同行专家业内评价意见书编号：20240858109

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： 肖婷婷

学号： 22160191

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

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】

1.对本专业基础理论知识和专业技术知识掌握情况

工程案例表明，本人熟练掌握了电力系统专业的基础知识与技术知识，包括但不限于高等数学、线性代数、电路理论、微机原理与接口技术、电力电子技术、自动控制系统、计算机实时控制系统、现代控制理论、电力系统分析、系统软件和硬件方案设计等知识。

案例还表明，本人掌握了行业相关的前沿技术，即基于边缘计算的配电运行就地智能与协调控制技术，具体包括基于数字电网边缘计算装置的无功电压控制技术和基于数字电网边缘计算装置的电动汽车有序充电技术。以上技术实现的基础包括但不限于人工智能算法与软件开发等跨专业领域知识。

在工程实践中，本人还掌握了诊断设备故障的技能，学会实际理解设备的性能，将多种设备与技术系统地整合以实现最优效果，适应并掌握新技术以创新问题解决方案。此外，在与团队合作的过程中，本人还掌握了现场管理与协调、沟通与解释等默会性工程知识。

2.工程实践的经历

2021年9月至2023年8月，本人作为学生技术骨干之一参与国家重点研发计划《数字电网关键技术》项目，与团队合作完成课题二《面向多业务协同的数字电网边缘计算控制装置研发及应用》。

课题针对现有方法精度和泛化能力不高、速度相对较慢、较难嵌入式部署实现的缺点，提出了基于边缘计算的配电运行就地智能与协调控制技术。同时，通过边缘计算控制装置实现对充电桩的有序充电就地控制，达到削峰填谷的效果。此外，本人参加了项目研讨会与集中办公工作，参与制作项目汇报幻灯片与课题绩效评价报告等，参与完成项目预验收相关材料的准备。

最终，本人发表了SCI期刊2区TOP一篇、EI会议论文一篇，参与发表中文一级期刊《中国电机工程学报》一篇。同时，参与数字电网边缘计算嵌入式业务应用研发与示范工程一项，解决复杂工程问题两例，包括基于数字电网边缘计算装置实现控制无功电压与电动汽车有序充电。

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）

本人与团队协作，运用所学知识有效解决了两个复杂工程问题，参与完成了相关示范工程的建设。示范工程选址为广州市南沙自贸区中心区，覆盖6个变电站、13条馈线、29个配电房，含充电桩、分布式电源，安装边缘计算控制装置50台。此外，示范区涉及19个大型居民小区、4个城中村，涉及用户3万人以上。该示范区配电系统属于分布式光伏等多种新型源荷接入的典型城市配电系统。

案例一：基于数字电网边缘计算装置的无功电压控制技术研究与应用

针对示范区分布式电源接入导致配电网电压波动的问题，传统的解决方案基于集中式统一优化，造成了收集全局数据困难、通信压力大的难题。因此，在案例一中，利用云边协同架构分层控制，支撑边缘侧自治与高效运行。具体来说，采用云端协调优化的长时间尺度运行策

略与边侧短时间尺度多模态运行控制相结合的手段，兼顾了就地控制快速性和全局协调的最优性，使典型场景下电压波动数值下降了2%。

一方面，针对数字配电网规模化分布式电源控制难问题，选取广州南沙培评中心微电网实现对分布式电源就地控制功能的示范验证，展示算法运行优化效果。该示范区包含7组光伏逆变器，经由配电房并网，每组逆变器容量为36kW。最终，实现降低电压的波动。在运行控制中，边缘侧边缘计算装置以15min为尺度计算边缘侧7组分布式光伏逆变器的无功可调容量，并向云端主站上报；云端主站以边缘侧无功可调容量为依据，基于集中式控制获得优化后光伏的总无功出力及优化后的电压值，并由云主站下发至边缘计算装置；边缘侧边缘计算装置以1min为尺度，基于边缘侧本地预测，优化边缘侧分布式光伏逆变器的就地控制曲线，并利用7组分布式光伏逆变器并网点的电压量测获得7组逆变器各自的无功出力，经由CSD580协调控制器实现对光伏逆变器的无功控制。

