the metaphors of traffic signal colors and backward-moving lane lines, either in straight or curved lane driving. Following several rounds of improvements based on moving-base simulator and real car experiments, finally a successful cue design was found, which could significantly alleviate motion sickness of passengers while engaging in NDT, with minimal impact on their NDT performances. However, the study also revealed limitations to the sickness-alleviating capability of our motion cue design, including potential lack of universal acceptance among different users and reduced effectiveness in severely uncomfortable driving conditions. This work may provide valuable insights for further visual cue improvements that can contribute in future carsickness-proof vehicles.

Keywords:

Motion sickness | non-driving tasks | sickness mitigation | visual cue | driving simulator | real car experiment

1. Introduction

The rapid advancement of autonomous driving technologies has expanded the range of passenger activities allowed inside vehicle cabins, especially non-driving tasks (NDT) such as watching videos and playing games on personal electronic devices. However, according to sensory conflict theory (Reason, 1978), engaging in NDT may lead to a conflict between visual motion information perceived by the eyes and motion information sensed by the vestibular system, resulting in severe motion sickness symptoms. These

INTERNATIONAL JOURNAL OF HUMAN–COMPUTER INTERACTION
https://doi.org/10.1080/10447318.2024.2359204

Can we Use Smart Phone on a Moving Vehicle Without Worrying About Carsickness? Developing an Effective Motion Cue APP with Driving Simulator and Real Vehicle Experiments

Daofei Li[a], Binbin Tang[a], Tingzhe Yu[a], Linhui Chen[a], Keyuan Zhou[b], Nan Qie[b], Yilei Shi[b], Cheng Lu[b], and Haimo Zhang[b]

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ABSTRACT

The prevalence of motion sickness among passengers using personal electronic devices, such as smartphones, during vehicle journeys has become a growing concern. This issue is expected to intensify with the increasing adoption of assistant or automated driving functions, which may lead to non-driving tasks (NDT) being performed by all on-board passengers, including the user in the "driver" seat during conditionally or fully automated driving modes. This trend presents challenges related to motion sickness, particularly in terms of specific performance requirements for non-driving tasks. In response to the need to alleviate passenger motion sickness, we have developed an easy-to-understand animation cue app that can be conveniently implemented on smartphones. The motion cue conveys information about vehicle accelerations, including their directions and magnitudes, using the metaphors of traffic signal colors and backward-moving lane lines, either in straight or curved lane driving. Following several rounds of improvements based on moving-base simulator and real car experiments, finally a successful cue design was found, which could significantly alleviate motion sickness of passengers while engaging in NDT, with minimal impact on their NDT performances. However, the study also revealed limitations to the sickness-alleviating capability of our motion cue design, including potential lack of universal acceptance among different users and reduced effectiveness in severely uncomfortable driving conditions. This work may provide valuable insights for further visual cue improvements that can contribute in future carsickness-proof vehicles.

KEYWORDS
Motion sickness; non-driving tasks; sickness mitigation; visual cue; driving simulator; real car experiment

1. Introduction

The rapid advancement of autonomous driving technologies has expanded the range of passenger activities allowed inside vehicle cabins, especially non-driving tasks (NDT) such as watching videos and playing games on personal electronic devices. However, according to sensory conflict theory (Reason, 1978), engaging in NDT may lead to a conflict between visual motion information perceived by the eyes and motion information sensed by the vestibular system, resulting in severe motion sickness symptoms. These symptoms, including yawning, distraction, dizziness, headache, nausea, and vomiting, significantly affect the passenger ride experience. Addressing motion sickness issues, or at least mitigating their negative impacts, remains a significant challenge in the automotive and transportation industries. If further considering the requirements of NDT performances, i.e., effectively and productively using smartphones on a moving vehicle without sickness concerns, substantial research in the field of human-computer interaction is needed.

Mitigating motion sickness in intelligent vehicles can involve various measures, starting from trip planning ("which kinds of transportation"), to motion planning ("route" or "lane"), to motion control ("powertrain" + "braking" + "steering" + "suspension"), and finally to human-vehicle-interfaces (HMI) within the cabin.

In recent years, many studies have focused on how to plan vehicle motion to make passenger more comfortable. For example, since the low-frequency vertical acceleration below 0.5 Hz is more prone to evoke motion sickness, motion sickness dose value (MSDV) can be calculated by weighting acceleration at different frequency bands to indicate the severity of motion sickness, according to ISO 2631-1:1997 (International Organization for Standardization [ISO], 1997). Subsequently, researches confirmed that horizontal acceleration contributes similarly to motion sickness, so MSDV can also be calculated by weighting longitudinal and lateral accelerations (Donohew & Griffin, 2004; Golding et al., 2001). With this, it is feasible to reduce the amplitude of low-frequency acceleration prone to cause motion sickness (Li & Hu, 2021) or to directly add MSDV in the cost

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Personalized Trajectory Planning Algorithm Considering Passenger Motion Sickness Level

Binbin Tang ; Tingzhe Yu ; Linhui Chen ; Jiajie Zhang ; Biao Xu ; Daofei Li All Authors

Abstract:
Autonomous vehicle, though rapidly developing, still faces several challenges, one of which is motion sickness. It is necessary to mitigate motion sickness without sacrificing driving safety. Even if experiencing the same vibrational stimulus, people experience motion sickness differently. However, in the field of motion planning that considers motion sickness, current studies are mostly focusing on how to reduce the discomfort index in general ways, i.e. not considering for any specific passenger. Therefore, to exploit further potential of sickness mitigation, two important issues need to be solved, 1) how to predict the motion sickness level; 2) how to plan a sickness-less trajectory. To this end, firstly we construct a radial basis function neural network model to predict the motion sickness level of passenger, based on the extensive experimental data that we accumulated previously. Then, we integrate this passenger-specific model into trajectory planning in autonomous vehicles, which is formulated as an optimal control problem. Finally, two typical scenarios prone to evoking motion sickness have been simulated to validate the proposed algorithm, including the lane change while decelerating and the longitudinal accelerating scenarios. Results demonstrate that our algorithm can generate safe and comfortable trajectories that are customizable according to passenger's specific susceptibility to motion sickness. Particularly, for those highly susceptible to motion sickness, our algorithm can reduce their motion sickness degree by 21.55% and 15.68% in the two above scenarios, respectively, compared with the conventional planning algorithm based on polynomial.

