Retraction

Retraction: Research on Urban Electric Vehicle Public Charging Network Based on 5G and Big Data (J. Phys.: Conf. Ser. 2066 012045)

Published 9 September 2022

This article has been retracted by IOP Publishing following an allegation that raises concerns this article may have been created, manipulated, and/or sold by a commercial entity. In addition, IOP Publishing has seen no evidence that reliable peer review was conducted on this article, despite the clear standards expected of and communicated to conference organisers.

The authors of the article have been given opportunity to present evidence that they were the original and genuine creators of the work, however at the time of publication of this notice, IOP Publishing has not received any response. IOP Publishing has analysed the article and agrees there are enough indicators to cause serious doubts over the legitimacy of the work and agree this article should be retracted. The authors are encouraged to contact IOP Publishing Limited if they have any comments on this retraction.

Retraction published: 9 September 2022
Research on Urban Electric Vehicle Public Charging Network Based on 5G and Big Data

Weijing Yao*, Cheng Zhang, Guoru Deng, Wansong Ke, Dai Zhang and Lei Li
State Grid Hubei Information & Telecommunication Company Limited, Hubei, China

*Corresponding author e-mail: ywq1005@whu.edu.cn

Abstract. Under the pressure of energy and environmental protection, we will promote the technological progress and demonstration of electric vehicles, and the construction of charging facilities will continue. Charging facilities planning and orderly charging, as two major research directions of electric vehicle infrastructure, are of great significance for the future development of electric vehicles. The optimal charging of electric vehicles can effectively improve the safe and economic operation ability of distribution network, which is of great significance to its safe operation. Therefore, this paper proposes the outsourcing test experiment and processing of urban electric vehicle public charging network based on 5G and big data. In this paper, through the analysis of the development status of urban electric vehicles, this paper proposes to optimize the charging mode of electric vehicles by combining the charging network forward and backward algorithm. In the outsourcing test experiment, the electrical safety test shows that when the current reaches 1.1-37.1kw: 5000A, when the power factor is 0.8 ~ 0.9, when the short-circuit current impact is tolerated, the connection device will not affect the breaking operation by contact fusion welding, and the insulation protection will not be invalid. Through investigation and analysis, the satisfaction degree of electric vehicle optimization algorithm is increasing year by year. Through the analysis of the test results, the research in this paper has achieved ideal results and made a contribution to the research of urban electric vehicle public charging network.

Keywords: Big Data, Electric Vehicles, Research on Charging Network, Outsourcing Test

1. Introduction

Traditional communication frequency is lower than 5G communication, so the traditional communication signal can cover more than 5G communications. Independent network base stations cannot cover all areas, and the application of open base stations can make up for the problem of signal transmission [1-3]. 5G technology as a wireless transmission technology, the data transmission bandwidth can meet the requirements of 4K or even 8K video signal transmission, and the super large communication frequency can strengthen the penetration of wireless communication [4, 5]. At the same time, the traffic cost of 5G era will also be reduced. Through the continuous development and
convenience of 5G era, the monitoring equipment can adopt the loading mode, realize the transmission of video signal through 5G communication mode, and connect the monitoring signal to the central computer room, extract valuable video information through big data analysis, and ensure the timeliness of video data.

As an important way to reduce carbon emissions and ease energy tension, electric vehicles powered by clean electric energy play an important role in the transformation of energy consumption structure [6, 7]. The large-scale promotion of electric vehicles can bring positive effects in many aspects, such as energy saving and emission reduction, fuel substitution and green environmental protection. Many countries have set strategic goals for the development of electric vehicle industry. The rapid growth of the scale of electric vehicles is conducive to further strengthening the connection between the two networks, but it also puts forward higher requirements for accurately grasping the charging behavior and charging demand of electric vehicles [8-10].

This paper studies the application of 5G and big data urban electric vehicle public charging network, analyzes the actual situation of 5G and big data urban electric vehicle public charging network, and concludes that 5G and big data are still lacking in the application of urban electric vehicle public charging network. Based on 5G and big data, this paper established the outsourcing test and processing of urban electric vehicle public charging network research. In the research and test, aiming at the actual situation of the public charging network of urban electric vehicles, the application of 5G and big data is optimized. The effective combination of the two can improve the efficiency of urban electric vehicles. Through the investigation and analysis of various data of urban electric vehicle public charging network, this paper believes that the use of 5G and big data is conducive to the development of urban electric vehicle public charging network, and provides technical support for urban electric vehicle public charging network, so as to realize the cooperation and win-win of both sides.

