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Optimization Method for Microgrid Economy and Financial Security Based on HSMOPSO Algorithm

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Abstract Economic development means energy consumption, and the damage to the environment is becoming more and more serious. With the rise of the fourth industrial revolution, the green revolution is quietly coming, and pollution-free energy is very popular. However, the randomness of its output fluctuates when the grid is connected. The emergence of microgrids facilitates the access and management of distributed power sources. This paper aims to study the optimization method of microgrid economy and financial security based on HSMOPSO algorithm, and expects to optimize the operation of microgrid system with the help of HSMOPSO algorithm to ensure the stability of power supply. The simulation proves that the particle swarm algorithm can effectively reduce the operating cost of the microgrid and transfer the peak load. A multi-objective optimization model with minimum voltage deviation, load power shortage rate and energy storage capacity is established to verify the effectiveness of the particle swarm optimization algorithm. For the distributed dynamic economic dispatch problem of distribution network with multiple microgrids, different from the island mode, the microgrid needs to exchange power with the distribution network after it is connected to the grid. The experimental results show that under the HSMOPSO optimization algorithm, the operation of the microgrid system costs a total of 15 yuan, and under other algorithms, the operation of the microgrid system costs a total of 123 yuan. It can be seen that the operating cost required by the optimal scheduling using the HSMOPSO algorithm is much lower than that required by other algorithms. The scheduling is more reasonable, and the system runs more economically.

Index Terms Security Optimization, Microgrid Economy, Particle Swarm Algorithm, Economic Operation

I. Introduction

At present, the global economy is developing rapidly, and the global power demand is increasing. The traditional power grid scale cannot support the current power demand. It is very important to use renewable energy to replace traditional energy to make up for the lack of centralized power generation in the current power grid. In the context of the green revolution, distributed generation has become a new development goal. Distributed has many advantages, but it also brings challenges to the grid if connected in large numbers. To reduce adverse effects, microgrids are beginning to appear. Therefore, it is very important to study the dynamic economic dispatch of microgrid for the economic security of microgrid.

For the economics of microgrid clusters, power transaction costs are very important. Wang P developed a scheduling model including wind turbines. The results showed that the algorithm had the improved rate of aggregation, higher precision and better global ability to realize optimization [1]. Cheng Q presented a multi-objective optimization scheme for the optimal scheduling problem of microgrids. It aimed to maximize the economic benefits and minimize the environmental costs of multi-objective optimization of microgrids. In the optimization process, a dual-chain structure and a dynamic rotation angle adjustment strategy were introduced, and a new and improved quantum genetic algorithm was proposed. Lastly, the validity and practicability of the suggested model, the policies and the proposed algorithms were verified by numerical examples [2]. Nurkanovi A discussed how an optimization-based approach can be used to manipulate microgrids with large amounts of renewable energy efficiently. How to use advanced step real-time iteration with non-uniform discretization grid to reduce computational burden was also demonstrated. Compared to standard unified methods, it reduced the computational burden by up to 60% with only a small performance penalty [3]. Prinsloo G described the principles of modelling rural electrical load distribution by using discrete-time equipment decomposition. The engineering simulation model incorporated physical equipment energy classes and equipment usage behaviour patterns as the basis for a comprehensive classified load prototype. The analogue data on migrating rural loads of requirements can be used to either test NEMs for newly projected SMES or for labs on experimental economic optimization and demand response for multi-priority load control in a rural smart microgrid environment [4]. Economics and environmental protection are taken as the optimization goals for the optimal dispatch of microgrids to promote their synergistic optimization. In this algorithm, the traditional MOPSO uses the crowding distance method to find the optimal position, which has good locality but poor globality. In order to enhance the global search ability of the algorithm, Qiu X proposed FMOPSO, and introduced the fuzzy similarity matrix method in MOPSO. To combine the advantages of the two algorithms, an improved MOPSO was proposed, called mixed-strategy MOPSO (HSMOPSO). A typical European microgrid was then set as the object of optimal dispatch. The results showed that the non-dominated solutions obtained by the HSMOPSO algorithm were closer to the real Pareto optimal frontier, with a wide and uniform distribution, which maintaining a good diversity. After the energy storage technology was introduced into the microgrid, the optimization results could be closer to the origin of the coordinates, thus achieving Pareto improvement. Therefore, it could be concluded that the proposed algorithm had satisfactory local and global search ability [5]. These theories have explored microgrids to some extent, but have not been combined with the HSMOPSO algorithm.

