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Analysis and Calculation of Marginal Electricity Price of Nodes With Network Loss From the Perspective of Intelligent Robot Considering Digital Signal Processing Technology

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This study investigates the calculation of marginal electricity prices using digital signal processing (DSP) technology, considering network losses and the role of intelligent robots. With the advancement of digital integrated circuits, embedded technology, and intelligent robot systems, the integration of DSP in electricity pricing has become increasingly relevant. Our research focuses on how DSP technology can be used to enhance the accuracy and efficiency of electricity price calculations in power grids, particularly accounting for network losses. By utilizing intelligent robots for real-time data collection and processing, our approach significantly improves grid management capabilities. Key findings demonstrate that integrating DSP with intelligent robotic systems can lead to more accurate pricing and efficient resource allocation. Additionally, the study underscores the importance of adopting a market-oriented approach to separate power transmission and distribution functions, which can effectively reduce energy consumption and improve overall productivity. This separation supports the establishment of specialized companies, promoting a more competitive and innovative energy market. These advancements not only contribute to the sustainable and healthy development of the energy sector but also offer practical solutions for modernizing power grid management. The results highlight the potential for enhanced operational efficiency and economic benefits through the integration of advanced digital technologies in the energy industry.

Povzetek: Razvita je metoda za izračun mejnih cen električne energije ob upoštevanju omrežnih izgub z uporabo tehnologije digitalne obdelave signalov (DSP) in inteligentnih robotov. Ugotovitve kažejo, da integracija DSP izboljša natančnost cen in učinkovito upravljanje omrežij ter prispeva k trajnostnemu razvoju energetskega sektorja.

1 Introduction

The marginal electricity price of nodes with network loss refers to another economic parameter that is being applied in electricity markets to express the cost of delivering one more unit of electricity to particular points in the electrical network. These losses which occur in the transmission lines and other circuits give rise to increased loss of voltage and heat, which in essence means less electrical energy for use upon delivery as compared to that generated at the source. This price requires an assessment of the impact of these losses on the total pricing model; this includes the generation cost and network cost resulting from the losses. Correct estimations of these marginal prices are important for the efficiency of electricity markets as well as for making more effective choices by market participants regarding prices for electricity, investments into power infrastructure, and energy conservation measures, which all can help to create a more stable and financially sound energy system. Under the centralized and unified management and operation mode of digital signal processing technology, the introduction of intelligent robot market competition is used to improve efficiency, reduce costs, and realize the effective use and development of energy. Due to the vast territory of the country and the huge network space, it is necessary to carry out the digital signal transportation between the provincial power grid, and at the same time, there must be a corresponding digital signal intelligent robot for intermediate processing. The goal of digital signal marketization is to maximize the optimal allocation and use of digital signal resources through market competition, to achieve the maximum return on investment, and to make it develop in harmony with the society, economy, and environment [1-2].

1.1 Digital signal processing technology and intelligent robot association

DSP encompasses the processing and handling of signals using mathematical and computational operations executed by computers. Sensors and AI-integrated intelligent robots work independently to collect data and efficiently execute the work. Combined, DSP and intelligent robots improve productivity and precision in signal processing, data handling, and decision-making in numerous applications such as energy control and industrial applications. The intelligent robot under digital signal processing technology is a commodity, and its price in the market is determined by the price. In our country, in the digital signal profession, the electricity price has been the question which all parties concerned jointly. The marketization reform of various countries all starts with the reform of the electricity price system [3-4]. We can say that the electricity price, as the "hub" of our country, can reveal some current system problems in our country. Improper electricity prices will have an adverse effect on the stability of the whole industry and even the whole society. To establish a sound digital signal market, we must formulate a set of reasonable price systems. Through the establishment of a perfect electricity price system, the resources of the grid can be optimized to the greatest extent, to realize the effective compensation of the grid and the reasonable distribution of the grid load, to promote the healthy development of the grid. The energy market price system ranges from a single-edge digital signal (UMP) to a district-edge digital Signal supply (ZMP) to a robot management node edge price (LMP). Only when there is no congestion in the grid, the uniform boundary electricity price will produce a false pricing information so that the dispatching personnel will frequently issue mandatory operation instructions to ensure the security of the grid, which contradicts the market competition goal and thus affects the effectiveness of the market. The zone boundary price is a simple robot-managed node boundary price. Generally, only a few lines will have ordinary traffic jams, and dividing the places that will not have traffic jams into a region and implementing a unified border price for a region is conducive to the trade between regions, and can also promote the trade between regions. It is now widely recognized that robot-managed node boundary pricing is currently the most efficient and secure pricing system in the different digital signal markets around the world. Examples include PJM (Pennsylvania, New Jersey, Maryland), New England ISO, New York ISO, NZEM, and so on. With the strong support of the Federal Energy Regulatory Council (FERC), the robot-managed node marginal price has been the basis of the "Standard Market Planning" (SMD) advocated by FERC [5-8].