另一方面，针对配电网边缘侧就地高效自治问题，开展就地电压无功调节功能示范验证，系统性展示配电网边缘侧自治优化算法优势。在澜悦3号综合房和沙螺湾1号综合房部署边缘计算装置，结合课题五的配电网智能优化云平台，建立云边协同的智能优化框架，对两组240kvar电容器组进行投切控制，实现无功电压支撑。由边缘计算装置监听主站下发的命令，以15分钟为指令周期，接收到主站下发的无功补偿指令后，边缘计算装置进入协同控制模式。边缘装置计算得到电容器控制命令，并通过Modbus协议与奔流智能电压检测器通信，由奔流智能电压监测器对电容器组执行投切动作。执行完毕后，监测器采集电容器状态，上报至边缘计算装置，并由边缘计算装置转发给配电自动化主站。若指令周期内配电自动化主站未下发命令，边缘计算装置进入就地控制模式，在电压控制模式或者功率因数控制模式下对电容器组进行就地控制。
案例二：基于数字电网边缘计算装置的电动汽车有序充电技术研究与应用

针对电动汽车无序充电负荷导致配电设备利用率不高、峰谷差加剧的问题，案例二依托边缘计算装置实现根据全局信息优化充电站控制指令，根据就地信息预测电压与功率变化趋势，协调优化电动汽车充电时段与功率，有效提升设备利用率和优化峰谷差。

示范应用场景选自广州市南沙局示范工程中市场监督管理局的充电桩。首先，在南沙区市场监督局充电桩安装边缘计算装置，同时改造充电桩的监测系统。边缘计算装置通过硬接线采集配变低压侧运行数据。同时，通过HPLC载波、RS485、无线网络、蓝牙等通信方式获取下行设备（充电桩和电气安全监控终端）的运行数据，包括电压、电流与功率数据。由负荷预测APP给出负荷预测信息，有序充电APP根据配变剩余可开放容量来调节充电桩功率。使用继电保护仪加量，模拟配变负载，调节继保仪输出，控制剩余可开放容量进入不同的区间和大小，观察有序充电APP的响应是否符合预期。若对电动汽车充电行为进行预测控制后，可在负荷高峰来临前主动限制电动汽车充电功率，保证配电变压器负载率不超过限值。

以上两个案例帮助创新边缘侧规模化数据的就地价值提取与融合利用机制，在此基础上提出基于就地智能的边缘感知与控制方法，突破了基于云-边、边-边协同架构的保护控制新技术，支撑实现了基于边缘计算的数字电网多业务智能协同运行。

（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**
A temporal and spatial electric vehicle charging optimization scheme with DSO-EVA coordination framework	TOP期刊	2023年12月28日	International Journal of Electrical Power & Energy Systems	1/3	SCI**期刊收录**
Research on Orderly Charging Strategy of Electric Vehicles Considering Uncertainties of User Behavior	会议论文	2023年11月03日	2023 10th International Forum on Electrical Engineering and Automation (IFEEA)	1/2	EI会议收录

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： 90 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： 1.5 **年**（要求1年及以上） 考核成绩： 88 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：**肖婷婷	

22160191

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 3月19日 中共浙江大学工程师学院委员会
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：22160191	姓名：肖婷婷	性别：女	学院：工程师学院	专业：电气工程	学制：2.5年
毕业时最低应获：26.0学分	已获得：27.0学分			入学年月：2021-09	毕业年月：2024-03
学位证书号：1033532024602199			毕业证书号：103351202402600425		授予学位：能源动力硕士

