同行专家业内评价意见书编号: 20240854152

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

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申报工程师职称专业类别（领域）： 电子信息

浙江工程师学院（浙江大学工程师学院）制

2024年03月18日

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】

基本情况

（1）对本专业基础理论知识和专业技术知识掌握情况

本人专业为电子信息大类下的控制工程专业，在本专业领域中，经过多年的努力学习，我在专业课程上有着坚实的理论基础，掌握了扎实的自动控制原理、模式识别与人工智能、现代控制理论、电路原理等课程的知识。除此之外，我有着较好的数理基础，掌握着数学建模和分析的理论知识和方法，如微积分、线性代数、概率论和数理统计等。同时，我理解并掌握设计开发控制系统所必须的计算机编程基础和数据结构等相关知识。在专业技术知识方面，我熟悉Python、C++、C编程语言，能够熟练利用其进行控制算法的设计和开发，并且能够熟练使用MATLAB、Simulink等控制工程专业的工具和软件，进行控制系统的仿真分析和设计。

（2）工程实践的经历

在工程实践上我有过一段历时668天的实践经历，实践公司为杭州大数云智科技有限公司，实践项目为与浙江省交通投资集团有限公司所合作的交通流预测与控制项目。实践内容包括在对沪杭甬高速公路门架数据分析的基础上研究合适的高速公路交通流预测模型和交通智能管控技术解决智能交通系统中交通拥堵等问题，提高交通出行的效率和安全性。具体的实践工作包括调研现有的高速公路交通流预测与控制算法，结合浙江省高速公路应用场景对现有的算法模型进行改进与优化，利用Python编程语言设计交通流预测与控制算法并进行效果验证，在此基础上将所设计的算法模型进行部署与落地应用，从而产生精益效益。

（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

在解决复杂工程问题上，我利用所学的知识解决了浙江省沪杭甬高速公路交通流预测与控制的问题。在目前的高速公路中一方面铺设了大量的各类传感器进行数据采集，但没有充分利用大数据和智能计算技术从所采集的数据中提取有价值的信息。另一方面高速公路拥堵频发，但目前对高速公路的管理和控制所采用定时控制和人工管理难以响应交通流状态突变的情况，存在一定的滞后性。因此利用传感器所采集的流量数据进行交通流预测和建立一种对交通流状态变化响应迅速、对交通流突变有较好控制效果的交通控制算法对缓解高速公路拥堵、提高运输效率有着重要意义和应用价值。交通流量预测是基于历史交通流量数据，对未来的交通流量进行预测。为了解决交通流量预测问题，需要考虑交通模式、数据类型、空间位置、时间周期等因素。现阶段基于深度学习的预测方法相比较基于统计分析的方法展现了一定的优越性，但现有的基于深度学习的方法没有充分考虑不同交通节点之间时空相互作用的相关性。为了深入挖掘交通节点之间的时空相关性，我引入图神经网络提出了一种新的时序时空相关性单元（SSTCU）方法来解决高速公路交通流量预测问题。SSTCU由一个时空相关单元（STCU）组成。STCU利用基于快速傅立叶变换的自相关机制捕捉不同时段之间的时间相关性，利用图神经网络注意力机制捕捉不同交通节点之间的空间相关性。能够深入挖掘交通节点之间的空间相关性、不同时间段之间的时间相关性以及时空交互的相关性。在高速公路交通控制上，我选取了可变限速控制这一重要控制措施来对高速公路合流区等容易引发交通拥堵的区域实施控制。为了克服以往可变限速控制策略过度依赖精确的交通模型以及对交通车流的变化响应慢等问题，此处将深度强化学习算法应用到可变限速控制策略中，并结合交通场景设计了控制算法的各个要素。状态空间设定为各条车道的占有率，该参数不仅可以衡量道路的拥堵程度，而且容易从目前高速公路中布设的各类交通检测器采集得到。动作空间通过将限速范围以5km/h进行离散化得到。为了解决延迟奖励的问题设计了以流量差作为奖励