2. Development Status of Urban Electric Vehicles and Introduction of Charging Network Forward Backward Algorithm

2.1 Development Status of Urban Electric Vehicles
In order to realize the rapid development of electric vehicle industry, a sound network of charging station and transfer station is the foundation. Not only to achieve a breakthrough in the number of charging facilities, but also to provide a variety of service objects. China's electric vehicle industry has entered a new period of rapid development. In order to meet the demand of power battery charging in this period, a large number of power battery charging stations have been established in domestic cities in recent years.

Since 2017, the service network construction of domestic automobile power battery charging and changing station has entered a stage of rapid development. At present, China has become the country with the largest number of charging stations and charging piles. By 2019, the State Grid alone will have built 400 charging stations and about 20000 charging piles. With the rapid development of electric vehicle industry, the construction and operation of charging and replacing power station has become a new industry type. In view of this market, power grid companies, equipment enterprises and other enterprises with relevant resources compete to get involved. Thanks to the support of relevant national subsidies and preferential policies, as well as the continuous improvement of relevant standards and specifications, China's industrial market has great development potential and broad application prospects in the future.

2.2 Introduction of Forward and Backward Algorithm for Charging Network
Most distribution networks are radial networks with tree topology. In this case, the power supply point is the root node of the tree. Since each line is not closed, the direction of power transmission can be determined. For any branch, you can determine the start and end nodes. There are three types of nodes: root node, leaf node and non-leaf node. The leaf node is the end of a branch and only one branch is
connected. When the voltage at the power supply point is taken as a known quantity, the calculation process is as follows:

In the first iteration, the voltage of the node outside the root node is assumed to be the rated voltage. Through deep search, the access sequence of backward nodes is obtained. Starting from the terminal node of distribution network, forward calculation is carried out for the first node to obtain the end power and head end power of each branch. The calculation method of branch power and voltage is shown in Formula (1), and the calculation formula of branch terminal power is as follows:

\[ S_{ij}^{(k)} = S_{ij}^{(0)} + \sum_{m \in N_j} S_{jm}^{(k)} \]  

(1)

Where \( N_j \) is the terminal set of the branch starting from \( j \), if \( j \) is the leaf node, then \( N_j \) is the empty set; \( k \) is the number of iterations, \( S_{ij}^{(k)} \) is the load power of node \( j \), and \( \sum_{m \in N_j} S_{jm}^{(k)} \) is the sum of the power at the head of each branch starting from \( j \). The head end power of each branch is \( S_{j}^{(k)} \), and the calculation formula is:

\[ S_{j}^{(k)} = S_{j}^{(k-1)} + \Delta S_{j}^{(k)} \]  

(2)

Where, \( \Delta S_{j}^{(k)} \) the calculation formula of branch power loss is:

\[ \Delta S_{j}^{(k)} = \frac{P_{ij}^{(k)} + Q_{ij}^{(k)} + r_j}{\frac{X_j}{r_j}} \]  

(3)

Where, \( P_{ij}^{(k)} \) is the second power of the active power at the end of the branch in step \( k \), \( Q_{ij}^{(k)} \) is the square of the reactive power at the end of the branch in step \( k \); \( r_j \) is the branch resistance and \( x_j \) is the branch reactance.

3. Investigation Results and Analysis of Outsourcing Test Experiment and Processing

Outsourcing testing covers a number of thematic technologies, such as: equipment control and data acquisition technology based on configuration software, outsourcing machining quality early warning method based on Genetic BP neural network and electrical safety, etc. This paper will carry out experiments based on the electrical safety technology test research.

 Electrical safety related tests include electric shock protection, grounding measures, insulation resistance and electrical strength, creepage distance, electrical clearance and penetration sealant distance, electrical trace resistance, breaking capacity and short-circuit current tolerance test. The short-time high current withstand test, breaking capacity test and limited short-circuit current withstand test in "grounding measures" involve high-voltage or large current test, which are several items with the most stringent requirements for the electrical safety of products, and also put forward high requirements on the test ability, which should be able to provide higher impulse current under rated voltage. The greater the current, the stronger the arc; if the arc is conductive, it may form a phase to phase arc short circuit accident, resulting in no risk of circuit disconnection.