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	新能源发电与变流技术		2.0	99	专业学位课	2021-2022学年秋冬季学期	研究生论文写作指导		1.0	88	专业学位课
2021-2022学年秋季学期	计算机实时控制技术		2.0	94	专业学位课	2021-2022学年夏季学期	研究生英语基础技能		1.0	免修	公共学位课
2021-2022学年秋季学期	智能控制与智能系统		2.0	90	专业选修课	2021-2022学年夏季学期	研究生英语		2.0	免修	公共学位课
2021-2022学年秋冬季学期	现代控制理论		3.0	98	专业学位课	2021-2022学年夏季学期	自然辩证法概论		1.0	90	公共学位课
2021-2022学年冬季学期	综合能源系统集成优化		2.0	87	专业学位课	2021-2022学年春夏季学期	微电网技术工程实践		4.0	93	专业学位课
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	95	公共学位课	2021-2022学年春夏季学期	优化算法		3.0	97	专业选修课
2021-2022学年冬季学期	工程伦理		2.0	94	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）。

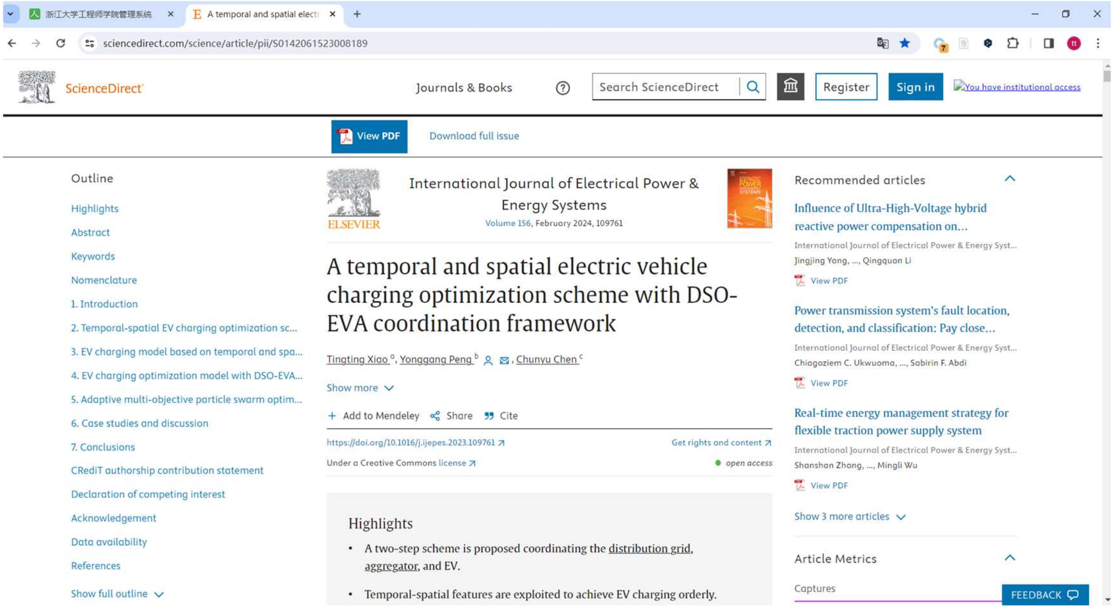
2. 备注中“*”表示重修课程。

学院成绩校核章：

成绩校核人：张梦依

打印日期：2024-04-02

[1] Xiao T, Peng Y, Chen C. A Temporal and Spatial Electric Vehicle Charging Optimization Scheme with DSO-EVA Coordination Framework[J]. International Journal of Electrical Power & Energy Systems, 2024, 156: 109761.（SCI）



Outline

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International Journal of Electrical Power & Energy Systems
Volume 156, February 2024, 109761

A temporal and spatial electric vehicle charging optimization scheme with DSO-EVA coordination framework

Tingting Xiao [a], Yonggang Peng [b], Chunyu Chen [c]

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Highlights

- A two-step scheme is proposed coordinating the distribution grid, aggregator, and EV.
- Temporal-spatial features are exploited to achieve EV charging orderly.