Particle swarm optimization is a promising approach to optimization. Song W proposed environment factor inspired PSO by taking into account environmental factors. To make full use of EPSO to solve clustering problems, the process was divided into two phases. The experimental results showed that EPSO outperformed these state-of-the-art clustering algorithms in most cases [6]. Due to poor diversity, particle swarm optimization often falls into local optima, which leading to premature stagnation. To overcome this shortcoming, Geng H proposed an IPSO based algorithm. First, a centralized mechanism was refined. Then the poor quality seed population was vaccinated, and the search range of the vaccine was controlled by the maximum concentration of particles, which improved the convergence accuracy of the algorithm. The results of modelling showed that the algorithm was effective and superior in addressing intricate problems of functional optimization [7]. Particle swarm optimization (PSO) is one of the suitable methods for solving NP-hard problems. So, it is reasonable to improve the PSO. Displacement flow shop scheduling is one of these problems. Zeidan M used the improved particle swarm optimization algorithm IPSO to solve the permutation flow shop scheduling problem. The improvement was accomplished by implementing the individual improvement scheme IIS, replacing the generated initial population with another population that was close to the optimal solution. The performance of IPSO was evaluated against PSO by several evaluation criteria and several questions randomly generated from a uniform distribution. The results showed that IPSO outperformed PSO [8]. These theories describe the particle swarm algorithm, but they are less integrated with the microgrid economy and are not practical.

The optimal dispatch of microgrid mainly includes economic operation cost and environmental impact. Through the research, it is found that in the function test, the optimal fitness of the genetic algorithm is 12.6, the optimal fitness of the double-layer optimization algorithm is 8.7, and the optimal fitness of the particle swarm optimization algorithm is 0.43. It can be seen that compared with other algorithms, the PSO algorithm has better effect in the optimization of microgrid economy and financial security. The initial value of the PSO algorithm is 2.3, and the optimization iteration is completed in about 28 iterations. The starting value of the genetic algorithm is 1.5, and the optimization iteration is completed in about 34 iterations. Therefore, particle swarm optimization algorithm has better performance in iterative optimization.

II. Optimization Methods for Microgrid Economy and Financial Security

With the needs of economic development, more and more electricity needs to be consumed [9]. The power sector has also built many large power sources. However, the frequent large-scale power outages in actual situations expose the shortcomings of traditional power grids. If it continues to expand, it will cause more pollution to the environment. Obviously, it has been unable to adapt to the development of the modern economy for continuing to expand the scale of the traditional power grid [10], [11].

In order to solve this problem, distributed generation began to appear, which has high energy utilization rate and less pollution, which improves the stability of power supply [12]. But the cost of exchanging distributed generation and large grids is very high. Moreover, if the large power grid fails, the distributed power supply should immediately withdraw from the grid-connected operation of the large power grid, which provides difficulties for the decentralized utilization of energy [13]. Figure 1 shows the distributed generation structure.

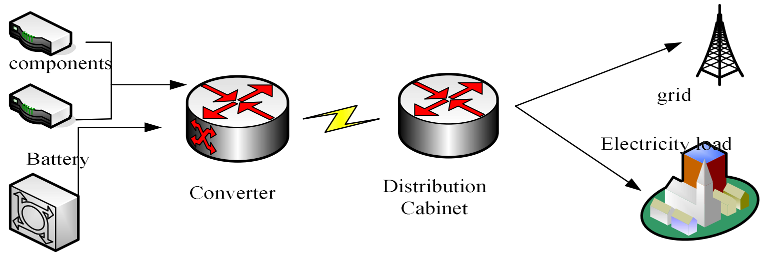

Figure 1: Distributed Generation Structure

In order to overcome the above problems, give full play to the advantages of distributed power, and reduce the impact of distributed power on large power grids, microgrids emerge as the times require [14], [15]. The emergence of microgrid solves the problem of distributed power generation. And when the microgrid is running, it can act as a controllable unit to supply power. Its reasonable planning can make it a powerful supplementary measure in the power system, improve the safety and stability of system operation, and meet the needs of different end users [16], [17]. If the large power grid fails, the microgrid can be disconnected from the power grid at the first time and transformed into an island operation mode to reliably and continuously supply power to users [18]. Figure 2 shows the relevant structure of the microgrid operation.

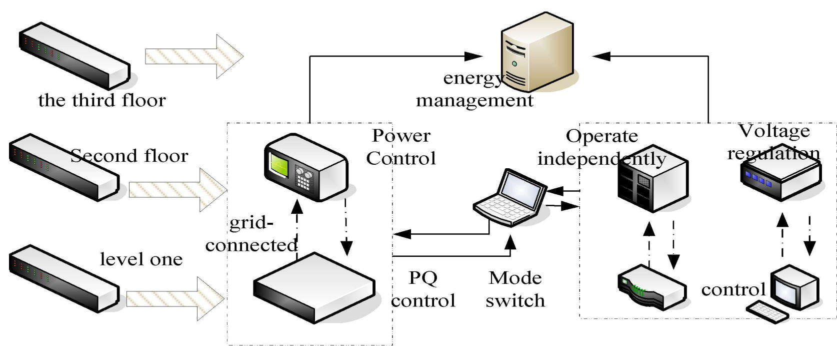

Figure 2: Microgrid Operation Related Structure

From a macro point of view, compared with other methods, microgrid is considered to be a very scientific and reliable system. It enables the grid dispatching system to effectively manage distributed power sources through the microgrid. This method can reduce the waste of energy and realize the state of switching between the two modes of the island and the main network at any time. Figure 3 shows the traditional state transition relationship of the microgrid.

