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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： 李孰

学号： 22260196

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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)

在交通运输专业理论知识方面，我系统掌握了交通规划、交通工程、运输管理等学科的核心理论，深入理解交通系统工程方法论、交通流理论模型及道路设计规范标准，能够运用层次分析法、四阶段法等技术开展交通需求预测与路网优化。同时，我掌握了自动驾驶前沿知识，包括感知模型，规控算法等。在专业技术知识方面，我能够熟练应用VISSIM、TransCAD等仿真软件完成交通组织方案模拟验证，运用Python、GIS工具进行交通大数据分析与可视化呈现，能够应用matlab等仿真软件进行自动驾驶仿真。

2. 工程实践的经历(不少于200字)

在浙江中控信息产业股份有限公司的自动驾驶人机共驾项目研发中，我主要负责驾驶控制权动态切换策略的算法优化与系统验证工作。针对人机协同驾驶中控制权切换时机模糊、驾驶员接管效率低等问题，基于ISO 26262标准构建了人机冲突评估模型，并分别使用概率共享算法和博弈论算法进行人机冲突消解。运用MATLAB/Simulink搭建多维度驾驶场景仿真平台，方向盘扭矩传感器等设备采集的驾驶员状态数据，开发了融合环境风险感知与驾驶员行为预测的切换决策算法。通过驾驶员在环实验完成300+组典型工况测试

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)

人机共驾是一种人类驾驶员与智能驾驶系统协同合作的驾驶模式，其有助于提高驾驶安全性和舒适性。然而，驾驶员和智能系统在驾驶意图、目标轨迹和驾驶习惯等方面存在明显差异，人机冲突依然是这一领域具有挑战性的问题。驾驶权分配方法是解决人机冲突的有效方式，但现有关于驾驶权分配方法的研究仍存在局限性，主要体现为智能系统对驾驶员的过度补偿和因意图不同而产生的人机冲突等问题。为解决上述问题，我围绕多决策主体转角耦合状态下的车辆横向控制权分配机制这个科学问题展开研究。

首先，构建了二自由度车辆动力学模型和车辆运动学模型，并对其进行了离散化处理。建立了基于模型预测控制的轨迹跟踪算法，用于实现智能系统对目标轨迹的跟踪。这些模型与算法为后续的研究提供了理论和技术支持。其次，本文设计了基于冲突度量的人机共驾驾驶权分配方法。推导了Stackelberg博弈均衡解的求解，并在此基础上进行改进，提出基于不完全信息的Stackelberg博弈方法。通过有限状态机对人机决策冲突进行量化，形成基于冲突度量的人机共驾驾驶权分配方法，从而减少智能系统对驾驶员的过度补偿。借助Carsim 和Simlink 仿真平台进行了实验验证，并利用东南大学Ubiquitous Traffic Eye数据集中的换道数据来评估不同驾驶风格的效果。仿真实验表明，该方法可有效降低因人机轨迹差异而产生的人机冲突并提高驾驶舒适度。

然后，提出了基于概率共享的人机共驾驾驶权分配方法。通过分析车辆状态与驾驶员决策，对短期轨迹进行预测，基于此计算驾驶员轨迹与智能系统轨迹之间的联合概率，选取具有最佳联合概率的轨迹作为人机共驾的目标轨迹。仿真实验结果显示，基于概率共享的人机共驾驾驶权分配方法能够消解人机意图差异导致的人机冲突，实现较好的驾驶效果。

最后，本文通过构建驾驶员在环实验平台，对所设计的方法进行了实验验证。驾驶员在环实验平台由Logitech G29 Driving Force 方向盘、Simulink 和Carsim

构建，招募多名不同驾驶风格的驾驶员参与实验。实验结果验证了本文的驾驶权分配方法在换道场景下的有效性，说明了基于冲突度量的人机共驾驾驶权分配方法能够降低驾驶负荷。基于概率共享的人机共驾驾驶权分配方法在消解因意图差异导致的人机冲突方面具有优越性。


总之，我在浙江中控信息产业股份有限公司的自动驾驶人机共驾项目研发中，综合运用所学知识解决了复杂的工程问题。主要用到的知识包括：二自由度车辆动力学模型和车辆运动学模型，最优化与最优化控制，博弈论，自动驾驶规控算法，模型预测控制算法，交通场景仿真，交通轨迹数据处理算法等。

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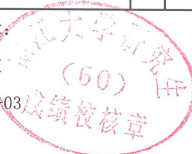
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Abstract

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Abstract:

In human-machine shared driving, the potential driving conflict between the natural driver and the automated system is an intractable issue. In order to effectively address the issue, a conflict resolution

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Conflict Resolution Methodology Based on Conflict Model for Human-Machine Shared Driving

Huang Li¹, Wei Jiang², Chunyue Song^{3*}, Yuxuan Yan⁴, Jun Zhao³

1. Polytechnic Institute, Zhejiang University, Hangzhou 310015, China
E-mail: li_huang@zju.edu.cn

2. The Mass Entrepreneurship and Innovation Center, State Grid Zhejiang Electric Power Co., Ltd, Hangzhou 310051, China
E-mail: schyby@sina.com