函数并形成了整体控制框架和控制流程，同时设计了控制策略的详细部署架构。在此期间我所提出的基于图神经网络的交通流量预测模型已部署于浙江省交通投资集团云湖大数据平台之上并已开始应用。在对云湖数据平台上的门架抓拍等实时数据进行了完整性、实时性评估之后，进行了模型训练和推理，然后通过收集浙江省高速公路门架每5分钟时间间隔内的数据，对区域路网内未来5分钟至2小时的多粒度交通流进行预测，其中短时交通流量预测的准确度达95%以上。准确预测的交通流量信息可以帮助管理人员提前制定高效合理的交通引导措施，优化交通组织和调度，从而减少交通拥堵和能源消耗。在高速公路可变限速交通控制上，选取了浙江省沪杭甬高速公路红垦到萧山机场高速路段进行了评价，在春节假期返程高峰时期，通过该路段门架所采集到的数据分析证实所提出的基于深度强化学习的控制策略可提升约20%的通行效率。在节假日交通流量比较大的时间段内，该控制措施可以优化交通流量，减少交通拥堵情况，提供更稳定可靠的出行体验。以上经历即为本人综合运用所学知识解决复杂工程问题的一个案例，我除了具有一定的工程研究能力之外，还兼具扎实的工程落地实施能力。

（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
Deep Reinforcement Learning based Lane-level Variable Speed Limit Control	会议论文	2023年09月20日	IEEE International Conference on Control Science and Systems Engineering	1/4	EI收录
SSTCU:A Spatial-Temporal Correlation Unit based Traffic Flow Prediction Approach	会议论文	2023年07月26日	IEEE International Conference on Universal Village	共1/5	EI收录

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： 82 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： 1.8 **年**（要求1年及以上） 考核成绩： 85 分（要求80分及以上）
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：**	

22160304

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）：　　2024年5月19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：22160304	姓名：陈希瑜	性别：男	学院：工程师学院	专业：控制工程	学制：2.5年
毕业时最低应获：26.0学分		已获得：26.0学分		入学年月：2021-09	毕业年月：2024-03
学位证书号：1033532024602236			毕业证书号：103351202402600462		授予学位：电子信息硕士

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
2021-2022学年秋季学期	交通大数据分析		2.0	87	专业学位课	2021-2022学年春季学期	自然辩证法概论		1.0	85	公共学位课
2021-2022学年秋季学期	运筹学		2.0	83	专业选修课	2021-2022学年春季学期	研究生英语		2.0	免修	公共学位课
2021-2022学年冬季学期	模式识别与人工智能		2.0	88	专业选修课	2021-2022学年春季学期	研究生英语基础技能		1.0	免修	公共学位课
2021-2022学年秋冬季学期	中国特色社会主义理论与实践研究		2.0	85	公共学位课	2021-2022学年夏季学期	智能交通系统与实践应用		2.0	92	专业学位课
2021-2022学年冬季学期	智慧交通仿真实践		1.0	83	专业选修课	2022-2023学年秋季学期	创新创业实践训练		2.0	通过	跨专业课
2021-2022学年秋冬季学期	研究生论文写作指导		1.0	86	专业学位课	2022-2023学年秋冬季学期	工程前沿技术讲座		2.0	88	跨专业课
2021-2022学年春季学期	数学建模		2.0	91	专业选修课	2022-2023学年秋冬季学期	工程伦理		2.0	91	公共学位课
2021-2022学年春季学期	高速公路交通监控技术		2.0	82	专业学位课						

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：2024-04-02

Deep Reinforcement Learning Based Lane-Level Variable Speed Limit Control

Publisher: IEEE   Cite This   PDF

Xiyu Chen ; Juntao Jiang ; Jiandang Yang ; Yong Liu   **All Authors**

Abstract:
Variable speed limit (VSL) is an effective traffic control method to alleviate congestion and increase safety. This paper incorporates deep reinforcement learning (DRL) into the VSL control strategy and proposes a twin delayed deep determin-istic policy gradient (TD3)-based solution. We set different speed limits between every lane to control the speed of vehicles entering the highway merging area, thereby increasing the traffic flow and improving passing efficiency. The proposed model learns a large number of discrete actions within continuous actions through the actor-critic framework, using the reward signal based on the difference between inflow and outflow to train the agent. We selected real-world road segments and collected corresponding data to test the proposed method. The simulation results show that the VSL control based on TD3 can effectively reduce average travel time and increase the number of passing vehicles.