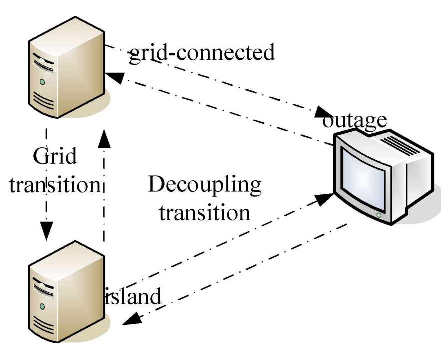

Figure 3: The Traditional State Transition Relationship for Microgrids

Economic security issues have always been the focus of power regulation. In the traditional power economic security supervision, macroeconomics and related policies are more emphasized. The accounting supervision theory of electric power companies mainly focuses on the public level of the government, and there is a lack of relatively independent supervision of the power industry. With the continuous reform of the power system and the continuous improvement of power policies, it is an inevitable move to build a reasonable power economic supervision system. With the continuous intensification of market competition, the current environment faced by power companies is very complex, and the requirements for power supervision work are very high, which poses new challenges to power economic security. Therefore, in the microgrid economy, it is not only necessary to reasonably allocate the output of the generator sets in the cycle to achieve the optimal system operation state, but also to minimize the power supply cost. Figure 4 shows the overall optimization goal of the microgrid grid-connected system.

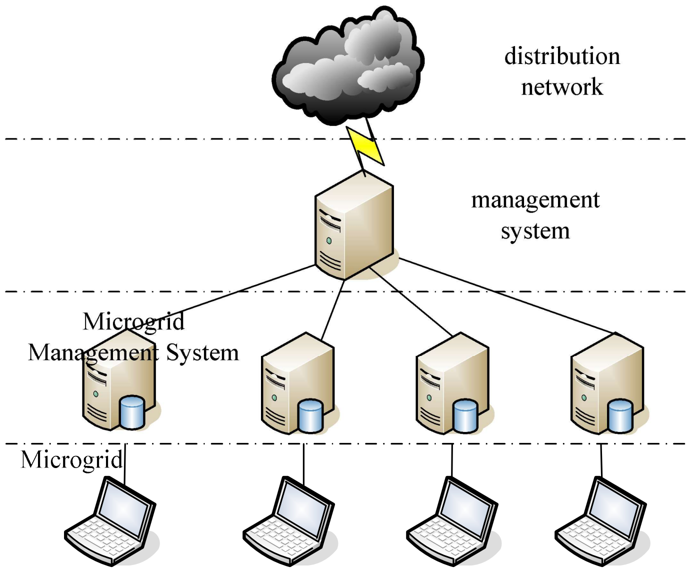

Figure 4: The Overall Optimization Goal of the Grid-connected System

In the context of the rapid development of the global economy, people's living standards continue to rise, and the global electricity consumption increases greatly, which leads to a large consumption of fossil energy. It not only causes waste of resources, but also causes environmental pollution. Through microgrid technology, the energy utilization efficiency of distributed generation has been greatly improved, thereby reducing energy consumption and improving the stability of power supply. Figure 5 shows the basic structure of the microgrid.

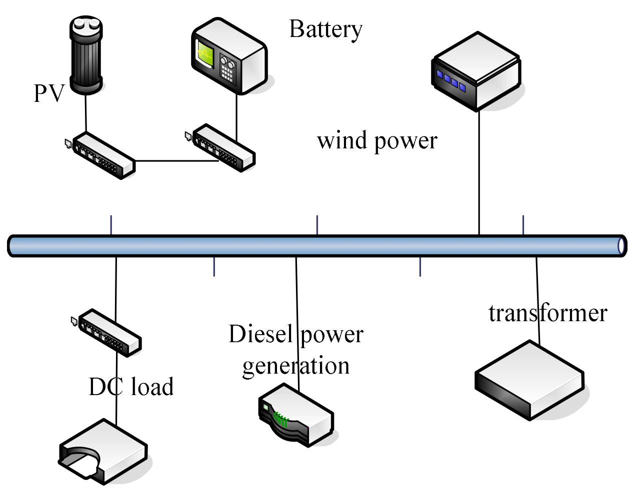

Figure 5: Microgrid Basic Structure

The particle swarm optimization algorithm has the ability of global optimization. This algorithm has good universality and can be applied in a variety of environments. Moreover, the algorithm has very strong distributed ability, so it is widely used in power systems and other fields.

$$\min k(a_1, a_1, \cdots, a_p) \tag{1}$$

$$\mathrm{a} = (\mathrm{a}_1, \mathrm{a}_1, \cdots, \mathrm{a}_\mathrm{p}) \epsilon \mathrm{A} \tag{2}$$

In this part of the Formula, A represents the definition domain of a, and Formulas (1) and (2) represent the mathematical model to be optimized.

$$a_{rt}^1 = rand * (a_t^{max} - a_t^{min}) + a_t^{min} \tag{3}$$

$$y_{rt}^1 = rand * (y_t^{max} - y_t^{min}) + y_t^{min} \tag{4}$$

The above Formulas represent the initialization steps of the particle swarm algorithm, y_t^{max} represents the flight speed, and a_{rt}^1 represents its initial position.