3. College of Control Science and Engineering, Zhejiang University, Hangzhou 310027, China
E-mail: song@zju.edu.cn; jzhao@zju.edu.cn

4. The Ant Group, Hangzhou 310023, China
E-mail: yuxuan@zju.edu.cn

Abstract: In human-machine shared driving, the potential driving conflict between the natural driver and the automated system is an intractable issue. In order to effectively address the issue, a conflict resolution method based on conflict model is proposed. We model the decision-making conflict between the driver and the automated system and give a definition of decision-making conflict. The decision-making conflict arises due to the difference in trajectory preview and the perception difference between the driver and the automated system. The decision-making conflict is resolved using incomplete information game theory. The effectiveness of the proposed conflict resolution method is demonstrated through simulation experiments and driver-in-the-loop experiments. The results of the experiments indicate that the proposed approach is highly effective in resolving conflicts that arise between the driver and the automated system in human-machine shared driving.

Key Words: Autonomous driving, conflict resolution, driver-in-the-loop, human-machine shared driving, game theory

1 Introduction

Numerous studies have demonstrated the potential of autonomous driving in enhancing driving safety and improving traffic efficiency [1]. However, high hardware costs and inadequate regulations have slowed down the development and widespread adoption of autonomous driving. We are encountering the difficulty in the rapid transition from assisted driving to fully autonomous driving [2]. The difficulty will exist for a long time. Human-machine shared driving is regarded as an effective method to overcome the difficulty [3].

Human-machine shared driving is a novel technology that combines the efforts of the driver and the automated system to perform driving tasks [4]. The driver and the automated system perceive the environment, make decisions and execute driving decisions in parallel. During driving, the automated system provides driving advice to the driver or shares the driving authority of the vehicle [5]. Human-machine shared driving not only gets the benefits of the automated driving but also keeps the driver in the driving loop [6]. Despite the many benefits of human-machine shared driving, the conflict between the driver and the automated system is a persistent challenge that needs to be addressed.

Conflict in human-machine shared driving is typically attributed to differences in perception and preview trajectories between the driver and the automated system [7]. Due to these differences, the driver and the automated system may make different assessments and driving

decisions, which can lead to conflicts. The conflicts can increase driving safety risks and even lead to security incidents [8]. Furthermore, the presence of conflicts can negatively affect the driver's driving operation and diminish driver's trust in the automated system. Therefore, it is important to address conflicts in human-machine shared driving to promote safe and efficient driving.

Currently, most of the solutions for resolving conflicts in human-machine shared driving rely on game theory, assuming perfect information [9]. Game theory provides an optimal framework for analyzing the decision-making process between the driver and the automated system and is well-suited for resolving the problem of allocating driving rights. Game theory methods used in human-machine shared driving include Nash equilibrium and Stackelberg equilibrium.

Most studies on allocating driving rights in human-machine shared driving using Nash equilibrium assume perfect information. M. Li et al. [10] proposed a novel dynamic control assignment strategy based on an elliptical driving safety field to solve the problem of human-machine conflict during obstacle avoidance. The Nash equilibrium solution is obtained through distributed model predictive control (DMPC). B. Ma et al. [11] designed a shared steering controller using a Nash equilibrium game strategy that balances the objectives of the driver and the automation system by adjusting lateral displacement weights. Additionally, X. Ji et al. [12] proposed a shared control framework based on stochastic Nash game theory and built a six-stage driver-vehicle dynamic system.

Stackelberg games are a type of non-cooperative, non-zero-sum, two-stage dynamic game that can be used to resolve conflicts between the driver and the automated

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Author affiliation:(1) Zhejiang University, Polytechnic Institute, Hangzhou, China; (2) Center State Grid Zhejiang Electric Power Co., Ltd, The Mass Entrepreneurship And Innovation, Hangzhou, China; (3) Zhejiang University, College Of Control Science And Engineering, Hangzhou, China

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Author affiliation:(1) Polytechnic Institute, Zhejiang University, Hangzhou; 310015, China; (2) The Mass Entrepreneurship and Innovation Center, State Grid Zhejiang Electric Power CO. Ltd, Hangzhou; 310051, China; (3) Zhejiang University, College of Control Science and Engineering, Hangzhou; 310027, China; (4) The Ant Group, Hangzhou; 310023, China

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Abstract

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Optimizing integrated energy systems' day-ahead scheduling lowers operating expenses. Human scheduling is more accurate and flexible, but machine scheduling can handle the uncertainty of

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1st Huang Li
Polytechnic Institute
Zhejiang University
Hangzhou, China
li_huang@zju.edu.cn

2nd Wei Jiang
The Mass Entrepreneurship and Innovation
Center
State Grid Zhejiang Electric Power Co., Ltd
Hangzhou, China
schyby@sina.com