Digital signal processing technology based on intelligent manipulator, analysis, and calculation of node marginal electricity price based on network loss

In the market-oriented system, pricing is based on the market as the core. At present, in the existing mature electricity markets at home and abroad, the node boundary price is used to estimate the change cost of the transmission network. The node boundary electricity price is at the node, and for each additional 1 MW of generation/load, the required operating expenses of the system will grow accordingly. Since the boundary price of the node contains the quotation information of the electricity market, the network loss information, and the blockage cost, it is generally calculated by the boundary price of the node. For each user, their final electricity bill can include several aspects, such as fixed charges for the power system, transmission line changes, grid nodes, cross-subsidies, government funds, additional business for the power company, and so on [9-11].

Conventional power supply is generally supplied by high-capacity generators, which are then supplied to the final customers through the transmission network and distribution network. Exchangeable energy is an important component of the marketability of electric power in our country. Exchangeable electricity markets in electricity markets are dominated by power networks and multi-energy systems. Micronetworks generally include electric energy storage, residential power, wind power, photovoltaic and electric vehicles. The energy hub includes cogeneration, electric energy storage, and electric boilers, and the energy hub is supplied by electricity and gas, and the output of electric energy and heat.

Marginal price distribution in the network nodes as a kind of effective market information, by assigning the distribution of the device to power distribution network, can reduce network losses, relieve the traffic congestion in the power system, reduce the power supply electric power equipment in the future under load caused by the energy transmission congestion, and make it when they do not conform to the requirements of the operation of the failure probability smaller than a predetermined degree of confidence. In the South West of England, the role of the power system in the power system is analyzed.

1.2 Application design of marginal electricity price with network loss nodes

Marginal electricity price with network loss nodes refers to designing the application such that computational models and algorithms should produce an accurate cost of providing electricity to points in the grid. This combines information from the IT networks, electric generation, and usage patterns to determine price points and resource use. At present, there is no independent provincial power transmission and distribution system, and the pricing mechanism evaluation index and means of spot transaction of electricity are still in temporary stage. At present, scholars at home and abroad have made a lot of achievements in the evaluation of the pricing mechanism of the electricity market, but the relevant literature is mainly focused on the national policy objectives, such as CO_2 emissions, new energy construction, etc., and more is the evaluation at the macro level, such as the transparency of the pricing mechanism, consumer satisfaction, cost sharing, and fairness. And the current domestic power spot trading system is not the same as the focus. For the purpose of establishing the initial policy for spot trading of electricity, "market competitiveness" (total cost of electricity generation and purchase) and "fairness of market competition" (deviation between the electricity generation of similar power plants and the national electricity price level) are currently the most concerned issues in the reform of domestic electricity market and power transmission and distribution prices. Therefore, in the quantitative evaluation of the power grid transaction pricing model based on fairness and efficiency, the mechanism of electricity price on transaction fairness is discussed， and its main structure is shown in Figure 1:

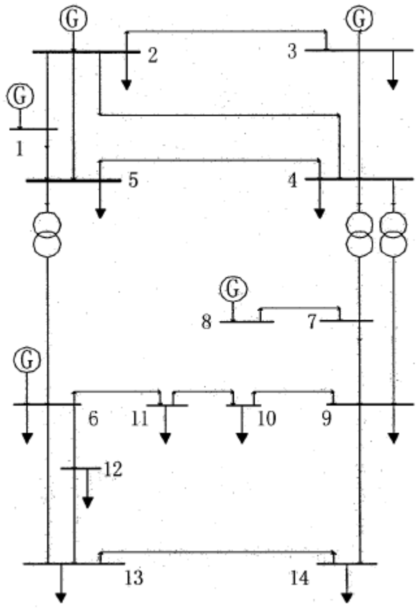

Figure 1: Analysis of the marginal electricity price structure of the network loss

According to the specification of digital signal processing, the four-level protocol mode is studied in detail, and a performance requirement of data transmission receiver based on physical level is proposed.

According to the signal system and system specification, the architecture of the receiving and receiving subsystem of digital signal processing is completed, and its implementation is analyzed and discussed. Direct modulation, orthogonal modulation, and orthogonal modulation are compared and analyzed in principle. Finally, waveform memory with orthogonal modulation is selected. Through the analysis and research of correlation demodulation and non-correlation demodulation, the bit error rate and anti-frequency offset of GMSK are simulated and compared. Combined with the characteristics of signal processing, this paper simulates and evaluates the detection accuracy of periodic feature detection, signal energy detection, and double-sliding window detection. Compared with the traditional FFT method, double-line amplitude method, and quadratic approximation method, the proposed algorithm has better performance in spectrum estimation. The method is deeply studied, simulated, and analyzed, and finally LM time method is selected.

The parallel-serial transform module converts the 32-bit parallel data transmission of ARM into Lbit serial for packet and modulation. Because Digital's message is indeterminate, but its total length is a one-byte integer, ARM uses 8 bits at 32 bits to populate the transmitted data. In view of the fact that a maximum of 1024 bits of digital signal processing data string detects the arrival of parallel data, the parallel data is cached using a 32-bit wide, 33-depth FIFO high-speed cache. After writing the data once, the data is read from the FIFO, and the eight bits read are stored in the shift register for statistical purposes. The ninth time the serial data is enabled. If the read bit reaches the data length plus seven points, then the parallel transform is over and the energy signal is reduced.

2 Related work

This detailed table helps to identify the present research gaps and supports the need for additional research by giving a clear summary of the major studies, their techniques, conclusions, limitations, and relevance to the current study. Table 1 shows the key studies.

Table 1: Summary of key studies in energy market research

Study	Methodology	Findings	Limitations	Relevance to Current Study
[16]	Formulated a market clearing problem for heat and electricity integration; Derived generalized locational marginal pricing (GLMP)	GLMP coordinates electric power with district heating, considering time-delay effects; Promotes efficiency and reduces cross-	Does not consider network constraints in the simplified model; Complexities in detailed component classification	Illustrates price linkage between heating and electricity markets; Shows the importance of considering integrated energy markets