$$y_{rt}^{q+2} = \vartheta^q * y_t^q + f * rand * (Ubest_t^q - a_{rt}^q) \tag{5}$$

$$a_{rt}^{q+2} = a_{rt}^q + y_{rt}^{q+2} \tag{6}$$

To calculate the initial fitness value of each particle, the smallest one should be selected as the initial global optimal solution among the local solutions of all particles. y_{rt}^{q+2} is the speed of the update, a_{rt}^{q+2} is the position of the update.

$$\vartheta^q = \vartheta_{max} - \frac{\vartheta_{max} - \vartheta_{min}}{q_{max}} * q \tag{7}$$

For ordinary particle swarm optimization, dynamic value changes need to be used, and ϑ_{max} represents the dynamic value.

In the parallel mode of the microgrid, the load demand is taken care of by the micropower supply. When there is excess energy, it can be charged to the energy storage device or sold to the grid to improve economy.

$$\min \mathrm{U} = \mathrm{u}_{\mathrm{ab}} + \mathrm{u}_\mathrm{q} + \mathrm{u}_{\mathrm{grid}} \tag{8}$$

Among them, U represents the minimum cost for the microgrid to meet the load demand. u_{ab} represents the controllable distributed power source, u_q represents the energy storage, and $\mathrm{u}_{\mathrm{grid}}$ represents the cost function of the exchange power of the main network.

$$\mathrm{u}_{\mathrm{ab}} = \sum\sum(\mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}(\mathrm{U}_\mathrm{z}(\mathrm{W}_{\mathrm{ab}}^{\mathrm{m}}) + \mathrm{V} * \mathrm{W}_{\mathrm{ab}}^{\mathrm{m}}) + \mathrm{S}_{\mathrm{ab}}^{\mathrm{m}} * \mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}) \tag{9}$$

In the above Formula, $\mathrm{W}_{\mathrm{ab}}^{\mathrm{m}}$ represents the output power of the controllable micro-power generator, and $\mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}$ represents the operating state of the controllable micro-power generator.

$$\underline{\mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}} \leq \mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}} \leq \overline{\mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}} \tag{10}$$

$$\left|\frac{\Delta \mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}}{\Delta t}\right| \leq k_g^{max} \tag{11}$$

In the above Formula, $\underline{\mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}}$ stands for the upper bound of the adjustable miniature source, $\overline{\mathrm{Q}_{\mathrm{ab}}^{\mathrm{m}}}$ stands for the lower bound of the adjustable miniature source and k_g^{max} stands for the maximum slope of each cell.

$$I_{d+} + I_{d-} \leq 2 \tag{12}$$

$$I_{grid+} + I_{grid-} \leq 2 \tag{13}$$

The state constraint means that the state of the same energy storage device can only be one of charging or discharging at the same time, and the microgrid can only purchase or sell electricity from the main grid at the same time.

$$\underline{G_d} \leq G_d \leq \overline{G_d} \tag{14}$$

$$\underline{\mathrm{GHJ}} \leq \mathrm{GHJ} \leq \overline{\mathrm{GHJ}} \tag{15}$$

In the above Formula, GHJ stands for the storage's charging condition, $\underline{\mathrm{GHJ}}$ stands for the storage's ceiling and $\overline{\mathrm{GHJ}}$ stands for the storage's floor. G_d stands for the recharging or discharging capacity of the stored power, $\underline{G_d}$ stands for the ceiling and $\overline{G_d}$ stands for the floor.

$$\Delta K^r = \sum(K_{ab}^{rD} - K_{ab}^r) - \sum(K_{unctrl}^{rD} - K_{unctrl}^r) \tag{16}$$

In the Formula, K_{ab}^{rD} is the real-time power of the load, K_{ab}^r is the predicted power, K_{unctrl}^{rD} is the real-time output of the renewable energy, and K_{unctrl}^r is the predicted output.

$$K_L^{rF*} = K_L^{rF} + \Delta K^r \quad (17)$$

In the Formula, L represents the selected optimization starting node, and $*$ represents the modified variable for error transfer.

$$K_{grid}(a) = K_{load}(a) - K_{TY}(a) - K_{BN}(a) - K_{GHJ}(a) - K_{diesel}(a) \quad (18)$$

In the above Formula, $K_{grid}(a)$ represents the state of charge of the randomly initialized particle and the value of each dimension of the particle.

III. Experiment on Optimization Method of Microgrid Economy and Financial Security

In order to verify the feasibility of quantum behavior particle swarm algorithm to solve the optimal scheduling problem of microgrid. In this paper, the above methods are used for comparative analysis in different situations. The details are as follows.