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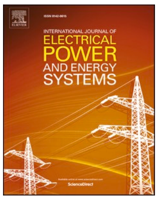

A temporal and spatial electric vehicle charging optimization scheme with DSO-EVA coordination framework

Tingting Xiao [a], Yonggang Peng [b,*], Chunyu Chen [c]

[a] Polytechnic Institute, Zhejiang University, Hangzhou 310015, China
[b] College of Electrical Engineering, Zhejiang University, Hangzhou 310027, China
[c] School of Electrical Engineering, China University of Mining and Technology, Xuzhou 221116, China

ARTICLE INFO

Keywords:
Demand response
Particle swarm optimization
Temporal-spatial feature
Mixed-integer second-order cone programming
Electric vehicle aggregator

ABSTRACT

Burdens of increasing penetration of electric vehicles (EVs) on distribution systems have attracted wide attention to the research of EV charging coordination. Nevertheless, existing coordination lacks the joint consideration of the temporal-spatial flexibility of EVs, which could reduce load fluctuations when meeting the EV charging demands. Moreover, a thorough investigation is required for the coordination of the benefits to the distribution system operator (DSO), EV aggregator (EVA), and EVs. In this paper, a novel EV charging scheme considering the temporal-spatial features of EVs is proposed, achieving the coordination of DSO, EVA, and EVs in two steps. First, a mixed-integer second-order cone programming (MISOCP)-based EV charging schedule is developed for DSO. Second, the temporal-spatial features of EVs are exploited by EVA to track the charging schedule. Specifically, a dynamic charging price mechanism based on active power margin is proposed for public charging facilities and a specific load regulation is designed for private charging facilities. On this basis, the modified adaptive multi-objective particle swarm optimization (AMOPSO) algorithm is proposed, including adaptive flight parameter adjustment and termination mechanisms. Case studies demonstrate the proposed strategy can attenuate load variance and raise EVA revenue. Further, the impact analysis of penalty price and the price elasticity of electricity demand can provide references for stable distribution network operation, higher EVA revenue, and charging cost reduction.

1. Introduction

Low-carbon development has become a significant challenge globally, with over 70 countries committed to achieving net-zero emissions by 2050 [1]. Consequently, the critical role of transportation energy electrification in this transition has heightened scholarly concerns about electric vehicles (EVs) [2,3]. Despite the benefits of emission reduction, the high penetration of EVs has caused problems in the electrical power system, including elevated peak loads [4] and power instrument overloads [5]. Under these circumstances, an effective EV charging strategy, capable of attenuating peak loads and smoothing the network load curve, is substantially appealing to the system operator [6–8]. Therefore, it is essential to investigate EV charging to improve the stability and operational efficiency of the distribution network.

Existing EV charging coordination research has predominantly incorporated three parties, namely the distribution system operator (DSO), EV aggregator (EVA), and EV owners. Grid-friendly EV charging coordination is investigated in [9] to foster the safe and economical operation of the distribution network. However, with the increasing penetration of EVs, it is difficult for the DSO to centrally coordinate all EVs under a feasible solution [10]. Hence, an EVA is introduced as an intermediary between the DSO and EVs for EV charging coordination [11]. Additionally, reducing charging costs [12] and preserving EV owners' privacy [13,14] are crucial to incentivizing owners' participation. Therefore, a large-scale EV charging coordination scheme must reflect the composite interests of DSO, EVA, and EV owners. Nevertheless, extant research lacks a comprehensive framework that simultaneously addresses these three parties' interests. For example, reference [15] utilizes EV charging to regulate load curtailments, which bolsters the security of the power system operation. However, the reduction in charging costs for EV owners is not reflected. Additionally, the EV owner's interests are involved in [16] while the EVA revenue is not considered, which makes the charging scheduling inconsistent with actual results. An optimal approach in [17] employs EV charging activities to offer flexibility for the distribution network, which only

