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*Research Article*

# Prediction of Phase-Controlled Breaking Zero Point of Electronic and Electrical Fault Current considering Branch Definition Algorithm

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Phase-control technology, which is also called simultaneous interconnection technology, is one of the latest developments in intelligent interconnection. With the subsequent development of the short-circuit system, which increased significantly, the switching capacity of the switch is tested. Applying arc power to the contact holes during a short circuit also causes extensive damage to the switch contacts, which severely affects the operation and life of the switch. To solve this problem, this paper introduces the branch definition algorithm, describes different types of faults occurring in power systems, proposes a general scheme for fault current phase-controlled breaking, derives a fault occurrence detection method and a phase control method, and performs a simulation analysis of the proposed branch definition algorithm; a single-phase short-circuit current model is built; and the algorithm is tested using simulation data. The oscilloscope acquisition data were simulated and analyzed to obtain the characteristic parameters of the waveform, and the online simulation results obtained were analyzed with the oscilloscope data. The experimental results show that the system designed in this paper can accurately predict the zero value, and the zero values obtained from four experiments conducted are 34.52 ms, 34.46 ms, 29.9 ms, and 29.84 ms, respectively.

## 1. Introduction

The reduction of circuit impedance in the event of a fault and the transient effect of a sudden short circuit lead to a significant increase in short-circuit current, which may be several times the rated current of the circuit, seriously affecting the safe and stable operation of electrical equipment. Using phase fault switching technology, the circuit converter is controlled to realize that the microcontroller circuit is close to the zero point of the short circuit current. This is an important way to improve the reliability and longevity of circuit breakers.

Phase-driven fault current control reduces contact wear, improves breaking performance and reliability, extends switch life, and facilitates the development of new breaking technologies. In the phase-controlled switch, according to the different characteristics of the load, the switch is matched to the most favorable phase voltage or phase current angle to realize switching or disconnection. The primary task of a phase-controlled fault current switch is to predict the expected zero-point current. Debt irregularities (such as harmonics, attenuated DC components, and so on) and the requirement for "fast" exchange rate protection make it very difficult to predict the error phase and zero point selection.

Regarding the branch-defining algorithm, relevant scientists have done the following research. Chung and Flynn investigate a discrete dynamic programming model for infinite-domain component switching in binary switching systems. When the system fails and the failed components need to be replaced, a cost is incurred, and an algorithm is developed to find the optimal solution [1]. Am considers a nonlinear semi-infinite problem with at least one semi-infinite constraint (SIC). Standard branch-and-bound algorithms adapt to such problems by extending the usual upper and lower-bound techniques for nonlinear inequality constraints to SIC [2]. Yongmoon presents a globally optimal algorithm for determining the rotational offsets between the rigidly coupled rotation sensor and the camera coordinate system. It uses a branch-and-bound algorithm to find global solutions that minimize errors in the geometric sense and demonstrates the effectiveness of the algorithm through experiments on synthetic and real data sets [3]. Amir et al. proposed a branching and constraint control algorithm inspired by decoding boxes to control current amplified converters. Verification of the proposed control algorithm by the simulation results verified by the experimental results shows that the suggested method gives the same outcome as the proposed enumeration algorithm and is computationally efficient [4]. Segundo et al. propose a new composite article and a limited algorithm for the maximum limits of a weighted crack problem. The algorithm is based on a new targeting process that is capable of eliminating a large number of branches and related points of the tree, and experiments show that the new algorithm is in many ways more advanced than the advanced algorithm [5]. Ho et al. incorporate a planned dynamic approach within the branching structure for the subsequent allocation of resources to the disease control to the crowd. The proposed algorithm can ensure the optimization and reduce the scope of optimization of medical procedures [6]. Dolgui and Gafarov investigate possible more difficult cases and how to design disciplinary algorithms, which show how to make a heavy packing bag. It was found that in the worst cases, algorithms that calculate the lower limit in polynomial time cannot solve a problem of medium size in a timely manner [7]. Nagai and Kuno have developed diagnostic and constraint algorithms to solve network flow problems that maximize production and transmission at the same time. On an economic scale, production costs are considered an empty operation. The proposed algorithm produces an ideal global solution to this problem of unconverted minimization in a limited time [8]. Bretthauer et al. proposed a branching and constraint algorithm to solve a problem that can be separated from a convex square point with lower and upper limits of integer variables. The algorithm solves the continuous quadratic problem under conditions. He discusses reorganization methods to effectively resolve persistent subproblems [9]. Chu et al. propose an efficient branch definition algorithm where effective elements include forward-looking construction methods and full use of three modification methods. Computational experiments were performed on a series of test data, and additional experiments were also conducted to analyze the contribution of each key element [10]. Bukata et al. set the mathematical settings of energy optimization problems, propose algorithms based on articles and links, and optimize existing robotic cells. The experimental results show that the performance of the branching algorithm with almost linear scale constraints on 12 microprocessor cores and the solution quality are obtained better or compared with other current works [11]. Ibaraki studied a number of problems that were converted into algorithms related to the article, which can be seen as a measure of the computational feasibility of the problem. One possible way to avoid this exponential growth is to use dominance tests along with lower limit tests [12]. Li et al. proposed a new branching algorithm to minimize the number of steam stations on both sides of the conveyor. The proposed method achieves the upper limit of high quality and uses two new control rules, the maximum memory load rule and the Jackson extended memory-based rule [13]. Wang et al. investigate the problem of cost-oriented control of power for dividing spectrum in networks of perception radios. Using feedback incentives, the revenue function of the primary user is represented as a function independent of the power broadcast by the secondary users. To address the lack of mastery by core users, they propose a cost-oriented analysis algorithm [14]. Ghaddar and Jabr propose a method for finding the optimal global solution for transmitting scheduling problems using the AC network model. This method is based on a semi-defined relaxation of the optimal AC power flow problem. The computer is a special branching and constraint algorithm for transmission expansion plans that takes care of the basic problem of mixed round numbers [15]. This approach provided some reference for our investigation, but due to the brief duration of the study and the small specimen size, this approach was not well accepted by the community.