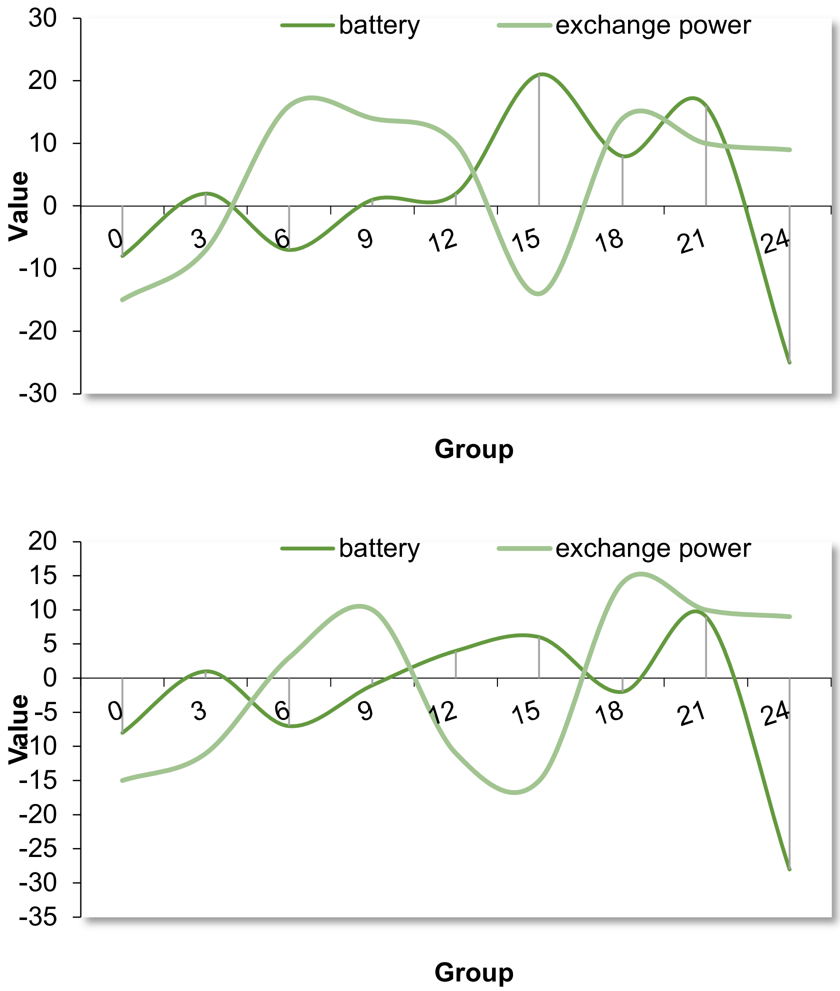

Figure 6: Comparative Analysis of the Optimization Results under Different Algorithms

According to the data in Figure 6, the optimization results under different conditions are compared and analyzed. First of all, from the results of windy and cloudy days, under the particle swarm algorithm, the initial power of the battery is -8kw/h. When the running time is 3, the power is 2kw/h; when the running time is 6, the power is -7kw/h; when the running time is 9, the power is 1kw/h; when the running time is 12, the power is 2kw/h; when the running time is 15, the power is 21kw/h; when the running time is 18 , the power is 8kw/h; when the running time is 21, the power is 16kw/h; when the running time is 24, the power is -25kw/h.

The starting power of the exchange power between the microgrid and the main grid is -15kw/h. When the running time is 3, the power is -7kw/h; when the running time is 6, the power is 16kw/h; when the running time is 9, the power is 14kw/h; when the running time is 12, the power is 10kw /h; when the running time is 15, the power is -14kw/h; when the running time is 18, the power is 14kw/h; when the running time is 21, the power is 10kw/h; when the running time is 24, the power is 9kw/h. According to the specific optimization results on cloudy days, it can be seen that the output of the battery is very unstable, and the variation range is very large, while the exchange power between the microgrid and the main grid is relatively stable, and the difference between the extremes is relatively small.

From the results of the wind and sunny days, under the particle swarm algorithm, the initial power of the battery is -8kw/h. When the running time is 3, the power is 1kw/h; when the running time is 6, the power is 7kw/h; when the running time is 9, the power is -1kw/h; when the running time is 12, the power is 4kw /h; when the running time is 15, the power is 6kw/h; when the running time is 18, the power is -2kw/h; when the running time is 21, the power is 9kw/h; when the running time is 24, the power is -28kw/h.

The starting power of the exchange power between the microgrid and the main grid is -15kw/h. When the running time is 3, the power is -11kw/h; when the running time is 6, the power is 3kw/h; when the running time is 9, the power is 10kw/h; when the running time is 12, the power is - 11kw/h; when the running time is 15, the power is -15kw/h; when the running time is 18, the power is 14kw/h; when the running time is 21, the power is 10kw/h; when the running time is 24 , the power is 9kw/h. According to the optimization results of sunny days, its power is lower than that of cloudy days as a whole, indicating that less resources are needed in sunny days. This is consistent with the actual situation, and from other results, the situation is similar to the cloudy day.

Table 1: Comparison of Optimization Scheduling Operating Costs of Different Algorithms

Situation	HSMOPSO algorithm	Other algorithms
Sunny	-28	30
Cloudy	43	93
Total	15	123

According to the data in Table 1, the optimization scheduling operation cost under different algorithms is analyzed. According to the specific situation, under the HSMOPSO algorithm, the running cost on a sunny day is -28 yuan, and the cost on a cloudy day is 43 yuan, and the total cost is 15 yuan. Under other algorithms, the running cost on a sunny day is 30 yuan, and the cost on a cloudy day is 93 yuan, a total of 123 yuan. It can be seen from this that the operating cost required for optimal scheduling using the HSMOPSO algorithm is much lower than that required by other algorithms. The scheduling is more reasonable, and the system runs more economically.

