同行专家业内评价意见书编号：20250861034

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：宋宴存

学号：22260191

申报工程师职称专业类别（领域）：交通运输

浙江工程师学院（浙江大学工程师学院）制

2025年05月22日

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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)

在基础理论知识方面：学习了交通工程原理包括交通流理论（宏观/微观交通流模型、通行能力分析），交通网络分析（图论、OD矩阵、路径规划算法）、学习了概率统计学、线性代数（矩阵运算、特征值分解）、概率论与数理统计（贝叶斯理论、假设检验）、时间序列分析（ARIMA、LSTM），以及机器学习与人工智能的相关知识包括监督学习（回归、分类）与非监督学习（聚类、降维）

在专业技术知识方面：我系统地学习了Python/R语言（Pandas、NumPy、Scikit-learn库）、数据库技术（SQL、NoSQL、时空数据库），其中重点包括交通GPS数据分析技术，掌握了时空数据处理、分析、挖掘等相关计算机技术。我也掌握了以python为工具的仿真模型的建立方法，可以模拟不同的出行场景，例如在共享单车领域，可以仿真车辆出行与出行行为选择。掌握了基本的全生命周期碳排放计算的方法。

2.工程实践的经历(不少于200字)

在宁波市共享微出行系统低碳管理优化项目中，我们团队围绕车辆无序停放、充电资源错配及碳排放评估粗放等核心问题，开展了一项跨学科工程实践。面对城市中心区共享电单车的高使用量与低效运营现状，项目以时空大数据分析与动态仿真为核心工具，系统整合全生命周期评估方法，探索管理策略的优化路径。

在车辆调度环节，团队通过解析出行数据，发现不同功能区的用户骑行行为存在显著差异：教育区域呈现出高频次、短距离的自组织闭环特征，而商业居住区则依赖人工调度维持供需平衡。基于此规律，我们设计了差异化调度策略，在教育区减少人工干预频率，转而利用用户自发骑行形成的动态平衡，同时在商业区引入需求响应机制，通过价格杠杆引导车辆流向低密度区域。这一策略大幅降低了传统调度模式对燃油车辆的依赖，显著减少了运营环节的碳排放。

针对充电桩布局难题，项目创新性地提出了电子栅栏规划技术，将出行热点时空分布与城市路网结构深度融合。通过仿真模拟用户寻桩行为与充电需求波动，团队构建了分层覆盖的充电桩布局方案，优先在通勤枢纽周边设置快充设施，并结合社区生活圈配置标准充电点位。该方案不仅缩短了用户寻桩时间，还通过优化充电桩利用率降低了设备冗余带来的资源浪费与隐性碳排放。

在碳排放评估层面，项目突破传统静态核算的局限，将代理模型与全生命周期分析动态耦合。通过模拟不同车队规模与车辆布局对生产、运营、回收各阶段的影响，团队揭示了车辆规模扩张与碳效益的非线性关系，并识别出关键阈值点。

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)

基于碳效益评估的共享微出行系统管理策略优化实践——以宁波市为例

随着全球城市化进程加快，共享微出行系统（Shared Micro-Mobility Systems, SMMS）因其灵活性和低碳特性，成为缓解交通拥堵与推动“双碳”目标的重要工具。然而，实际运营中面临车辆调度效率低、充电桩布局不合理、碳排放核算不精准等复杂问题。以宁波市中心城区为例，某研究团队围绕SMMS的碳效益评估与管理策略优化，综合运用时空大数据分析、全生命周期评估（LCA）与代理仿真模型（Agent Model），完成了一项覆盖技术研发、策略设计与政策落地的系统性工程实践。