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* Corresponding author.
E-mail address: pengyg@zju.edu.cn (Y. Peng).

https://doi.org/10.1016/j.ijepes.2023.109761
Received 27 April 2023; Received in revised form 9 November 2023; Accepted 28 December 2023
Available online 4 January 2024
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第 1 条，共 1 条

标题:A temporal and spatial electric vehicle charging optimization scheme with DSO-EVA coordination framework

作者: Xiao, TT(Xiao, Tingting);Peng, YG(Peng, Yonggang);Chen, CY(Chen, Chunyu);

来源出版物:INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS

卷:156 **文献号:**109761 **提前访问日期:**JAN 2024 **DOI:**10.1016/j.ijepes.2023.109761 **出版年:**2024 FEB 2024

入藏号:WOS:001154607100001

文献类型: Article; Early Access

地址:

[Xiao, Tingting] Zhejiang Univ, Polytech Inst, Hangzhou 310015, Peoples R China.

[Peng, Yonggang] Zhejiang Univ, Coll Elect Engn, Hangzhou 310027, Peoples R China.

[Chen, Chunyu] China Univ Min & Technol, Sch Elect Engn, Xuzhou 221116, Peoples R China.

通讯作者地址:

Peng, YG (corresponding author), Zhejiang Univ, Coll Elect Engn, Hangzhou 310027, Peoples R China.

电子邮件地址:pengyg@zju.edu.cn

IDS 号:GS2W5

ISSN:0142-0615

eISSN:1879-3517

注:

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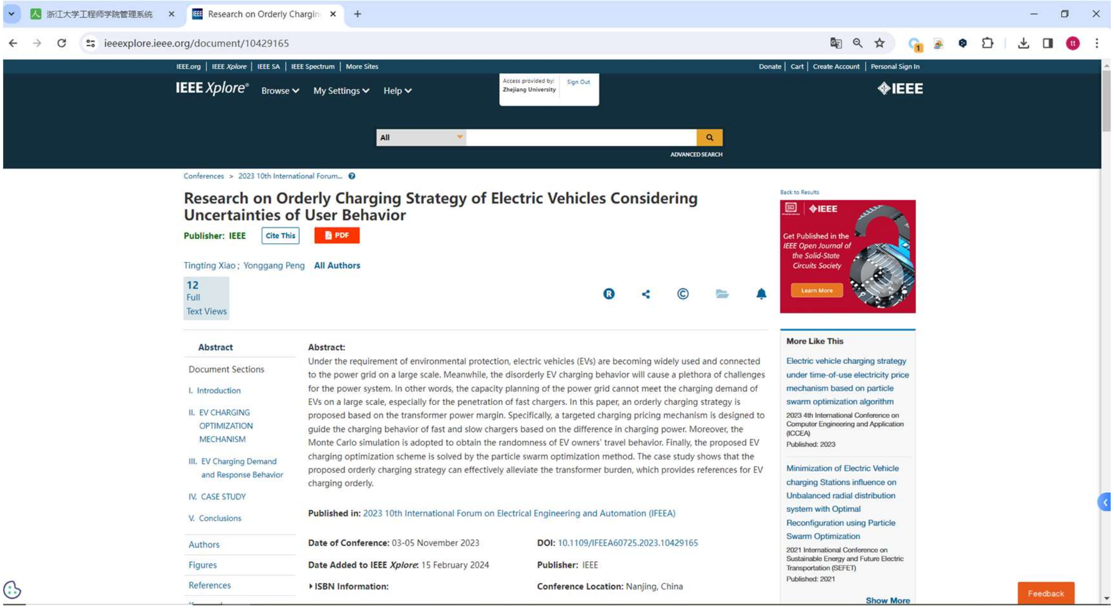
2. **以上检索结果均得到委托人及被检索作者的确认。**