Published in: 2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC)

Date of Conference: 24-28 September 2023

DOI: 10.1109/ITSC57777.2023.10421959

Date Added to IEEE *Xplore*: 13 February 2024

Publisher: IEEE

ISBN Information:

Conference Location: Bilbao, Spain

ISSN Information:

Funding Agency:

SECTION I.
Introduction

2023 IEEE 26th International Conference on
Intelligent Transportation Systems (ITSC)
24-28 September 2023. Bilbao, Bizkaia, Spain

Personalized Trajectory Planning Algorithm Considering Passenger Motion Sickness Level

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2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC) | 979-8-3503-9946-2/23/$31.00 ©2023 IEEE | DOI: 10.1109/ITSC57777.2023.10421959

***Abstract*— Autonomous vehicle, though rapidly developing, still faces several challenges, one of which is motion sickness. It is necessary to mitigate motion sickness without sacrificing driving safety. Even if experiencing the same vibrational stimulus, people experience motion sickness differently. However, in the field of motion planning that considers motion sickness, current studies are mostly focusing on how to reduce the discomfort index in general ways, i.e. not considering for any specific passenger. Therefore, to exploit further potential of sickness mitigation, two important issues need to be solved, 1) how to predict the motion sickness level; 2) how to plan a sickness-less trajectory. To this end, firstly we construct a radial basis function neural network model to predict the motion sickness level of passenger, based on the extensive experimental data that we accumulated previously. Then, we integrate this passenger-specific model into trajectory planning in autonomous vehicles, which is formulated as an optimal control problem. Finally, two typical scenarios prone to evoking motion sickness have been simulated to validate the proposed algorithm, including the lane change while decelerating and the longitudinal accelerating scenarios. Results demonstrate that our algorithm can generate safe and comfortable trajectories that are customizable according to passenger's specific susceptibility to motion sickness. Particularly, for those highly susceptible to motion sickness, our algorithm can reduce their motion sickness degree by 21.55% and 15.68% in the two above scenarios, respectively, compared with the conventional planning algorithm based on polynomial.**

***Index Terms*— autonomous driving, motion sickness, trajectory planning, optimal control problem, ride comfort**

I. INTRODUCTION

Autonomous vehicle is likely to induce more serious motion sickness (MS), since the drivers are released from driving tasks and it is even worse when they conduct non-driving tasks (NDT), e.g. reading or gaming on phone. If not well handled, this challenge would greatly affect passengers' ride experience and undermine their trust in autonomous vehicles.

There have been some studies that consider MS in motion planning of autonomous vehicles. For example, in [1], various transition curves, e.g., B-spline, Bezier and Hermite curve, were evaluated to minimize MS probability. Optimization-based approaches are the most straightforward and extensively adopted. For instance, the subjective vertical conflict model was used for minimizing the motion sickness incidence (MSI) in turning [2] and lane change scenarios [3]. A trajectory planning method based on Nonlinear Model Predictive Control was developed for highway driving in [4]. Optimal Control Problem (OCP) formulation was used to plan one MS-optimum velocity profile on a given section of road [5]. Referring to ISO 2631-1:1997 [6], a frequency-shaping approach was proposed to optimize acceleration profile, specifically by rearranging the acceleration distribution at different frequencies to reduce the low frequency acceleration around 0.16 Hz [7].

Understably, even if experiencing the same vibrational stimulus, different passengers usually suffer differently from MS. This is due to the fact that different people are differently susceptible to MS, as suggested in the work [8]. However, in the field of motion planning that considers MS, current studies are mostly focusing on how to reduce the discomfort index in general way, i.e. not considering MS for any specific passenger.

Therefore, to exploit further potential of sickness mitigation in automated vehicles, two important issues need to be solved, 1) how to predict the MS level; 2) how to plan a sickness-less trajectory.

As for the prediction of MS, it is common to use physiological data during the ride, such as electrogastrography (EGG), electrodermal activity (EDA), electroencephalography (EEG), electrocardiography (ECG), attempting to indicate MS levels. Combined with the latest machine learning developments, a mapping between these indicators and the subjects' MS level is possible to be established. For example, a machine learning algorithm for predicting passenger MS level based on EEG data was designed, whose classification accuracy can reach over 95% [9]. In another research, a multi-modal fusion model has been proposed to predict MS level more consistently and accurately based on multiple physiological data [10]. However, in these studies the vibrational stimuli were not considered as model inputs, which means the model is not sufficiently related to motion itself. Additionally, even with the most advanced on-board occupant state monitoring system, these physiological data are not easy to access, due to concerns of privacy or sensor costs.

To this end, this paper contributes in two ways as follow.

1) We construct a radial basis function neural network (RBFNN) model to predict the MS level, based on the extensive experimental data that we accumulated previously. The model inputs mainly consist of motion

This work was supported by National Natural Science Foundation of China (Grant No. 52372421) and the Department of Science and Technology of Zhejiang under Grant 2022C01241 and 2023C01238. It was also supported by a student project from Scientific Research Fund of Zhejiang Provincial Education Department. The experimental works are supported by the Engineering Innovation and Training Center in Polytechnic Institute of Zhejiang University.

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