宁波市中心城区作为典型的中等规模城市，共享电单车与单车日均使用量超10万人次，但无序停放、车辆空置率高、充电桩供需错配等问题突出。传统管理依赖人工调度，导致运营成本攀升，且缺乏对碳排放的系统评估。研究团队通过实地调研发现两大核心问题：一是车辆自组织行为未被量化利用，调度策略粗放；二是充电桩布局缺乏科学依据，导致用户寻桩耗时长、系统碳排放增加。此外，既有研究对SMMS全生命周期碳排放的测算存在静态化缺陷，难以支撑动态决策。

为解决上述问题，团队构建了“数据驱动分析—动态建模—策略优化”的全流程技术框架。首先，基于宁波市交通管理部门提供的共享出行订单数据（含GPS出行数据、用户骑行时间、起讫点等），结合土地利用数据（POI密度、功能区划分），利用时空聚类算法识别车辆自循环行为的空间特征。研究发现，教育集聚区的单车自循环链密度是居住商业区的2.3倍，且大部分单车在3天以内能够实现自循环行为。这一规律为差异化调度提供了依据：在教育区减少人工干预，利用用户自组织行为降低调度频次；在商业区通过动态定价引导车辆流向低密度区域。

针对碳排放评估的复杂性，团队创新性地将LCA与Agent Model耦合，构建动态碳核算体系。例如，在车辆生产阶段，通过数据分析得出单车制造碳排放为120 kg CO2-eq，电单车为280 kg CO2-eq；在运营阶段，使用代理模型模拟单车出行行为包括出行行为替代，动态计算出因为替代其他交通方式从而节约的碳排放；在回收阶段，按照全生命周期的计算方式根据历史回收的碳排放数据进行计算。通过仿真实验发现，当共享电单车车队规模超过3000辆时，因生产排放的线性增长与运营减排的边际效益下降，系统净碳效益出现拐点，这一结论直接指导了宁波市“控量提质”的政策调整。

在方法论层面，项目首次实现了“数据—模型—政策”的闭环验证。例如，通过重建30万条出行链，量化了自组织行为对调度成本的节约效应；通过Agent-LCA模型，揭示了车辆规模与碳效益的非线性关系，为政府避免“一刀切”管控提供了依据。

这一案例表明，交通大数据与复杂系统理论的结合，能够有效破解共享微出行管理的“粗放困局”，为城市低碳交通转型提供科学引擎。宁波市的实践经验不仅验证了技术路线的可行性，更展现了跨学科协同在解决复杂工程问题中的核心价值。

（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
Self-loop analysis based on dockless bike-sharing system via bike mobility chain: em- pirical evidence from Shanghai	权威期刊	2024年01月05日	Transportation	1/7	SCI期刊收录
Enhancing carbon efficiency in shared micro-mobility systems: An agent-based fleet size and layout assessment approach	权威期刊	2024年03月25日	Journal of Cleaner Production	2/6	SCI期刊收录
Nonlinear Influence and Interaction Effect on the Imbalance of Metro-Oriented Dockles Bike-Sharing System	国际期刊	2024年01月31日	Sustainability	1/7	SCI期刊收录

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】

<table>
<tr><td colspan="2">（三）在校期间课程、专业实践训练及学位论文相关情况</td></tr>
<tr><td>课程成绩情况</td><td>按课程学分核算的平均成绩： 87 分</td></tr>
<tr><td>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)</td><td>累计时间： 1 年（要求1年及以上）
考核成绩： 82 分</td></tr>
<tr><td colspan="2">本人承诺</td></tr>
<tr><td colspan="2">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：宋宴存</td></tr>
</table>