 Short time high current withstand test is the same as the three standards. The purpose is to check the continuous effectiveness of the earth protection. This standard allows the temperature rise test and short-time high current resistance test. The national standard and UL standard shall be selected. The limit short-circuits current withstand test refers to the test that the connecting device will not affect the breaking action due to short-circuit current impact under a certain voltage and power factor, and the insulation protection will not fail. The test requires that fuses with the same or higher rated current shall be connected in series in the circuit. The specific test conditions are shown in Table 1.
Table 1. Comparison of limited short circuit current withstands test conditions

| Limiting the flow of knowledge and Application | GB/T20234.1-2011 | TEC62196-1:2012 | UL2251 |
|-----------------------------------------------|------------------|-----------------|--------|
| Tolerance test requirements                   |                  |                 |        |
| Test voltage                                  | 10000A           | 10000A          | 1.1-37.1kw: 5000A (10000A can be selected according to the manufacturer's requirements); 39-149kw: 10000A |
| Rated voltage                                 | No requirements  | No requirements | 0.8-0.9 |

4. Discussion

4.1 Research Status of Optimal Charging Algorithm for Electric Vehicles

In order to improve the computational efficiency of the optimization method and obtain the global optimal solution, a variety of models and algorithms for centralized and orderly charging of electric vehicles are proposed. By connecting the three-phase photovoltaic inverter and the electric vehicle charging pile in the low-voltage distribution network, the control system is adjusted to three independent units to adjust the charging efficiency, and the heavy load line load is adjusted to the light load line, so as to achieve the purpose of adjusting the three-phase unbalanced distribution network. Taking the minimum network loss as the objective, the topology structure of distribution network is optimized by adjusting the parameters of distribution network, which improves the calculation efficiency and reduces the dimension of optimization variables. On this basis, an optimization method considering node voltage constraint and rolling mode is proposed. The calculation method of three-phase unbalance is proposed. Taking the profit maximization of distribution network operators as the objective function, a piecewise linear programming model of distribution network is established based on linearization of power flow equation and inequality of node voltage. The calculation method greatly improves the calculation efficiency, but it fails to optimize the vehicle charging power, and the linearization requirements are complex, which cannot guarantee the optimal calculation results.

According to the characteristics of radial operation in distribution network, the node voltage iterative correction method is adopted. Through this structure, the dimension of optimization variables can be greatly reduced and the operation efficiency can be improved. In this paper, the method is extended to the general case, that is, the objective function is not only limited to the minimum network loss, but also takes into account the constraints of node voltage and branch power.

Figure 1. Proportion of main charging methods for electric vehicles
Figure 1 shows the proportion of the main charging methods of electric vehicles. In addition, in order to further analyze the application of the optimized algorithm of electric vehicles, the results are shown in Figure 2. As can be seen from Figure 2, the satisfaction of electric vehicle optimization algorithm has increased year by year. After using the optimization algorithm of electric vehicle, the utilization rate of electric vehicle is improved, and the market benefit of electric vehicle is greatly improved. Through investigation and analysis, it is shown that the advantages of the application of the optimized algorithm for electric vehicles outweigh the disadvantages, which is very important for the promotion of electric vehicles.

![Figure 2. Satisfaction survey after the promotion of electric vehicle optimization algorithm](image)

4.2 Problems in Electric Vehicle Industry

(1) It is difficult for industry stakeholders to cooperate effectively

In the development of electric vehicles, automobile, electric power and other related enterprises need effective cooperation, especially in the power station replacement mode. However, in practice, this mode is difficult to operate. The interests of State Grid, power battery enterprises and electric vehicle users are in game. For electric vehicle manufacturers, it is difficult to participate in the mode of electricity for electricity because of subsidy distribution, technical characteristics and upgrading. For electric vehicle users, it is difficult to identify the power exchange mode due to the difference of power battery and the calculation of residual power.

(2) Industrial development leads to increased risk of urban power grid

Network construction and operation of charging service facilities depends on the distribution and power supply capacity of power grid. The charging process of automobile is a nonlinear high-power charging process. Therefore, in the working process, it will not only cause heavy load of the power grid, but also produce harmonics, which will impact the current and voltage of the power grid. If it cannot be effectively controlled, the power load of power grid will be seriously deteriorated, the overload of power grid equipment, the grid pollution caused by multiple harmonics, and the increase of peak valley difference of power consumption will seriously threaten the stability and security of power grid operation. Power grid construction usually requires a large amount of capital investment, occupying a large amount of land area and traffic roads and other resources. Considering that the power resources in big cities have been extremely tight, it is difficult to solve the problem of urban distribution network reconstruction and expansion by large-scale production of electric vehicles in the future.