Table 2: Time-varying Tariffs and Base Loads

Time	-	0	1	2	3	4
Price	-	2.5	2	1.4	0.9	3
Load	-	0.22	0.22	0.22	0.22	0.14
Time	5	6	7	8	9	10
Price	3.2	4.3	4	5.3	6.4	5.2
Load	1.5	0.6	1.1	2.2	4.3	2.2

Table 3: Electricity-using Equipment Parameters

Contents	1	2	3	4	5
Start time	0	3	6	9	12
End time	22	11	10	13	17
Consumption	20	15	7	8	6
High power	1.5	2.5	2	2	1
Low power	0.5	1.5	1	1	0
Dissatisfaction factor	0.2	0.1	0.2	0.2	0.1

According to the data in Table 2 and Table 3, the time-varying electricity price, base load and electrical equipment parameters in the experimental part are all known. From the electricity price situation, with the increase of time, the price also increases. When the time is 58, its load rises rapidly.

According to the above situation, if the actual microgrid includes 3 controllable micropower sources and the control point of the distribution network exchange power, the particle swarm optimization algorithm is used to optimize the centralized layer, and the results are as follows:

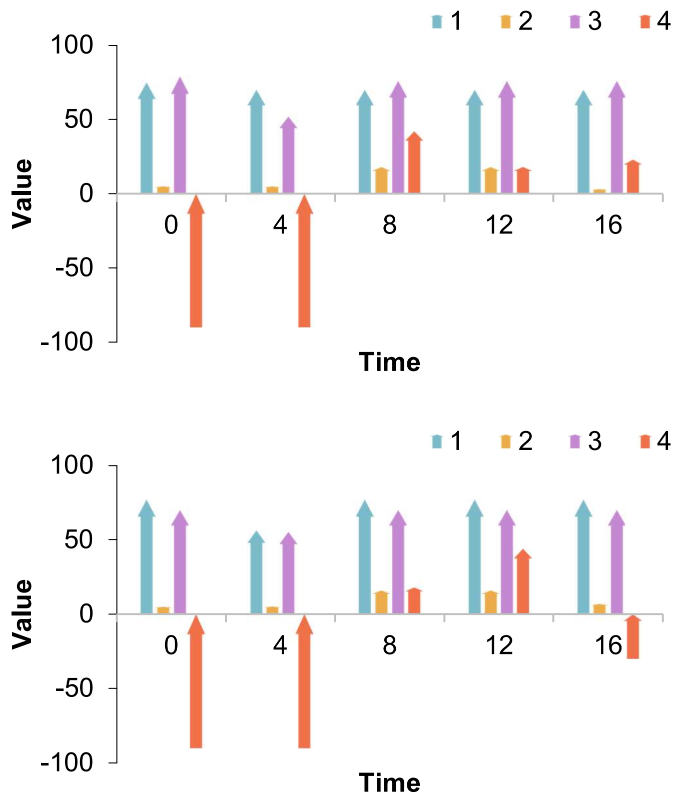

Figure 7: Analysis of Optimization Results

According to the data in Figure 7, the optimization results of different layers are compared and analyzed. When the exchange power is positive, it means that the microgrid purchases electricity from the distribution network, and a negative value means selling electricity. When the load level is low, the microgrid obtains greater economic benefits by fully transmitting power to the external grid, and when the load level is high, the microgrid purchases electricity from the external grid. From the results of the centralized optimization layer, the exchange power of the first controllable micro power supply is very stable, between 70-75P/KW. The exchange power of the second controllable micro power supply has a certain range of change, but its exchange power is very small, not exceeding 18P/KW. The exchange power of the third controllable micro power supply has a very large change range, indicating that it is very unstable during operation. The exchange power of the fourth controllable micro power supply has the largest change. But from the overall situation, the use of particle swarm algorithm to solve the economic scheduling problem with various forms of cost functions has a good effect.

From the perspective of distributed optimization results, by comparing the centralized optimization results and distributed real-time optimization results, the distributed algorithm can obtain a relatively stable solution only when the wind and load fluctuations are uncertain. It can be seen that the use of particle swarm optimization algorithm to optimize the centralized layer is better.

IV. Microgrid Economic Dispatch

Distributed power (DG) technology has low cost, less pollution to the environment, and has important functions in the field of power supply. In the optimization of microgrid economy, it is necessary to minimize the energy loss of the entire distribution network system as the goal of distribution network loss optimization. The reconstruction of distribution network is realized by binary particle swarm algorithm. In the analysis, the combination of binary particle swarm optimization and ordinary particle swarm optimization is used to comprehensively optimize distribution network reconfiguration and DG injection power.