22260191

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）： 2025 年5月22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：22260191	姓名：宋宴存	性别：女	学院：工程师学院	专业：交通运输	学制：2.5年
毕业时最低应获：24.0学分		已获得：26.0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	工程技术创新前沿		1.5	75	专业学位课	2022-2023学年春季学期	自然辩证法概论		1.0	86	公共学位课
2022-2023学年秋冬学期	数据分析的概率统计基础		3.0	78	专业选修课	2022-2023学年春季学期	研究生英语基础技能		1.0	81	公共学位课
2022-2023学年秋冬学期	高阶工程认知实践		3.0	90	专业学位课	2022-2023学年夏季学期	综合交通运输规划		2.0	95	跨专业课
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	90	公共学位课	2022-2023学年春夏学期	工程伦理		2.0	85	公共学位课
2022-2023学年冬季学期	产业技术发展前沿		1.5	93	专业学位课	2022-2023学年夏季学期	研究生论文写作指导		1.0	90	专业学位课
2022-2023学年秋冬学期	研究生英语		2.0	83	公共学位课	2022-2023学年夏季学期	智能交通系统与实践应用		2.0	93	专业学位课
2022-2023学年春季学期	科技创新案例探讨与实战		2.0	90	专业选修课		硕士生读书报告		2.0	通过	

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

浙江大学研究生院（60）成绩校核章

Transportation
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Self-loop analysis based on dockless bike-sharing system via bike mobility chain: empirical evidence from Shanghai

Yancun Song[1] · Li Zhang[1] · Kang Luo[1] · Chenyan Wang[2] · Chengcheng Yu[3] · Yonggang Shen[1] · Qing Yu[4]

Accepted: 28 May 2024

Abstract
Self-loop is a unique phenomenon observed in the daily operations of bike-sharing systems, characterized by bike returning to its original starting point after several trips within the bike mobility chain. The bike mobility chain concept involves forming new bike chains with a minimal fleet size. By understanding self-loop behavior, we can optimize fleet management and reduce operational costs. This study specifically investigates the self-loop behavior within the bike mobility chain while considering potential demand, using the case of the dockless bike-sharing system in Shanghai, China. An advanced multiply censored Tobit model is utilized to incorporate potential demand into origin–destination (O–D) data and reconstruct the bike mobility chain. The formation mechanisms of self-loop chains based on the land use and geographic location are analyzed. Our model achieved an R^2 of 0.871, significantly outperforming the baseline model. The results indicate that 76% of the bike chains can form self-loops within a 2-week period. Campus areas exhibit the highest self-loop rates, while suburban campuses can sustain operations with minimal or no scheduling required. This study not only reveals the back-and-forth behavior but also provides insights for scheduling and deployment strategies to enhance the environmental sustainability of bike-sharing systems.

Keywords Bike-sharing system · Tobit model · Bike mobility chain · Self-loop analysis · Shared micro-mobility service

Introduction

Dockless bike-sharing systems were first introduced in China in 2016, and since then, their presence has significantly expanded across major cities in the country (Cao and Shen 2019), working as micro-mobility services to be a supplement of multi-modal public transportation system (Yang et al. 2023). The introduction of bike-sharing led to notable environmental and economic benefits for urban areas (Qiu and He 2018; Sun and Ertz 2022; Yu et al. 2020). However, the increasing number of shared bike systems has put pressure on cities and raised operational costs (Litan et al. 2023). Recently, a novel perspective based on the bike mobility chain offers new opportunities for mobility

Extended author information available on the last page of the article

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Enhancing carbon efficiency in shared micro-mobility systems: An agent-based fleet size and layout assessment approach

Yonggang Shen [a,c,e,1], Yancun Song [b,c,1], Qing Yu [d,*], Kang Luo [b], Ziyi Shi [a,c], Xiqun (Michael) Chen [a,c,**]

[a] Institute of Intelligent Transportation Systems, College of Civil Engineering and Architecture, Zhejiang University, Hangzhou, China
[b] Polytechnic Institute & Institute of Intelligent Transportation Systems, Zhejiang University, Hangzhou 310058, China
[c] Zhejiang Provincial Engineering Research Center for Intelligent Transportation, Hangzhou, China
[d] School of Urban Planning and Design, Peking University Shenzhen Graduate School, Shenzhen, 518055, China
[e] Innovation Center of Yangtze River Delta, Zhejiang University, Hangzhou, China