教育部科技查新工作站（Z09）
检索人（签章）：应湘艺
2024 年 3 月 12 日

[2] Xiao T, Peng Y. Research on Orderly Charging Strategy of Electric Vehicles Considering Uncertainties of User Behavior [C]// 2023 10th International Forum on Electrical Engineering and Automation (IFEEA). Nanjing, China: IEEE, 2023.（EI）



Research on Orderly Charging Strategy of Electric Vehicles Considering Uncertainties of User Behavior

Publisher: IEEE

Tingting Xiao ; Yonggang Peng

12 Full Text Views

Abstract
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III. EV Charging Demand and Response Behavior
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Abstract:
Under the requirement of environmental protection, electric vehicles (EVs) are becoming widely used and connected to the power grid on a large scale. Meanwhile, the disorderly EV charging behavior will cause a plethora of challenges for the power system. In other words, the capacity planning of the power grid cannot meet the charging demand of EVs on a large scale, especially for the penetration of fast chargers. In this paper, an orderly charging strategy is proposed based on the transformer power margin. Specifically, a targeted charging pricing mechanism is designed to guide the charging behavior of fast and slow chargers based on the difference in charging power. Moreover, the Monte Carlo simulation is adopted to obtain the randomness of EV owners' travel behavior. Finally, the proposed EV charging optimization scheme is solved by the particle swarm optimization method. The case study shows that the proposed orderly charging strategy can effectively alleviate the transformer burden, which provides references for EV charging orderly.

Published in: 2023 10th International Forum on Electrical Engineering and Automation (IFEEA)

Date of Conference: 03-05 November 2023

DOI: 10.1109/IFEEA60725.2023.10429165

Date Added to IEEE *Xplore*: 15 February 2024

Publisher: IEEE

ISBN Information:

Conference Location: Nanjing, China

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2023 10th International Forum on Electrical Engineering and Automation (IFEEA)

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2023 10th International Forum on Electrical Engineering and Automation (IFEEA) | 979-8-3503-0937-9/23/$31.00 ©2023 IEEE | DOI: 10.1109/IFEEA60725.2023.10429165

Tingting Xiao
Polytechnic Institute, Zhejiang University
Hangzhou, China

Yonggang Peng*
College of Electrical Engineering, Zhejiang University
Hangzhou, China
pengyg@zju.edu.cn

***Abstract*—Under the requirement of environmental protection, electric vehicles (EVs) are becoming widely used and connected to the power grid on a large scale. Meanwhile, the disorderly EV charging behavior will cause a plethora of challenges for the power system. In other words, the capacity planning of the power grid cannot meet the charging demand of EVs on a large scale, especially for the penetration of fast chargers. In this paper, an orderly charging strategy is proposed based on the transformer power margin. Specifically, a targeted charging pricing mechanism is designed to guide the charging behavior of fast and slow chargers based on the difference in charging power. Moreover, the Monte Carlo simulation is adopted to obtain the randomness of EV owners' travel behavior. Finally, the proposed EV charging optimization scheme is solved by the particle swarm optimization method. The case study shows that the proposed orderly charging strategy can effectively alleviate the transformer burden, which provides references for EV charging orderly.**

Keywords-pricing strategy; electric vehicle; user behavior; Monte Carlo simulation; particle swarm optimization

I. INTRODUCTION

Nowadays, electric vehicles (EVs) are attracting considerable interest due to environmental concerns and the global commitment to reducing carbon emissions [1]. However, the widespread adoption of EVs has inadvertently brought a plethora of challenges for the existing power system [2]. Specifically, a large number of EVs connected to the distribution network will lead to load peaks, which will burden the existing power infrastructure. For example, the surging electricity demand, coupled with disorderly EV charging behavior, may lead to transformer overloads [3]. Therefore, it is essential to investigate an orderly EV charging strategy to mitigate the burden on the power system.