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2023 9th International Conference on Control Science and Systems Engineering

Deep Reinforcement Learning Based Lane-level Variable Speed Limit Control

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***Abstract*—Variable speed limit (VSL) is an effective traffic control method to alleviate congestion and increase safety. This paper incorporates deep reinforcement learning (DRL) into the VSL control strategy and proposes a twin delayed deep deterministic policy gradient (TD3)-based solution. We set different speed limits between every lane to control the speed of vehicles entering the highway merging area, thereby increasing the traffic flow and improving passing efficiency. The proposed model learns a large number of discrete actions within continuous actions through the actor-critic framework, using the reward signal based on the difference between inflow and outflow to train the agent. We selected real-world road segments and collected corresponding data to test the proposed method. The simulation results show that the VSL control based on TD3 can effectively reduce average travel time and increase the number of passing vehicles.**

***Keywords*—Deep reinforcement learning, TD3, Variable speed limit control, Intelligent transportation system**

I. Introduction

Highways are essential parts of the transportation networks. With the economy's development, the transportation demand continues to increase. Especially during holidays, highways are often plagued with congestion problems. The merging area, where traffic from various sections converges, is a common cause of interruptions in the primary traffic flow, leading to significant congestion. Once congestion occurs, passing capacity drops sharply, further aggravating the situation [1]. To alleviate highway congestion, developing intelligent transportation systems (ITS) is a practical and effective solution.

Variable speed limit (VSL), as a traffic control technology of ITS, effectively mitigates congestion in merging areas, enhancing traffic efficiency. VSL system dynamically detects traffic flow parameters of vehicles on the road and inputs this traffic flow information into the controller. After processing through an algorithm, the system outputs the calculated speed limit value to the variable message signs. VSL has been proven to enhance traffic safety [2, 3] and reduce environmental pollution [4] while simultaneously boosting traffic efficiency.

Traditional VSL strategies include determining the speed limit value based on traffic state thresholds or feedback control [5]. Recently, artificial intelligence has played a more critical role in traffic flow control. Reinforcement learning (RL), a branch of machine learning, involving interacting with the environment and receiving feedback, has been widely applied. The emergence of deep learning significantly improved RL, and deep reinforcement learning (DRL) has achieved impressive success in areas like robotics and gaming. There are many DRL methods, such as deep Q networks (DQN) [6], Deep Deterministic Policy Gradient (DDPG) [7], Proximal policy optimization (PPO) [8], twin delayed deep deterministic policy gradient (TD3) [9], etc. DRL also holds great potential for ITS control tasks. Experimental results demonstrate that DRL methods outperform traditional model-driven traffic control methods in traffic signal control, showing their practical application value [10].

Many scholars have applied RL to VSL [11–14]. In [11], Q-learning (QL) was applied to VSL and compared with the feedback strategy. The study found that VSL based on QL can significantly reduce travel time under different demands. To represent and explore the large state-action space, the study [12] applied DQN to VSL, and the results showed that this method could improve the average travel speed. A VSL algorithm based on DDPG was proposed in [13] to eliminate chronic highway bottlenecks. In [14], multi-agent reinforcement learning was applied to VSL. The proposed distributed QL-VSL method can improve traffic flow by maintaining high traffic density levels close to critical density on highways. This paper applies the TD3 algorithm to VSL and proposes a lane-based VSL algorithm for highway merging areas. Considering that the discrete action space of lane-based control is too large, we use continuous action output and map it to a discrete action space. This algorithm can set corresponding speed limits for both mainline and ramp according to real-time traffic states upstream and downstream.

The organization of this paper is as follows. Section II describes the mechanism of VSL. Section III introduces the TD3 algorithm and its application in VSL. Section IV presents the selected traffic scenarios and traffic demands. Section V analyzes the simulation results. Finally, the main conclusions are drawn in the last section.