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Keywords:
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Life cycle assessment model
Fleet size deployment
Data-driven simulation

ABSTRACT

Shared micro-mobility systems (SMMS) have the potential to reduce CO_2 emissions of urban transportation. However, the reduction varies with fleet sizes (i.e., the number of different types of bikes in the market) and layouts. The excessive commercialization of SMMS has resulted in a decline in carbon benefits. In this study, we propose an agent-based model integrated with a lifecycle assessment (LCA) approach to evaluating the carbon benefits of unknown shared bike scale scenarios by establishing a brand-new SMMS. The proportion of satisfied actual trip demand and bike utilization rates also be analyzed for exploring the inherent mechanisms of SMMS. Take San Francisco, California, as an example, the evaluation of free-floating shared electric bikes and station-based shared-bikes analyzes five different layouts, each consisting of 121 different combinations. The results indicate that, for an area of approximately 100 km^2 with a daily travel demand of over ten thousand, a fleet size of 4500–7500 bikes is suggested, potentially leading to a weekly carbon reduction of 10,000–11,000 kg CO_2-eq. This study will provide insights for launch plan and scale management of SMMS from a sustainable perspective.

1. Introduction

Road traffic, with its high carbon emissions, poses a significant barrier to building low-carbon cities globally (Kazancoglu et al., 2021), and contributing to severe air pollution (Yu et al., 2023). According to the International Council on Clean Transportation (ICCT, 2020), there is an estimated increase of more than 70% in global CO_2 emissions related to transportation by 2050 (Zhong et al., 2023). It is necessary for the transportation sector to quickly undergo a low-carbon development transformation as part of a global effort to address climate change (Zhi-Yi et al., 2021).

Recent technological advancements have led to the rapid emergence of shared micro-mobility services (Reck et al., 2021). Shared micro-mobility services involve the use of small and lightweight human- or electric-power bikes shared among multiple users (Choi et al., 2023), and these transportation modes have the potential to reduce greenhouse gas (GHG) emissions (Liu et al., 2022). Many studies have investigated the carbon benefits of shared bike (SB) or shared electric bike (SEB) systems from a life cycle perspective (Wang et al., 2020). However, research has indicated that the over-commercialization and low utilization rate of shared micro-mobility can render it an environmentally unfriendly mode of transportation (Mao et al., 2021). The large-scale production and inadequate recycling of SBs can result in significantly negative environmental impacts (Mao et al., 2021). It has also been observed that the potential benefits of GHG emissions reduction from shared micro-mobility systems (SMMS) are significantly contingent upon its lifecycle mileage (Sun and Ertz, 2022). These studies highlight a critical issue: despite the inherent environmental friendliness of the SMMS, a critical threshold in terms of its scale necessitates careful consideration. Consequently, it becomes imperative to thoroughly investigate the relationship between fleet size and carbon efficiency.

* Corresponding author.
** Corresponding author at: Institute of Intelligent Transportation Systems, College of Civil Engineering and Architecture, Zhejiang University, Hangzhou, China.
E-mail addresses: yuq@pku.edu.cn (Q. Yu), chenxiqun@zju.edu.cn (X. Chen).
[1] These authors contributed equally to this work.

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0959-6526/

sustainability

Article

Nonlinear Influence and Interaction Effect on the Imbalance of Metro-Oriented Dockless Bike-Sharing System

Yancun Song [1,2,3,†], Kang Luo [3,†], Ziyi Shi [4], Long Zhang [1,2,3] and Yonggang Shen [2,4,*]

[1] Institute of Intelligent Transportation Systems, Zhejiang University, Hangzhou 310058, China; 22260191@zju.edu.cn (Y.S.); 22260193@zju.edu.cn (L.Z.)
[2] Zhejiang Provincial Engineering Research Center for Intelligent Transportation, Hangzhou 310058, China
[3] Polytechnic Institute, Zhejiang University, Hangzhou 310015, China; kangluo@zju.edu.cn
[4] Institute of Intelligent Transportation Systems, College of Civil Engineering and Architecture, Zhejiang University, Hangzhou 310058, China; zyshi@zju.edu.cn
* Correspondence: sygdesign@zju.edu.cn
† These authors contributed equally to this work.