Table 4: Results Variation under Different Algorithm Tests

Test	Optimal adaptation			Variance		
Functions	Genetic algorithms	Double layer optimisation	Particle Swarm Optimisation	Genetic algorithms	Double layer optimisation	Particle Swarm Optimisation

1	0.52	0.33	0	1.6	1.1	0
2	1.3	0.87	0.03	6.9	6	0.54
3	12.6	8.7	0.43	165	158	8.7

According to the data in Table 4, the particle swarm optimization algorithm is compared with the other two algorithms. According to the data, the particle swarm algorithm has the best effect on the optimal fitness, which can obtain the optimal solution under all test functions, and has greatly improved the iterative accuracy. It can find the global optimal solution faster, avoid falling into the local optimal solution in the iterative process, and avoid the algorithm being too premature and unable to converge to the optimal solution. In the third function test, the optimal fitness of the genetic algorithm is 12.6, the optimal fitness of the two-layer optimization algorithm is 8.7, and the optimal fitness of the PSO algorithm is 0.43. It can be seen that the optimization performance of PSO algorithm is indeed greatly improved compared with other algorithms. It shows excellent optimization characteristics and search stability, and plays a great role in the optimization of microgrid economy and financial security.

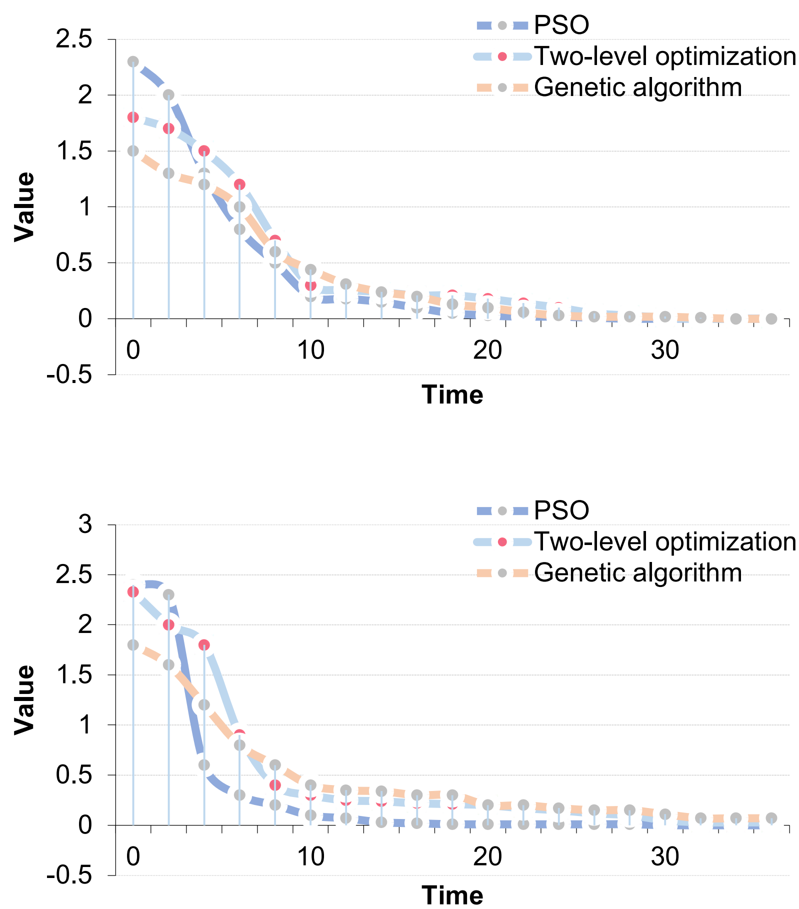

Figure 8: Analysis of Fitness Convergence under Different Functions

According to the data in Figure 8, in this experiment, three algorithms are used to perform iterative analysis under different functions. In the first set of function optimization graphs, the initial value of the particle swarm optimization algorithm is 2.3, and the optimization iteration is completed in about 28 iterations. The initial value of the double-layer optimization algorithm is 1.8, and the optimization iteration is completed in about 32 iterations. The starting value of the genetic algorithm is 1.5, and the optimization iteration is completed in about 34 iterations. According to the data, the particle swarm optimization algorithm has better performance in iterative optimization, and its speed of converging to the optimal value is very fast compared with the other two groups of algorithms.

In order to ensure the authenticity and stability of the data, the iterative optimization analysis is also carried out under other functions. According to the specific situation, in the first set of function optimization graphs, the initial value of the particle swarm optimization algorithm is 2.4, and the optimization iteration is completed in about 30 iterations. The initial value of the double-layer optimization algorithm is 2.33, and the optimization iteration is completed in about 32 iterations. The initial value of the genetic algorithm is 1.8, and the optimization iteration is completed in about 32 iterations. According to the two sets of data, the three algorithms in the experiment all complete the optimization in about 20-30 generations. And the particle swarm optimization algorithm is compared with the other two groups of algorithms, and the optimization speed is more obvious, and can converge to the global optimal value, the success rate is very high, which shows that the improved algorithm can effectively balance the global and local search ability. It can not only ensure that the algorithm converges to the global optimal solution, avoid prematurely falling into the local optimal solution, but also ensure the convergence speed of the algorithm, showing excellent algorithm accuracy and stability of iterative optimization.

