# A Mobile Application Platform Based on BP Artificial Neural Network Model Algorithm

Juanping Shen and Guozhong Wang
*Wenshan Power Supply Bureau of Yunnan Power Grid Co., Ltd, Wenshan Yunnan, China*

Keywords: BP Artificial Neural Network Model Algorithm, Infrastructure Site Control, Mobile Application Platform.

Abstract: In order not to consider the application requirements of on-site control in infrastructure, which leads to the unreasonable distribution of mobile application platforms, in order to meet the application needs of on-site control of mobile application platforms, this paper studies the reasonable distribution of on-site control applications in infrastructure. First of all, the number of mobile application platforms for infrastructure site control in the research area is calculated on the basis of the redivision of land types, and the application demand coefficient of mobile application platforms is calculated. Then the BP artificial neural network model algorithm is proposed to enrich the diversity of the population, and the non-linear convergence factor is used to prevent the algorithm from falling into the local optimal, and complete the reasonable distribution research of the application of the field control in infrastructure. Simulation experiments prove that the proposed method in this paper can effectively meet the application needs of infrastructure site control mobile application platform and the convenience needs of infrastructure site control mobile application platform.

## 1 INTRODUCTION

In recent years, the consumption of some fossil fuels, such as oil and natural gas, has led to an increasingly serious energy crisis and environmental problems (Cheng, and Hu, et al. 2022). The traditional infrastructure site uses fossil fuels, while the mobile application platform is different from the traditional infrastructure site, which has unique development advantages, and can convert chemical energy into electric energy stored in the rechargeable control pool group (Gulcu, 2022). In order to respond reasonably, the goal of carbon neutrality proposed by China is to establish a low-carbon and efficient energy system with electric energy as the main core, and to vigorously promote the infrastructure on-site control of mobile application platform is a very important link (Han, 2023). Different from the traditional infrastructure site, the endurance of the mobile application platform for infrastructure site control is relatively poor. Therefore, it is necessary to set up the mobile application platform for infrastructure site control in each city (Li, and Ding, et al. 2022). However, due to the limitations of buildings in different cities and the differences in different demands, the reasonable distribution of mobile application platforms has the corresponding randomness and non-uniformity (Liu, and Xue, et al. 2022). For example, if the power supply line between the infrastructure field mobile application platform and the power dispatching center is not properly planned, it will increase the construction cost of the mobile application platform and the loss generated in the power transmission process (Wu, and Zeng, et al. 2023). Therefore, it is of great research significance to rationalize the distribution of infrastructure to the on-site control of the mobile application platform, improve the application efficiency of the mobile application platform and reduce the construction cost (Zhang, and Wang, et al. 2022).

## 2 RELATED WORKS

The rationalization of the distribution of mobile application platform for on-site control needs to consider many factors such as power grid, transportation and economy, which is a non-linear optimization problem. At present, many experts and scholars have conducted in-depth research on this problem (Zhang, 2022). The reasonable distribution of the mobile application platform based on the



Shen, J. and Wang, G.
A Mobile Application Platform Based on BP Artificial Neural Network Model Algorithm.
DOI: 10.5220/0013538300004664

In *Proceedings of the 3rd International Conference on Futuristic Technology (INCOFT 2025) - Volume 1*, pages 200-205
ISBN: 978-989-758-763-4

simulated annealing algorithm is proposed. First of all, the application of on-site control is in line with the impact on the distribution network and the reasonable distribution of the mobile application platform on the infrastructure site, and analyzes the penetration rate at different moments and different loads (Zhang, and Wang, 2023). The application load of on-site control will have different effects on the offsets of the distribution network voltage. According to the queuing theory, the waiting time of the infrastructure field control mobile application platform and the utilization rate of the mobile application platform are taken as the satisfaction function, and the optimal number of infrastructure field mobile application platforms is obtained (Zheng, 2022). The simulated annealing algorithm is used to obtain the optimal distribution of the mobile application platform. According to the simulation experiment results, the mobile application platform can effectively reduce the impact of the site control application load on the voltage of the distribution network system, but this method does not improve the utilization rate of the mobile application site control platform. Put forward a new analysis method, first of the construction site control mobile application platform construction factors comprehensive analysis, the construction site mobile application platform operators of the early stage of the investment economic cost and late economic cost of operation and maintenance, and construction site control mobile application platform application waiting time cost minimum as a target function to build construction site control mobile application platform distribution model. Analyze the quantity configuration of mobile application platform under the known demand mode of infrastructure site control application. Taking a commercial district in a city as an example, the analysis results show that the comprehensive cost of the operators of the mobile application platform installed in the commercial district is low, and the utilization rate of the mobile application platform in the infrastructure site is also high, but the method has the overall process. The reasonable distribution method of mobile application platform based on multi-stage collaborative planning is proposed. Considering the timing characteristics, the infrastructure site control distribution and load power consumption planning model are constructed. Taking the satisfaction and carbon emission of mobile application platform as the target function, build an infrastructure field mobile application platform planning model for data envelope analysis. Taking a system composed of a transportation network and distribution network as an example, the free search algorithm is used to solve the nonlinear optimization problem, and get the optimal configuration scheme of each stage. The results of the simulation experiment show that the proposed method can achieve the reasonable distribution goal of the mobile application platform, but there is the problem of equipment redundancy in the early stage.