Abstract: Dockless Bike-Sharing (DBS) is an eco-friendly, convenient, and popular form of ride-sharing. Metro-oriented DBS systems have the potential to promote sustainable transportation. However, the availability of DBS near metro stations often suffers from either scarcity or overabundance. To investigate the factors contributing to this imbalance, this paper examines the nonlinear influences and interactions that impact the DBS system near metro stations, with Shenzhen, China serving as a case study. An ensemble learning approach is employed to predict the imbalance state. Then, the machine learning interpretation method (i.e., SHapley Additive exPlanations) is used to quantify the contribution of effects, discover the strength of interactions between factors and uncover their underlying interactive connections. The results indicate the influence of external factors and the relations between pairwise variables (e.g., road density and the day of the week) for each imbalanced state. Provide two quantized sets of factors that can result in the supply-demand imbalance and support future transport planning decisions to enhance the accessibility and sustainability of Metro-oriented DBS systems.

Keywords: dockless bike-sharing (DBS); metro-oriented DBS system; imbalanced state; nonlinear influence; interaction effect; SHapley Additive exPlanations (SHAP)

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1. Introduction

Road traffic poses a significant obstacle to developing low-carbon cities worldwide due to its high carbon emissions [1]. In response, dockless Bike-Sharing (DBS) has been getting more focus in recent years due to its potential to promote greener travel habits, reduce carbon emissions, and lower energy use [2–5]. Even though issues like blocked sidewalks from parked bikes and infrequent use of helmets have been noted [6], people generally appreciate the flexibility that DBS systems offer. By the end of 2019, urban rail systems had been launched in forty cities in mainland China, with more cities planning to introduce such systems [7]. As these urban rail systems continue to grow, DBS programs can serve as a practical way for people to travel the first and last miles to and from metro stations [8], further promoting sustainability in urban transport.

However, DBS near metro stations is often scarce or overabundant, resulting in a phenomenon known as imbalance [9]. The underlying cause of this phenomenon is the imbalance between supply and demand, which predominantly occurs during peak hours. This imbalance, with its spatiotemporal characteristics, poses a challenge for the management of Metro-oriented DBS systems. Although there has been a growing interest in the combined use of DBS and metro [10], few articles have specifically investigated the factors influencing this imbalance. To fill this gap, this study aims to explore the relationship

经检索《Web of Science》、《Journal Citation Reports（JCR）》及《中国科学院文献情报中心期刊分区表》数据库，《Science Citation Index Expanded (SCI-EXPANDED)》收录论文及其期刊影响因子、分区情况如下。（检索时间：2024年9月18日）

第 1 条，共 1 条

标题: Self-loop analysis based on dockless bike-sharing system via bike mobility chain: empirical evidence from Shanghai

作者: Song, YC(Song, Yancun);Zhang, L(Zhang, Li);Luo, K(Luo, Kang);Wang, CY(Wang, Chenyan);Yu, CC(Yu, Chengcheng);Shen, YG(Shen, Yonggang);Yu, Q(Yu, Qing);

来源出版物:TRANSPORTATION **提前访问日期:**JUN 2024 **DOI:**10.1007/s11116-024-10500-w **出版年:**2024 JUN 5 2024

入藏号:WOS:001242214600002

文献类型: Article; Early Access

地址:

[Song, Yancun; Zhang, Li; Luo, Kang; Shen, Yonggang] Zhejiang Univ, Polytech Inst & Inst Intelligent Transportat Syst, Hangzhou 310058, Peoples R China.

[Wang, Chenyan] Shanghai Univ Finance & Econ, Sch Informat Management & Engn, Shanghai 200433, Peoples R China.