		subsidies		
[17]	Used deep learning neural network (CNN) for 24 h-ahead locational marginal price (LMP) forecasting	Higher accuracy in 24 h-ahead LMP forecasting compared to traditional methods	Requires manual parameter optimization; Performance dependent on training data quality	Demonstrates use of advanced machine learning for price forecasting in electricity markets
[18]	Developed a local energy market design integrating P2P energy trading with probabilistic locational marginal pricing	Combines benefits of distribution locational marginal pricing and P2P trading; Reduces renewable generation curtailment	Complexity in managing uncertainty; Need for robust transaction fees	Highlights integration of P2P trading and locational pricing to enhance market efficiency
[19]	Proposed a P2P joint electricity and carbon trading model with carbon-aware distribution locational marginal pricing	Facilitates low-carbon and secure network operation; Effective bi-level optimization for P2P transactions	Challenges in decentralizing P2P joint trading; Requires robust incentive mechanisms	Shows the relevance of combining energy and carbon trading to promote low-carbon energy markets
[20]	Presented a double-sided auction market mechanism for zero marginal cost renewable generation pricing	Ensures reasonable pricing for renewable generation; Maintains nodal pricing system compatibility	Potential issues with market dominance by zero-cost generators; Need further validation in real-world scenarios	Addresses pricing challenges in renewable-dominated markets; Supports investment in renewable generation
[21]	Introduced a novel model for electricity locational marginal price forecasting using a relevance vector machine and Extreme Gradient Boosting	High accuracy and computational efficiency in LMP forecasting; Outperform various traditional models	Dependent on the quality of training data; Requires multiple models and integration steps	Shows the effectiveness of machine learning ensemble methods for electricity price forecasting
[22]	Proposed a new electricity market clearing mechanism combining DLMP and ULMP; Developed a bi-level coordinated robust economic dispatch model	Effective coordination of DS and MGs; Derives DLMP and ULMP for robust economic dispatch	Complexity in bi-level optimization; Needs advanced computational techniques	Highlights the need for robust market-clearing mechanisms to handle renewable integration and uncertainty
[23]	Investigated optimal TOU electricity pricing model using particle swarm optimization; Defined novel indices for voltage variation and power loss	Improves power quality and reduces power loss; Effective period partitioning for TOU pricing	Limited to specific system configurations; Requires accurate system modeling	Demonstrates the impact of TOU pricing on power distribution system efficiency and reliability

3 Research methods

3.1 Dataset collection

The packet box count is set to 0 and the system goes into idle mode. A 40-bit packet beginning with _ data is created by combining the start tag, training sequence, and power increase sequence with the stop tag and buffer, and a 28-bit packet ending with data.

3.2 System loss including marginal electricity price of network loss nodes

The effect of grid price on the long-term benefit of spot trading is mainly reflected in the input of the grid plan. Generally speaking, a power plan is an economical power plan for a power system in a given time and under the precondition of reliability. Before this, the design scheme of the national power system was designed according to the system load forecast, fuel source, system security, and other technical and economic indicators, and the on-grid power price was verified by the pricing method during the operation period, and then the annual power generation utilization hours were determined through the planned dispatch, to guarantee the overall economy of investment and operation. When the spot trading system is completed, the price of power supply and the quantity of power generated will be decided according to the market supply and demand [12-14].

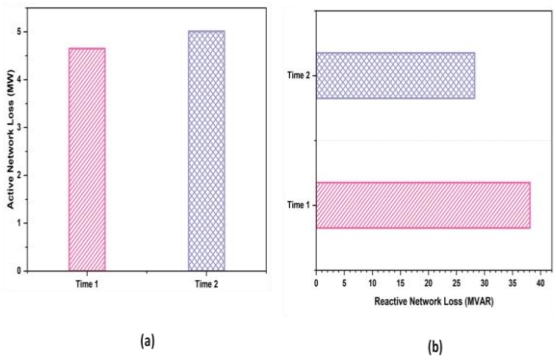

Figure 1: graph result of loss of step-by-step quotation system in DC mode

Table 2: Loss of a step-by-step quotation system in DC mode

	Active network loss(MW)	Reactive Network Loss (MVAR)
Time 1	4.65	38.09
Time 2	5.01	28.23

As shown in Table 2 and Figure 1 above, when reset, the system enters idle mode, and the packet box count is set to 0, merging the power rise sequence, the training sequence, and the start tag to form a 40-bit packet starting _ data, and merging the stop tag and buffer into a 28-bit packet ending _ data [15]. The sl state consists of a power rise sequence, a training sequence, and a start tag. Whenever the clock arrives, it outputs the largest value in the beginning _ data, then loops to the left beginning _ data, and when the frame count for that group reaches 39, the stater goes to s2 with the count set to 0.

S2 state executes the addition of data bits and check bits, and the bits are filled. This mode reads data from FFO and uses five mode counters, cnt _ 5, to count the consecutive outputs of 'l'. If five '1s' occur, the next step is to stop reading FIFO and instead set cnt _ 5 to 0 and output 'o' directly. If the frame counter of the group equals the data and the total encoding length of the CRC equals the increase of the data bit and the check bit.