(3) Huge cost and profit limitation of power battery
Compared with traditional fuel vehicles, pure electric vehicles have lower operating costs, but higher costs in other aspects. The most important factor is the high cost of power batteries. Compared with the same level of traditional cars, the price of the whole car is not dominant at all. At present, the power battery cost of pure electric vehicle usually accounts for about 27% of the whole vehicle cost. The cost of electric vehicles is too high to be reduced to a lower level than gasoline and diesel vehicles in the short term. If the battery rental mode is adopted, the individual only purchases the naked car other than the power battery, the battery cost is too high and the rent is too high. Unless the power battery rental units rely on the government's sufficient battery subsidies, it is difficult to achieve their own profits.

5. Conclusions
In the research of 5G and big data urban electric vehicle public charging network, this paper takes the city electric vehicle public charging network as the main line research. Through the research, this paper thinks that 5G and big data in the research of urban electric vehicle public charging network has brought benefits, and through the charging network forward and back generation algorithm, it optimizes the public charging mode of urban electric vehicles, and plays a very important role. In this paper, the electrical safety test analysis and research of outsourcing test values are carried out. The results show that when the current reaches 1.1-37.1kw, 5000A, when the power factor is 0.8 ~ 0.9, when the short-circuit current impact is tolerated, the connection device will not affect the breaking operation due to contact fusion welding, and the insulation protection will not be invalid. Through the research on the status quo of electric vehicle optimal charging algorithm and the satisfaction analysis after investment, with the input of electric vehicle optimization charging algorithm, the main charging methods of electric vehicle have been reasonably optimized, and the satisfaction degree has been improved year by year. Through the analysis of data, it can be seen that the outsourcing test and processing of 5G and big data urban electric vehicle public charging network research, whether systematic, professional or standardized, has been significantly improved, which can meet the needs of urban electric vehicle charging network. This research has achieved ideal results and provided technical support for urban electric vehicle charging network.

Acknowledgments
The project name:Research on public charging network of urban electric vehicle based on 5G and big data

The work in this paper was supported by the Science and Technology Project of State Grid Hubei Electric Power Co., Ltd. (Grant No.52153320002J)

References
[1] Zaharia, M., Xin, R. S., Wendell, P., Das, T., Armbrust, M., & Dave, A., et al. (2016). Apache spark: a unified engine for big data processing. Communications of the Acm, 59(11), 56-65.
[2] Calderaro, & A. (2015). Book review: big data: a revolution that will transform how we live, work, and think. Media Culture & Society, 37(7), 1113-1115.
[3] Obermeyer, Z., & Emanuel, E. J. (2016). Predicting the future - big data, machine learning, and clinical medicine. N Engl J Med, 375(13), 1216-1219.
[4] Li, S., & Mi, C. C. (2015). Wireless power transfer for electric vehicle applications. Emerging & Selected Topics in Power Electronics IEEE Journal of, 3(1), 4-17.
[5] Rezvani, Z., Jansson, J., & Bodin, J. (2015). Advances in consumer electric vehicle adoption research: a review and research agenda. Transportation Research Part D, 34(34), 122-136.
[6] Gonzalez Vaya, M., & Andersson, G. (2015). Optimal bidding strategy of a plug-in electric vehicle aggregator in day-ahead electricity markets under uncertainty. IEEE Transactions on Power Systems, 30(5), 2375-2385.
[7] Yong, Wang, Haichong, Bian, & Chunning, Wang. (2015). Research on charging and discharging dispatching strategy for electric vehicles. Open Fuels & Energy ence Journal,
[8] Liu, J. (2015). Research on the development strategies of new energy automotive industry based on car charging stations and battery management. International Journal of Smart Home, 9(7), 213-222.

[9] Handley, S., & Gray, J. (2015). Managing quality in a heterogeneous contract manufacturing environment. Decision Sciences, 46(6), 1011-1048.

[10] Smith, & D., R. (2015). The outsourcing and commercialization of science. Embo Reports, 16(1), 14-16.