[Yu, Chengcheng] Tongji Univ, Urban Mobil Inst, Shanghai 200092, Peoples R China.

[Yu, Qing] Peking Univ, Shenzhen Grad Sch, Sch Urban Planning & Design, Shenzhen 518055, Peoples R China.

通讯作者地址:

Yu, Q (corresponding author), Peking Univ, Shenzhen Grad Sch, Sch Urban Planning & Design, Shenzhen 518055, Peoples R China.

电子邮件地址:22260191@zju.edu.cn; 22260297@zju.edu.cn; kangluo@zju.edu.cn;2020111491@live.sufe.edu.cn; chengchengyu@tongji.edu.cn;sygdesign@zju.edu.cn; yuq@pku.edu.cn

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期刊《TRANSPORTATION》2023 年的影响因子为 3.5，五年影响因子为 4.3。

期刊《TRANSPORTATION》2023 年的 JCR 分区情况为:

Edition	JCR® 类别	类别中的排序	JCR 分区
SCIE	ENGINEERING, CIVIL	45/181	Q1
SSCI	TRANSPORTATION	24/57	Q2
SCIE	TRANSPORTATION SCIENCE & TECHNOLOGY	26/72	Q2

期刊《TRANSPORTATION》2023 年升级版的中科院期刊分区情况为:

刊名	TRANSPORTATION

《SCI-EXPANDED》收录、《JCR》期刊影响因子、分区及中科院期刊分区证明

年份	2023		
ISSN	0049-4488		
	学科	分区	Top 期刊
大类	工程技术	2	否
小类	ENGINEERING, CIVIL 工程：土木	3	-
小类	TRANSPORTATION 交通运输	3	-
小类	TRANSPORTATION SCIENCE & TECHNOLOGY 运输科技	3	-

注:

1. 期刊影响因子及分区情况最新数据以 JCR 数据库、《中国科学院文献情报中心期刊分区表》最新数据为准。

2. 以上检索结果来自 CALIS 查收查引系统。

3. 以上检索结果均得到委托人及被检索作者的确认。

教育部科技查新工作站（Z09）

检索人（签章）：周伟

2024 年 9 月 18 日

经检索《Web of Science》和《Journal Citation Reports (JCR)》数据库，《Science Citation Index Expanded (SCI-EXPANDED)》收录论文及其期刊影响因子、分区情况如下。(检索时间：2024 年 8 月 13 日)

第 1 条，共 2 条

标题: Enhancing carbon efficiency in shared micro-mobility systems: An agent-based fleet size and layout assessment approach (Vol 443, 141209, 2024)

作者: Shen, YG(Shen, Yonggang);Song, YC(Song, Yancun);Yu, Q(Yu, Qing);Luo, K(Luo, Kang);Shi, ZY(Shi, Ziyi);Chen, XQ(Chen, Xiqun (Michael));

来源出版物:JOURNAL OF CLEANER PRODUCTION **卷:**446 **文献号:**141328 **提前访问日期:**MAR 2024

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文献类型: Correction

地址:

[Shen, Yonggang; Shi, Ziyi; Chen, Xiqun (Michael)] Zhejiang Univ, Coll Civil Engn & Architecture, Inst Intelligent Transportat Syst, Hangzhou, Peoples R China.

[Song, Yancun; Luo, Kang] Zhejiang Univ, Polytech Inst, Hangzhou 310058, Peoples R China.

[Song, Yancun; Luo, Kang] Zhejiang Univ, Inst Intelligent Transportat Syst, Hangzhou 310058, Peoples R China.

[Shen, Yonggang; Song, Yancun; Shi, Ziyi; Chen, Xiqun (Michael)] Zhejiang Prov Engn Res Ctr Intelligent Transportat, Hangzhou, Peoples R China.

[Yu, Qing] Peking Univ, Shenzhen Grad Sch, Sch Urban Planning & Design, Shenzhen 518055, Peoples R China.