# 3 DISTRIBUTION ANALYSIS OF MOBILE APPLICATION PLATFORM FOR ON-SITE CONTROL OF INFRASTRUCTURE

## 3.1 Demand Analysis of Mobile Application Platform

Based on the analysis of the application characteristics of on-site control, the application time of on-site control in large application power and small application power within one day is found, which is expressed as: （1）

$$T_i = \sum_{n=1}^{N_i} \frac{E_i^n}{P_i} \tag{1}$$

In the formula, it means that the power obtained by the infrastructure site control in the corresponding application mode, and Pi represents the power of the infrastructure site control application.

Through the daily average service time of high-power mobile application platform and low-power mobile application platform, the number of mobile application platforms required for infrastructure on-site control can be calculated. Because in real daily life, the application behavior of infrastructure on-site control will be concentrated in a certain period of time, resulting in a large number of infrastructure on-site control with application needs in the same period of time. Therefore, in order to meet the timely application needs of infrastructure site control, when clarifying the number of mobile application platforms for infrastructure site control, it is necessary to comprehensively consider the simultaneous application of a large number of infrastructure site control, and test and correct the number of mobile application platforms.

Each city will be divided into many administrative areas, at the same time the administrative area economic development situation also different, economic indicators to reflect the number of the infrastructure site control, therefore, according to the administrative area GDP in the city in the proportion of GDP calculation for the administrative area infrastructure site control the number of mobile application platform. The number of mobile application platforms for infrastructure site control required by each administrative region is expressed as:（2）

$$N_i = \frac{GDP_i}{GDP} N \tag{2}$$

In the formula, N i represents the number of mobile application platforms in the i administrative region, and N indicates the total number of mobile application platforms in the infrastructure control in the city.

### 3.2 Division of urban areas

The location accuracy of the mobile application platform mainly depends on the rationality of the urban area division. The division of urban land types is applicable to urban construction and planning, but not applicable to power grid planning. According to the characteristics of electric power and the load density, the urban land types are divided into seven types. They are housing, government, culture, medical and education, industrial and commercial land, public facilities and municipal transportation, and green waters. These seven types of urban land use not only consider the diversity of land use types, but also conform to the planning of the power grid.

### 3.3 On-site control application demand

After the division of urban areas, the demand coefficient of infrastructure site control application in each region is calculated according to the characteristic index of normalized attributes and the traffic congestion index.

There is a direct relationship between the attribute characteristic index of urban divided areas and the region type, while different regional types need to correspond to different application needs. The larger the attribute characteristic index, the higher the application needs. The attribute characteristic index of the social public application network is shown in Table 1.

The size of the traffic congestion index can indicate the size of the traffic flow. The larger the traffic congestion index, the greater the traffic flow, and the higher the application demand. The traffic congestion index of different roads should be averaged over the same time period.

Table 1: The attribute feature index of the divided regions

| Area Type | Characteristic Index |
|---|---|
| House | 0.1 |
| Cultural And Medical Education | 0.4 |
| Industrial Business District | 0.7 |
| Government | 0.1 |
| Municipal Traffic | 1 |
| Communal Facilities | 0.4 |
| Green Water | 0.3 |

The demand coefficient of infrastructure site control application in each divided area is expressed as:（3）

$$p_i^j = w_1 p_{i1}^j + w_2 p_{i2}^j \tag{3}$$

In the formula, i is the number of the divided area, indicating the attribute characteristic index of the area where the mobile application platform is located, and indicating the traffic congestion coefficient of the area where the mobile application platform is located. The w 1, w 2 indicates the index weights.

## 4 RATIONALIZED DISTRIBUTION OF INFRASTRUCTURE FIELD CONTROL AND MOBILE APPLICATION PLATFORM BASED ON BP ARTIFICIAL NEURAL NETWORK MODEL ALGORITHM

Combined with the above comprehensive analysis results of the reasonable distribution of the infrastructure site control mobile application platform, the BP artificial neural network model algorithm is used to plan the reasonable distribution of the infrastructure field control mobile application platform.