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SSTCU:A Spatial-Temporal Correlation Unit based Traffic Flow Prediction Approach

Publisher: IEEE Cite This PDF

Yao Liu ; Xiyu Chen ; Zhongfu Jin ; Yujie Zhang ; Jiandang Yang **All Authors**

Abstract:
Traffic flow prediction is a crucial application in traffic guidance and control. Existing approaches rarely consider the dynamically correlated spatial-temporal features between multiple road segments. To effectively capture the spatial-temporal features between multiple road segments, we propose a novel approach, Spatial-Temporal Correlation Unit (STCU). STCU utilizes a fast Fourier transform-based autocorrelation mechanism to extract the correlations between temporal sequences, a graph attention mechanism to extract the correlations between spatial traffic monitors, and a feedforward neural network to fuse the interacting spatial-temporal correlations. We construct a traffic flow prediction model with a stacked STCU module called Sequential STCU (SSTCU). We conduct a lot of experiments and compared them with the several baselines to verify the effectiveness of SSTCU. The results show that the proposed method outperforms the baselines and achieves state-of-the-art performance. We also conduct ablation experiments to verify the effectiveness of the STCU module. Moreover, we change the layer depth of the model to find the most efficient setting for a computation efficiency consideration.

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SSTCU:A Spatial-Temporal Correlation Unit based Traffic Flow Prediction Approach

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***Abstract*—Traffic flow prediction is a crucial application in traffic guidance and control. Existing approaches rarely consider the dynamically correlated spatial-temporal features between multiple road segments. To effectively capture the spatial-temporal features between multiple road segments, we propose a novel approach, Spatial-Temporal Correlation Unit (STCU). STCU utilizes a fast Fourier transform-based autocorrelation mechanism to extract the correlations between temporal sequences, a graph attention mechanism to extract the correlations between spatial traffic monitors, and a feedforward neural network to fuse the interacting spatial-temporal correlations. We construct a traffic flow prediction model with a stacked STCU module called Sequential STCU (SSTCU). We conduct a lot of experiments and compared them with the several baselines to verify the effectiveness of SSTCU. The results show that the proposed method outperforms the baselines and achieves state-of-the-art performance. We also conduct ablation experiments to verify the effectiveness of the STCU module. Moreover, we change the layer depth of the model to find the most efficient setting for a computation efficiency consideration.**

Keywords*—*traffic flow prediction, attention mechanism, graph neural network, spatial-temporal features.

I. Introduction

As a relief from the rapidly increasing traffic demands, many countries have begun to develop Intelligent Transportation Systems (ITS) to decrease the risk of potential traffic jams and accidents and improve traffic efficiency. As a critical component in ITS, traffic flow prediction can optimize the traffic schedule beforehand, which is helpful for traffic flow control, vehicle route planning, and traffic congestion mitigation [1]. Therefore, many researchers and data scientists devote themselves to developing traffic flow prediction systems. Classical approaches utilize the time series models as tools since the temporal profile of traffic flow prediction can be modeled as a time series problem. For example, machine learning methods such as Support Vector Regression (SVR) [2] and K-Nearest Neighbours (KNNs) [3] have also been utilized for traffic flow prediction of a single road segment. The time series methods show adequate prediction performance for a single traffic monitor while losing their efficiency for a traffic network. Recently, Deep Learning (DL) approaches have been adopted as effective approaches for traffic flow prediction. Existing DL approaches can be divided into Convolutional Neural Networks (CNN) based methods and Recurrent Neural Networks (RNN) based methods. CNN-based traffic flow prediction approaches show adequate efficiency [4] due to the traffic network being geometrically irregular, which contradicts the regular Euclidean spatial formula in CNN models. RNN-based traffic flow prediction approaches include the Long Short Term Memory networks (LSTM) based approaches [5] and the Gated Recurrent Unit (GRU) based approaches [6]. RNN-based approaches are experts at tackling the temporal sequence analysis and prediction while suffering from the gradient vanishing problem, especially for long-term sequences [7]. Especially, Yao et al. [8] used both the CNN and LSTM models to predict traffic flow; however, the mentioned problems of the CNN and LSTM models still exist.

Graph Neural Network (GNN) [9] provides another solution for the problem on traffic flow prediction. GNN is powerful in modeling a spatial network with irregular geometric form [10]. Famous GNN approaches to traffic flow prediction include Diffusion Convolutional Recurrent Neural Networks (DCRNN) [11], Spatial-Temporal Graph Convolutional Networks (STGCN) [12], etc. These models introduce GNN to model the spatial dependency for the traffic network and utilize a time series method to model the temporal dependency for the traffic nodes. However, the utilized graph structure is static and pre-defined, which restricts the prediction accuracy. Thus, some researchers utilize the graph attention techniques [13]

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经检索"Engineering Village"，下述论文被《Ei Compendex》收录。(检索时间：2024年3月11日)。

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