[Shen, Yonggang] Zhejiang Univ, Innovat Ctr Yangtze River Delta, Hangzhou, Peoples R China.

[Yu, Qing] Peking Univ, Shenzhen Grad Sch, Sch Urban Planning & Design, Shenzhen, Peoples R China.

通讯作者地址:

Chen, XQ (corresponding author), Zhejiang Univ, Coll Civil Engn & Architecture, Inst Intelligent Transportat Syst, Hangzhou, Peoples R China.; Yu, Q (corresponding author), Peking Univ, Shenzhen Grad Sch, Sch Urban Planning & Design, Shenzhen, Peoples R China.

电子邮件地址:yuq@pku.edu.cn; chenxiqun@zju.edu.cn

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期刊《Journal of Cleaner Production》2023 年的 JCR 分区情况为:

Edition	JCR® 类别	类别中的排序	JCR 分区
SCIE	ENGINEERING, ENVIRONMENTAL	9/81	Q1
SCIE	ENVIRONMENTAL SCIENCES	24/358	Q1
SCIE	GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY	13/91	Q1

第 2 条，共 2 条

《SCI-EXPANDED》收录及《JCR》期刊影响因子、分区情况证明

标题: Nonlinear Influence and Interaction Effect on the Imbalance of Metro-Oriented Dockless Bike-Sharing System

作者: Song, YC(Song, Yancun);Luo, K(Luo, Kang);Shi, ZY(Shi, Ziyi);Zhang, L(Zhang, Long);Shen, YG(Shen, Yonggang);Tong, HY(Tong, Hing Yan);Torrao, G(Torrao, Guilhermina);

来源出版物:SUSTAINABILITY **卷:**16 **期:**1 **文献号:**349 **DOI:**10.3390/su16010349 **出版年:**JAN 2024

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文献类型: Article

地址:

[Song, Yancun; Zhang, Long] Zhejiang Univ, Inst Intelligent Transportat Syst, Hangzhou 310058, Peoples R China.

[Song, Yancun; Zhang, Long; Shen, Yonggang] Zhejiang Prov Engn Res Ctr Intelligent Transportat, Hangzhou 310058, Peoples R China.

[Song, Yancun; Luo, Kang; Zhang, Long] Zhejiang Univ, Polytech Inst, Hangzhou 310015, Peoples R China.

[Shi, Ziyi; Shen, Yonggang] Zhejiang Univ, Inst Intelligent Transportat Syst, Coll Civil Engn & Architecture, Hangzhou 310058, Peoples R China.

通讯作者地址:

Shen, YG (corresponding author), Zhejiang Prov Engn Res Ctr Intelligent Transportat, Hangzhou 310058, Peoples R China.; Shen, YG (corresponding author), Zhejiang Univ, Inst Intelligent Transportat Syst, Coll Civil Engn & Architecture, Hangzhou 310058, Peoples R China.

电子邮件地址:22260191@zju.edu.cn; kangluo@zju.edu.cn; zyshi@zju.edu.cn;22260193@zju.edu.cn; sygdesign@zju.edu.cn

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eISSN:2071-1050

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期刊《Sustainability》2023 年的 JCR 分区情况为:

Edition	JCR® 类别	类别中的排序	JCR 分区
SCIE	GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY	**58/91**	**Q3**
SSCI	GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY	**58/91**	**Q3**
SCIE	ENVIRONMENTAL SCIENCES	**159/358**	**Q2**
SSCI	ENVIRONMENTAL STUDIES	**66/182**	**Q2**

注:

1. **期刊影响因子及分区情况最新数据以 JCR 数据库最新数据为准。**
2. **以上检索结果来自 CALIS 查收查引系统。**
3. **以上检索结果均得到委托人及被检索作者的确认。**

教育部科技查新工作站（Z09）

检索人（签章）: 徐恺咏

2024 年 8 月 13 日