Suppose that the search space of the mobile application platform on the infrastructure site is D dimension and N represents the Wolf pack composed of gray wolves. In the process of tracking and surrounding the prey, the mathematical model of controlling the distribution of mobile application platforms on the infrastructure site is expressed as follows:

In the above formula, t represents the number of iterations, and the vector of the representation coefficient, represents the position vector of the target prey, and represents the position vector of the gray Wolf. The coefficient vector can be defined as:

In the above formula, representing the factor of convergence, the number of accompanying iterations decreases from two to zero.

After the pack locks in the position of the target prey, the pack surrounds the prey. Generally, the leader of a Wolf pack will have a better understanding of the potential location of the target prey, so he can judge the location of the prey according to their own location, and update their position at the same time, and gradually approach the target prey. The mathematical model of the hunting behavior of wolves is expressed as:（4）

$$D_{\alpha} = \left|\vec{C}_1 \bullet \overrightarrow{X_{\alpha}} - \vec{X}\right| \tag{4}$$

The initial population is introduced into the BP artificial neural network model algorithm. The chaotic map is a piecewise linear map, and the function can be expressed as:（5）

$$\frac{x_t}{u}, 0 \le x_t < \mathrm{u} \tag{5}$$

Chaos maps have a uniformly distributed sequence and can have the same distribution density for different parameters, thus referencing u=

The 1 / 2 chaos mapping formula, expressed as:（6）

$$0 \le x_t < \frac{1}{2} \tag{6}$$

The nonlinear decreasing method is adopted to improve the convergence factor. The decline speed in the early stage is slow, the large convergence factor can effectively enhance the global search ability, prevent falling into the local optimal solution, the convergence speed in the later stage is slow, and the small convergence factor can enhance the local search ability, so as to accelerate the convergence speed of the algorithm. This nonlinear convergence mechanism can reasonably coordinate the local and global search ability of BP artificial neural network model algorithm, and the convergence factor A value is adaptive. The improved convergence factor is expressed as:（7）

$$a = 2 - 2 * \frac{k^{\frac{t}{t_{\max}}} - 1}{k - 1} \tag{7}$$

In the formula, k is the adjustment coefficient, the specific value determines the speed of the convergence factor with increasing the number of iterations, and t is the current number of iterations, $t_{max}$ Represents the maximum number of iterations.

Different weights are used to refer to the location information of the Wolf pack leaders. The higher the level, the greater the reference weight. Random disturbance is added to avoid falling into the local optimal solution, which is expressed as:（8）

$$\vec{X}(t+1) = \frac{\vec{X}_1}{2} + \frac{\vec{X}_2}{3} + \frac{\vec{X}_3}{6} + \frac{randn}{10} \tag{8}$$

The above process will complete the reasonable distribution of the infrastructure field control mobile application platform based on BP artificial neural network model algorithm. Figure 1 shows the whole process of BP artificial neural network model algorithm.

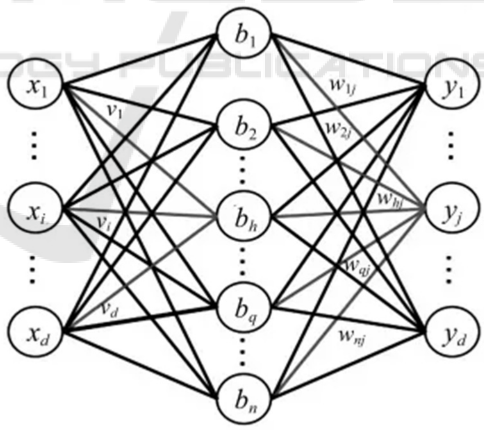


Figure 1: Network structure of the BP neural network

## 5 EXPERIMENTAL RESULTS

In order to verify the validity of the reasonable distribution of the mobile mobile application platform based on the BP artificial neural network model algorithm proposed in this paper, the simulation experiment is carried out in the Matlab simulation environment. Table 2 shows the parameters of the field control of the infrastructure.

Table 2: Parameters of infrastructure site control

| Parameter | Numeric Value |
|---|---|
| Infrastructure Quality | 1610kg |
| The Rest Of The Application | 13.5kwh |
| Full Power Application | 60kwh |
| Internal Temperature In Infrastructure | 24℃ |

Using BP artificial neural network model algorithm will shortest total travel time, mobile application platform cost and total travel time and total cost of mobile application platform rationalization distribution target, infrastructure site control mobile application platform rationalization distribution results expressed by Figure 2.