According to the above analysis, compared with other methods, the hybrid strategy multi-objective particle swarm optimization algorithm used in this paper has better distribution. Therefore, it is beneficial to obtain the global optimal solution, and the probability of finding the local optimal solution is small. And its iteration speed is very fast and work efficiency is high. In order to test the specific effect, the iterative analysis is carried out under two algorithms by using the voltage deviation and the load power shortage rate. The specific conditions are as follows:

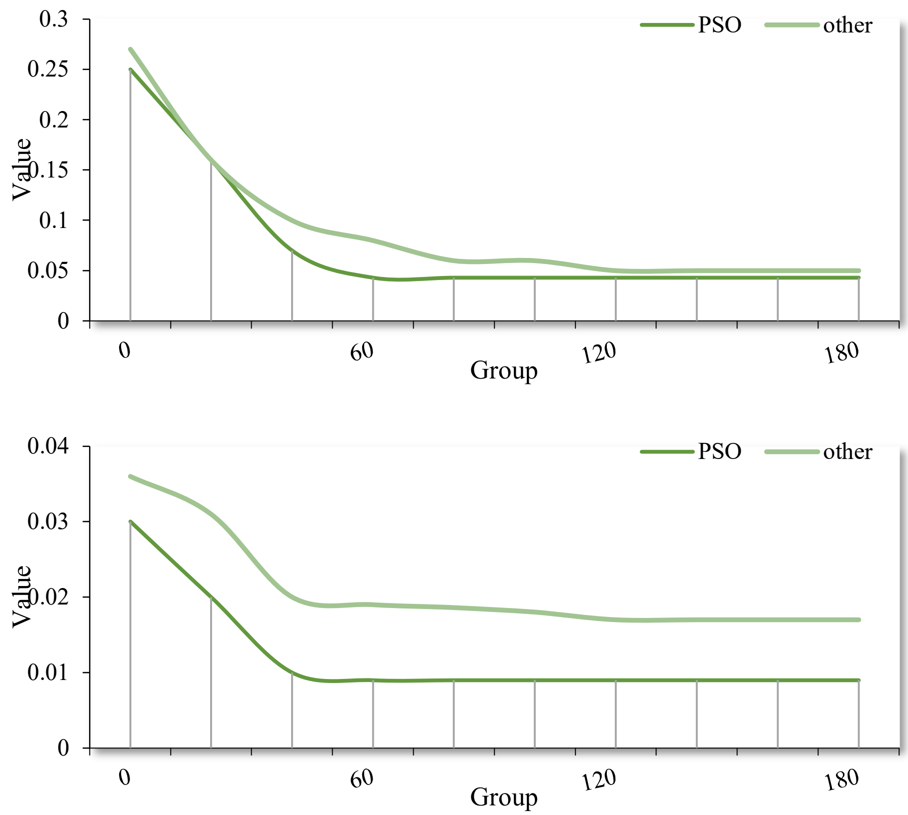

Figure 9: Convergence Curves for Different Objective Functions

According to the data in Figure 9, in the voltage deviation, the initial value of the hybrid strategy multi-objective particle swarm optimization algorithm is 0.25, and the optimization iteration is completed in about 50 iterations to find the optimal solution. The starting value of the compared algorithms is 0.27, and the optimization iteration is completed in about 100 iterations to find the optimal solution. In line with the power shortage rate, the initial value of the hybrid strategy multi-objective particle swarm optimization algorithm is 0.03, and the optimization iteration is completed in about 60 iterations to find the optimal solution. The starting value of the compared algorithms is 0.036, and the optimization iteration is completed in about 110 iterations to find the optimal solution. According to this situation, the optimization effect of the mixed strategy multi-objective particle swarm optimization algorithm is better, and it is more suitable for the optimization of microgrid economy to save resources.

V. Conclusions

With the development of new energy and distributed generation technology, microgrid technology has become an effective way to utilize renewable energy. There are many types of power sources in the microgrid, which are affected by weather and energy storage elements, which brings challenges to optimal scheduling. How to dispatch the controllable distributed generation units, energy storage systems and regulated loads on the demand side in the microgrid to make the system operating cost the most economical has become a key issue at present. This paper aims to study the optimization method of microgrid economy and financial security based on HSMOPSO algorithm. With the help of the HSMOPSO algorithm, it is expected to optimize the operation of the microgrid system, to give full play to the advantages of each micropower source, and to ensure that the security and stability of the power grid are not affected. Through research, it is found that the hybrid strategy multi-objective particle swarm optimization algorithm has better effect on the optimal fitness, and has greatly improved the iterative accuracy, and can find the global optimal solution faster. This paper draws some conclusions, but there are still shortcomings. When studying the load-side response to the economic optimal dispatch of microgrids, the influence of real-time electricity price incentives on the behavior of shiftable and dispatchable loads should be considered. Due to the limitation of the level, this part of the content is not described in the article, and it is hoped that the follow-up research can continue to be in-depth.

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