Recent developments in orderly EV charging strategy have mainly focused on improving the stable operation of the electric power system, increasing revenues for EV aggregator (EVA), and reducing the charging costs of EV owners [4–7]. On the one hand, improving revenues for EVA is beneficial in motivating them to participate in maintaining the stable operation of the grid. On the other hand, decreasing the charging costs for EV owners will encourage them to take part in the charging optimization scheme. Therefore, the major objective of the EV orderly charging strategy revolves around these three in recent years. For example, reference [5] uses an optimized time-of-use pricing method to achieve EV charging orderly, which effectively reduces the peak load and enhances the stability and efficiency of power system operation. Reference [6] formulates the objective function for maximizing the comprehensive benefits of EVA to guide EV charging orderly. Reference [7] focuses on minimizing the charging costs for EV owners while improving the safety and economy of the grid operation.

However, previous work has failed to take into account the differences between the fast charging mode and the slow charging mode for EVs. For instance, reference [8] proposes an EV charging optimization scheme for DC fast charging stations based on the Genetic Algorithm and Dynamic Programming method, which fails to achieve the coordination optimization for slow charging stations. Orderly EV charging strategies in [5,6] only involve the slow charging mode, which fails to involve the fast charging mode in real applications. Generally, EV charging can choose one from both fast charging mode and slow charging mode in regional distribution network. Specifically, the charging power rate of the EV fast charging mode is about 3-20 times higher than that of the slow charging mode [9]. In other words, the fast charging mode imposes more load-carrying pressure on the power system than the slow charging mode. Meanwhile, the charging behavior and travel characteristics of EV owners are usually uncertain [10], which may reduce user satisfaction and acceptance of EV charging optimization strategy [11]. Besides, these uncertainties will also lead to unpredictable fluctuations of loads and affect the efficiency of the proposed EV charging orderly strategy, especially during peak hours [12]. Hence, it is necessary to formulate a targeted EV charging orderly strategy to guide the fast and slow charging EVs while considering the uncertainties in EV charging behavior.

Therefore, this paper proposed an orderly charging strategy for EVs considering uncertainties of user behavior. The Monte Carlo simulation method is adopted to obtain the disorderly charging load and simulate uncertainties of EV owners. Firstly, an effective EV charging optimization scheme is designed, which includes fast charging piles and slow charging piles. Secondly, a charging pricing method based on the active power margin of the transformer is proposed for EVA. Specifically, the charging price is different in fast and slow charging piles according to charging power rates. Thirdly, EV owners will decide on whether to participate in the charging optimization scheme or not to reduce their charging costs while meeting travel demands. Finally, the charging time of EVs participating

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Accession number:20241015692765
Title:Research on Orderly Charging Strategy of Electric Vehicles Considering Uncertainties of User Behavior
Authors:Xiao, Tingting (1); Peng, Yonggang (2)
Author affiliation:(1) Zhejiang University, Polytechnic Institute, Hangzhou, China; (2) Zhejiang University, College of Electrical Engineering, Hangzhou, China
Corresponding author:Peng, Yonggang(pengyg@zju.edu.cn)
Source title:2023 10th International Forum on Electrical Engineering and Automation, IFEEA 2023
Abbreviated source title:Int. Forum Electr. Eng. Autom., IFEEA
Part number:1 of 1
Issue title:2023 10th International Forum on Electrical Engineering and Automation, IFEEA 2023
Issue date:2023
Publication year:2023
Pages:1030-1033
Language:English
ISBN-13:9798350309379
Document type:Conference article (CA)
Conference name:10th International Forum on Electrical Engineering and Automation, IFEEA 2023
Conference date:November 3, 2023 - November 5, 2023
Conference location:Hybrid, Nanjing, China
Conference code:197343
Sponsor:IEEE
Publisher:Institute of Electrical and Electronics Engineers Inc.
Number of references:14
DOI:10.1109/IFEEA60725.2023.10429165
Funding text:This work was supported by the National Natural Science Foundation of China under Grant 51877188 and the National Key Research and Development Program of China under Grants 2020YFB0906000 and 2020YFB0906002.
Database:Compendex
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