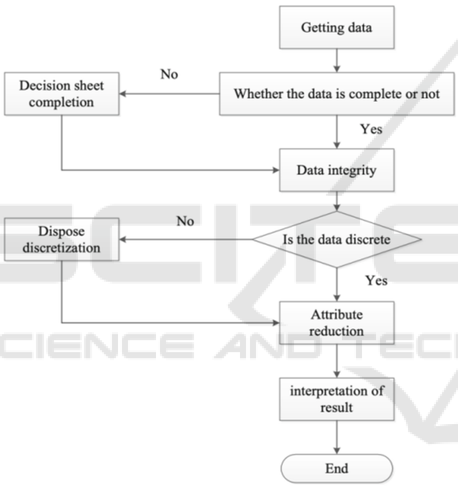


Figure 2: Flowchart of attribute reduction based on rough set theory

Table 3: Reasonable distribution results information of mobile application platforms

| Optimization Objective | The Total Travel Time Is The Shortest | The Lowest Cost Of The Total Cost For Mobile Application Platforms |
|---|---|---|
| Distance From Driving | 5.86km | 5.70km |
| The Time Of The Total Trip | 0.31h | 0.43h |
| Initial Application | 10.39kwh | 8.59kwh |
| Application Application | 13.59kwh | 15.29kwh |
| Total Cost Cost | Thirty-Eight Point Four Three Yuan | Twenty-Nine Point Four Eight Yuan |

The details during the rationalization of the distribution of mobile application platforms under different optimization objectives are presented in Table 3.

Analysis table 3 can see, the infrastructure site control total travel time and mobile application platform overall optimal as a reasonable distribution target, than the construction site control total travel time as a reasonable distribution target shortest construction site control total cost reduce 10.12 yuan, than the construction site control mobile application platform total cost as a reasonable distribution target reduce 1 yuan, and the total travel time also reduced. It can be seen that the method proposed in this paper can effectively rationalize the distribution of the mobile application platform for the field control of infrastructure.

In order to compare the impact of infrastructure on-site control on the power grid after access to the mobile application platform under different optimization objectives, the analysis results are shown in Figure 3 .

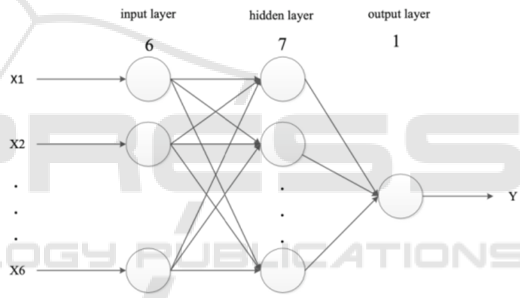


Figure 3: The impact of on-site control of different optimization objectives

Analyze of figure 3 can see that the construction site control the shortest total travel time and construction site control the minimum cost of mobile application platform as infrastructure site control mobile application platform rationalization distribution of optimization target, relative than the construction site control total travel time as a shortest rationalization distribution target in the morning and evening peak, the overall power will decrease, thus, the construction site control the shortest total travel time and infrastructure site control the total cost of the lowest as a reasonable distribution optimization target is more conducive to the stable operation of the power grid. Figure 4 compares the optimal distribution results of the proposed method and the traditional method.

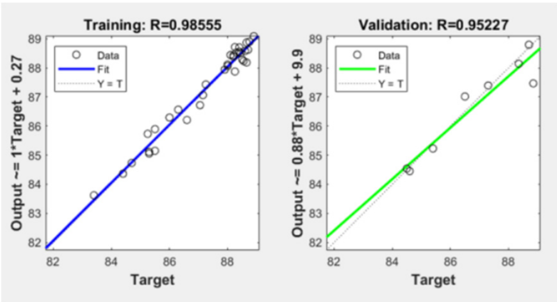


Figure 4: The optimal distribution results of the proposed method

From the analysis of Figure 4, it can be seen that the curve convergence of the reasonable distribution length of the mobile application platform of the proposed method is 39.1m, while the curve convergence of the reasonable distribution length of the traditional method is 41.1m, indicating that the convergence rate of the proposed method is fast. This is because the traditional method is easy to fall into the local optimal solution, and the method proposed in this paper is to use the chaotic mapping to produce the initial solution of the population, so as to enrich the diversity of the population, by introducing the non-linear convergence factor and adding the disturbance position formula to prevent the algorithm from falling into the local optimal, and increase the convergence speed of the later algorithm. This shows that the overall stability of the method proposed in this paper is good, and can be better applied to the reasonable distribution of mobile application platform on infrastructure control.

# 6 CONCLUSIONS

Driven by the low-carbon target, because infrastructure site control is better than traditional infrastructure sites in terms of greenhouse gas emissions and energy consumption, infrastructure site control is considered to be a very promising sustainable transportation mode in the future. However, with the rapid development of on-site control, there are still some problems from the perspective of mobile application platform and mobile application platform. Therefore, this paper carries out in-depth research on the reasonable distribution of on-site control of mobile application platform. First of all, through economic indicators to research area can calculate the infrastructure site control mobile application platform, on the land type again on the basis of urban area, and the construction site control mobile application platform application demand coefficient calculation, and then use BP artificial neural network model algorithm of infrastructure site control mobile application platform mobile application platform rationalization distribution analysis. And the simulation experiments prove that the proposed method is practical.

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