The simulation results show that different pricing mechanisms have different effects on the fairness of the spot market under different network congestion conditions.

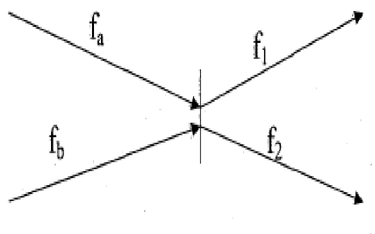

Figure 2: Mathematical modeling of various voltage ratios in DSP

Figure 2 shows that the calculation mode of the boundary digital signal price of the robot management node can be divided into two types: one is the optimal digital signal system, and the other is the optimal digital signal system. Through the research on the basic theory of electricity spot market quotation, it is found that in the unclogged power grid, the difference in electricity price (reflecting different power supply modes) and freight is caused by the difference in electricity price and freight. In this case, if no staged pricing is applied, allowing the lower generation unit to pay the transmission fee based on its long-term marginal cost in the transmission and distribution network, the additional revenue will be the same as the marginal price, resulting in unequal market competition. But because of the low price of transmission line jam in the power system, the price of each node is at a higher level. Therefore, the method of centralized restriction or non-payment of transmission price can ensure the fairness of the power system.

The Lagrangian function of the problem is defined as follows.

$$L(x, \boldsymbol{\lambda}, \boldsymbol{v}) = f(x) + \sum_{i=1}^{m} \lambda_i g_i(x) + \sum_{i=1}^{p} v_i h_i(x) \quad (1)$$

Where:

$L(x, \boldsymbol{\lambda}, \boldsymbol{v})$ is the Lagrangian function, combining the objective function and constraints.
$f(x)$is the objective function, representing the goal of the optimization problem.
λ_i are Lagrange multipliers associated with inequality constraints$g_i(x)$
v_i are Lagrange multipliers associated with equality constraints$h_i(x)$
The Lagrangian function is used to formulate the problem in such a way that it combines the objective function and the constraints into a single expression.
The equation (2) represents the infimum (greatest lower bound) of the Lagrangian function:

$$\phi(\boldsymbol{\lambda}, \boldsymbol{v}) = \inf_x L(x, \boldsymbol{\lambda}, \boldsymbol{v}) = \text{i} \quad \left(f(x) + \sum_{i=1}^{m} \lambda_i g_i(x) + \sum_{i=1}^{p} v_i h_i(x)\right) \qquad (2)$$

This equation helps determine the minimum value of the objective function $f(x)$ subject to the given constraints $g_i(x)$ and $h_i(x)$.
Based on the reality, because the domestic power system is different from the private power grid of the United States and other countries and regions, the domestic power grid is the overall arrangement of the national energy management institutions, and the power grid congestion is mainly caused by the blockage of transmission intervals, and the congestion is not frequent. Most of the time, however, generators with a price advantage, such as resource-rich areas or craters, will be given priority in bidding for most of the time, resulting in additional benefits; while in high-energy tariff areas, such as load centers, they will become marginal devices of the system, resulting in non-participation in bidding, which has an adverse effect on market fairness.

3.3 The association design of the marginal electricity price of the node and the digital signal processing technology

From the above description, in the marginal electricity price of robot-managed nodes, if the load of a robot-managed node increases, the marginal electricity price of the robot-managed node will improve the security of the whole grid. By solving the optimal model, the boundary price of the robot management node is obtained, and its economic significance is Lagrange multiplier. The system uses a linearized model and ignores the network loss. It can be known that the node marginal electricity price is as follows.

$$LMP_j = \lambda - \sum_{l \in L} \mu_l \frac{\partial p_l(p_i, d_j)}{\partial d_j} \qquad (3)$$

This equation signifies the relationship between the marginal electricity price of a node (LMP_j), the Lagrange multiplier (λ), and the partial derivatives of power generation (p_i) with respect to the demand (d_j).