3rd Lingjie Chen
Polytechnic Institute
Zhejiang University
Hangzhou, China
22260148@zju.edu.cn

4th Chunyue Song*
College of Control Science and Engineering
Zhejiang University
Hangzhou, China
csong@zju.edu.cn

Abstract—Optimizing integrated energy systems' day-ahead scheduling lowers operating expenses. Human scheduling is more accurate and flexible, but machine scheduling can handle the unpredictability of thermoelectric demands and renewable energy sources better. For integrated energy systems, we suggest a human-machine cooperation scheduling approach to fully leverage the benefits of both human and machine intelligence. By keeping the human involved, the human-machine cooperation scheduling approach prevents the decline of human proficiency and excessive reliance on the computer. Both human and computer scheduling decisions are assigned weights using fuzzy reasoning. The differences in human-machine decision-making and prediction are taken into consideration in the proposed method. Simulation trials illustrate the efficacy of the suggested human-machine cooperative scheduling strategy. The trials' findings show that the proposed method can successfully lower the integrated energy system's operating costs.

Keywords—human-machine cooperative, integrated energy system, fuzzy reasoning, human-machine system, optimized scheduling

I. INTRODUCTION

To address a variety of energy demands, integrated energy systems can incorporate renewable energy sources, natural gas grids, external power grids, and heat grids. It is complimentary and multi-coupled. Energy efficiency can be increased and renewable energy generation volatility can be handled via integrated energy systems[1].

Day-ahead scheduling optimization of integrated energy systems can reduce operating costs and improve operational efficiency [2]. Research on integrated energy system scheduling optimization has focused on constructing and solving optimization models. Dong [3] proposed a multi-timescale optimal operation strategy for an integrated energy system. The strategy considers integrated demand response and equipment response time. He [4] summarized the integrated energy system dispatch optimization method based on game theory. Game theory can effectively solve the problem of multi-intelligence transactions in integrated energy systems[5]. Arief [6] proposed an integrated energy system game model. The model takes into account the energy production side, supply chain and demand side. Chen [7] proposed a model of interoperability between different energy sources in an integrated energy system to achieve low-carbon operation. More efficiently than manual dispatch, model-

based automatic dispatch optimization strategies can handle fluctuations in renewable energy. Machines are more accurate than human in predicting demand for thermoelectricity[8]. Manual dispatch is more precise and adaptable, though[9]. Unexpected circumstances are better suited for human handling. In order to lower system operating costs, human-machine cooperation has been added to integrated energy systems. The benefits of both human and machine scheduling are combined in human-machine collaboration, which also keeps the operator informed. Staying informed keeps operators from becoming less proficient and from over-trust in the machine.

Human-machine collaboration means that humans and machines make decisions together to control the system[10]. In human-machine collaboration, the rule-based approach or game theory is the main method for decision weight allocation. Han [11] proposed a human-machine cooperative driving method based on a non-cooperative game. Machines make gaming decisions by predicting driver trajectories. He [12] addresses the problem of conflict in human-machine collaboration. Liu[13] quantifies and analyzes the conflicts that arise in human-machine collaboration and gives a method for conflict resolution. He used the Stackelberg game to construct a human-machine collaborative control model. This model takes into account the delay characteristics of human muscle nerves. Ezeh [14] proposed a rule-based human-machine cooperative control model for smart wheelchairs. The model uses probabilistic sharing for the assignment of human-machine weights. Human-machine collaboration has been studied in complex control areas such as assisted driving and robotics [15]. In human-machine collaboration, dynamic allocation of human-machine decision weights can improve the accuracy and robustness of the system.

In order to fully utilize the advantages of humans and machines in the scheduling optimization of integrated energy systems, this study proposes a human-machine collaboration method based on fuzzy reasoning. Fuzzy reasoning is used to assign decision weights to humans and machines. The human-machine collaborative scheduling method can reduce the system operation cost while ensuring that the human is in the loop.

Compared to current research on integrated energy system scheduling, the innovation of this paper can be summarized as follows:

Corresponding author: Chunyue Song.

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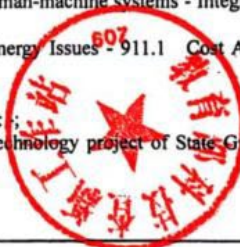
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<RECORD 2>

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Title:Conflict Resolution Methodology Based on Conflict Model for Human-Machine Shared Driving

Authors:Li, Huang (1); Jiang, Wei (2); Song, Chunyue (3); Yan, Yuxuan (4); Zhao, Jun (3)

Author affiliation:(1) Polytechnic Institute, Zhejiang University, Hangzhou; 310015, China; (2) The Mass Entrepreneurship and Innovation Center, State Grid Zhejiang Electric Power CO. Ltd, Hangzhou; 310051, China; (3) Zhejiang University, College of Control Science and Engineering, Hangzhou; 310027, China; (4) The Ant Group, Hangzhou; 310023, China

Corresponding author:Song, Chunyue(csong@zju.edu.cn)

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