When the power plant does not pay the power to the power consumers, the pricing of spot transactions will lead to excessive power demand in the power system in the areas rich in power resources. Since the short-term marginal cost of a power plant usually includes fuel and transportation costs, electricity and freight are also included in the price, as are electricity and transportation costs, to cover the cost of fuel and transportation needed to generate electricity. However, for power plants in resource-rich areas that provide electricity over long distances, the fuel conversion fee included in their settlement price is an additional benefit if the transmission fee is not paid.

4 Analysis technique

4.1 Description of mathematical modeling of intelligent robot considering digital signal processing

Because the supply and demand relationship between the two sides of power supply and demand is not coordinated, the power system can not achieve a reasonable distribution of power system. To promote the fairness of the power system, the coordination between the power system and the spot market is to promote the reasonable recovery and sharing of power generation and transmission costs. For example, in the area where each unit is relatively concentrated, because the fuel and transportation costs of each generating unit are relatively close, the profits of power generation are not much different, and the usage of the transmission system is almost the same. Therefore, the power generation party does not pay the power transmission fee or adopts the method of direct power transmission fee to ensure the fairness of market competition. However, for those areas with obviously concentrated resources, concentrated loads, and long-line transmission projects, the adoption of the method of "no payment of power transmission fees" or "postage stamp" for power transmission amount can neither reflect the ability of power plants in enriched areas to use the electric power system, nor achieve the principle of "apportionment" of "who benefits apportions", nor it is very difficult to contain the excessive profits of thermal power enterprises in enriched areas, nor can it guarantee fair market competition. Through the example calculation, it is proved that the transmission price of electricity and the real-time transaction of electric energy have synergistic effects on the fair transaction in the spot market.
The model of node marginal electricity price is as follows.
Equation (4) represents the objective function for optimizing the node's marginal electricity price. It

minimizes the sum of squared terms related to power generation (P_{Gi}) for all generator units (iii) within the system. The coefficients a_i, b_i, and c_i determine the shape of the cost function.

Equations (5) and (6) are power flow equations that govern the balance between power generation (P_{Gi}) and power consumption (P_{Di}) at each node (iii) within the system. These equations ensure that the real and reactive power injected into the network by generators matches the power consumed by loads, considering the network impedance represented by the G_{ij} and B_{ij} parameters and the voltage magnitudes (V_i) and phase angles (θ_{ij}) at each node.

$$\min \sum_{i=S_G} (a_i P_{Gi}^2 + b_i P_{Gi} + c_i) \quad (4)$$

$$P_{Gi} - P_{Di} - V_i \sum_{j=1}^{n} V_j \left(G_{ij} \cos \theta_{ij} + B_{ij} \sin \theta_{ij}\right) = 0 \quad (5)$$

$$Q_{Gi} - Q_{Di} - V_i \sum_{j=1}^{n} V_j \left(G_{ij} \sin \theta_{ij} - B_{ij} \cos \theta_{ij}\right) = 0 \quad (6)$$

These formulas serve as the basis for simulating the marginal price of electricity at every node in the power system, taking network constraints and generation costs into account.

5 Result

There are five devices in total for IEEE-14, and their quotation indicators are shown in Table 3 below:

Table 3: IEEE-14 Robot management node system equipment price indicators

The generator Serial number	The smallest reactive	Generator quotation parameter	
		a	b
1	0	0.06	20
2	−40	0.22	20
3	0	0.02	40
4	−6	0.04	40
5	−6	0.03	40

As can be seen in Table 2, if there is no blockage, the generated power of this system and the marginal price of each robot management node will change because the network loss is taken into account in the model. When the energy cost is basically the same when the load of some robot management nodes increases each time, the marginal cost of their robot management nodes will increase, and when the loss of robot management nodes decreases, the marginal cost of their robot management nodes will decrease.

5.1 Description of the mathematical modeling of intelligent robot management

It is proved that there is a synergistic effect between electricity transmission price and electricity spot trading mechanism, and transmission price plays an important role in the long-term competitiveness of the spot market. Under the condition of no congestion, the unit will be put into operation at a lower fixed cost and lower place when the system's marginal price is adopted. Therefore, the use of segmented pricing in power systems can effectively guide the site selection of power plants, thus playing a role in the long-term market. If the system is blocked, the node marginal price is adopted, and the spot price can provide sufficient positioning information for the generating unit, then the generation terminal can adopt an intensive price or no price unless the method of segmented price is adopted, it can be concluded that:

$$\sin\left(\theta_i - \theta_j\right) \approx \theta_i - \theta_j$$

$$P_{ij} \approx \frac{\theta_i - \theta_j}{x_{ij}} \quad (7)$$

$$V_i \approx V_j \approx 1$$

To ensure the normal operation and benign development of the electricity market, the future electricity price system should attach importance to the formation and adjustment of electricity prices.

With the gradual improvement of the spot trading system, how to choose and evaluating the transmission price system to match the future power trading environment and ensure the fairness and efficiency of trading is an urgent problem to be studied.

Therefore, through the study of the electricity pricing mechanism in the electricity market, this paper puts forward a quantitative evaluation index to measure the equity and benefit in the electricity market. In the time and position prediction of power system input, the net present value method is used to calculate the discounted income of a batch of equipment during the operation period, and the effect of terminal price on node load is analyzed synthetically. This paper presents a quantitative evaluation index and calculation model based on power quality and puts forward new suggestions for evaluating the electricity pricing mechanism in power grid operation.

Through an example, the influences of grid price on short-term competition efficiency, grid congestion, and spot price on electricity price are studied. In the future, we should pay attention to the competition effect of electricity prices and the coordination between electricity prices and electricity prices in the spot market. The quantitative evaluation method proposed in this paper has the following defects: 1) it does not fully reflect the electricity price policy of the power system; 2) it does not take into account the node load migration due to the change of the terminal price; 3) it does not incorporate the restriction factors of the investment plan of a single project with multiple projects into one project. These problems will become the research focus in the future.

6 Discussion

Despite their valuable contributions, each of the studies reviewed has certain limitations. The study [16] presented a new pricing method called generalized locational marginal pricing (GLMP) for a heat-and-electricity-integrated market. However, their simplified model does not consider network constraints, complicating the detailed component classification of GLMP. The research [17] introduced a deep learning neural network for 24-hour ahead locational marginal price (LMP) forecasting, achieving higher accuracy compared to traditional methods. Nonetheless, the study required manual parameter optimization and the performance was heavily dependent on the quality of the training data. The article [18] proposed a local energy market design integrating peer-to-peer (P2P) energy trading with probabilistic locational marginal pricing. While it combines the benefits of distribution locational marginal pricing and P2P trading, it faces complexity in managing uncertainty and requires robust transaction fees to be effective. The paper [19] developed a novel P2P joint electricity and carbon trading model incorporating carbon-aware distribution locational marginal pricing. Despite facilitating low-carbon and secure network operation, the study encountered challenges in decentralizing P2P joint trading and required robust incentive mechanisms for effective bi-level optimization. These studies highlight significant advancements in energy market pricing mechanisms but also reveal areas needing further research and development, such as network constraints, manual optimizations, uncertainty management, and incentive mechanisms, to improve efficiency and integration in evolving energy systems.

7 Conclusion

The construction of digital signal technology needs an efficient, transparent, reasonable, and accurate price mechanism. The price changes can reflect the supply and demand relationship between the digital signals and intelligent robots in real-time, to guide reasonable use and utilization. The power flow mode of the optimal DC digital signal system is a simple AC digital signal system, which is more suitable for the actual digital signal system because of its high efficiency and low precision. In this paper, the advantages and disadvantages of the intelligent robot and AC-DC mode are integrated, and an improved DC mode based on network loss is established based on principle deduction, which is used for intelligent robots to manage the node edge electricity price. Based on typical IEEE data, the algorithm of an intelligent robot is compared with that of a traditional AC/DC system. The results show that the intelligent robot can better reflect the economic significance of the intelligent robot management node without affecting the calculation speed.

Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of interest

The authors declare no conflicts of interest.

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