The novelty of this paper is to introduce the causes of short circuits and related technologies of phase-controlled connection, the understanding of different types of short circuits, and the technical development status of phase-controlled connection technology. This document provides a detailed overview of faulty current management systems that control one phase, analyze the basic functions needed to predict zero current, and generate a single-phase short-circuit current model. It checks the effect of the correct variable on the current zero. This paper introduces methods for implementing algorithms, describes different ways to display error streams, and uses the same algorithms for simulation and analysis.

## 2. Method

*2.1. Branch-Bound Algorithm.* The branch definition algorithm is one of the most common algorithms for solving problems with integer programming. This approach addresses not only pure integer programming but also problems with mixed integer programming. The branch and bind method is a search-and-copy method that selects various diagnostic variables and subsystems for branch division. Figure 1 shows the architecture of the branch-and-bound algorithm.

The constraints for finding the optimal solution to the objective function are divided into three cases. The first one contains only equality constraints; the second one contains only inequality constraints; and the third one contains both equality constraints and inequality constraints.

$$\begin{cases} \min f(m), \\ s.t.h(m) = 0, \end{cases}$$
$$\nabla f(m^*) + \sum_{u=1}^{l} j_u^* \nabla g_u(m^*) = 0, \tag{1}$$

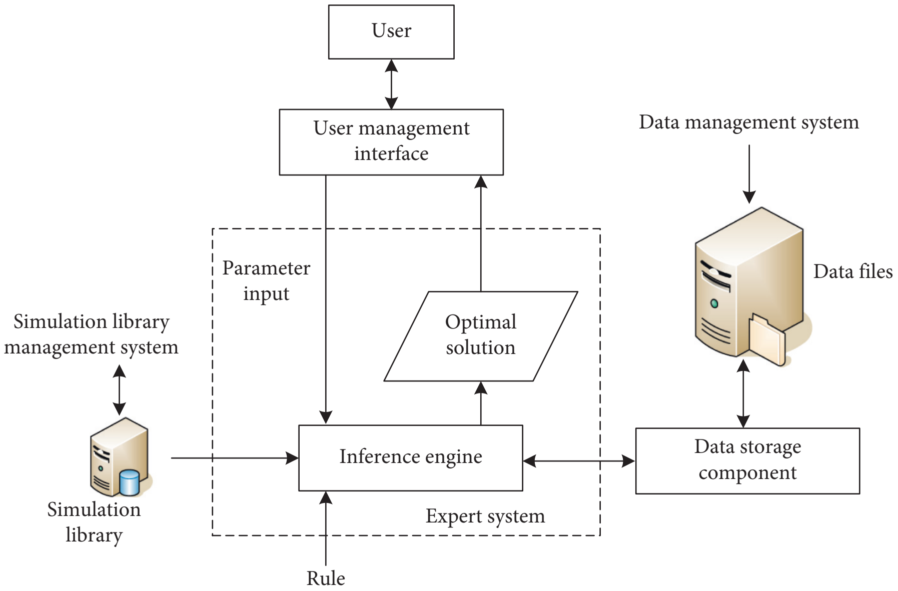

Figure 1: The architecture of the branch-and-bound algorithm.

where $m^*$ is the local optimal solution.

$$\nabla f_u(m^*) + \sum_{u=1}^{a} i_u \nabla h_u(m^*) = 0, \tag{2}$$

where $i_u$ is a constant not less than 0.

$$\begin{cases} \min f(m), \\ s.t. g(m) \leq 0, g(m) = 0, \end{cases} \tag{3}$$

where $I$ is the tightly constrained set of $m^*$.

$$\begin{aligned} &\nabla f_u(m^*) + \sum_{u=I}^{a} i_u^* \nabla h_u(m^*) \\ &\quad + \sum_{v=1}^{l} j_v \nabla g_v(m^*) = 0, \\ &i^T h(m^*) = 0, \end{aligned} \tag{4}$$

where $g_v$ is the differentiable convex functions and $m^*$ is the global optimal solution.

$$\begin{cases} -c + (-I)i + X^T j = 0, \\ i^T m = 0, \\ i \geq 0, \end{cases} \tag{5}$$

where $X$ is the matrix. $l \times n$.

Constrained regions for linear two-level programming are

$$\begin{aligned} D &= \{(m,n): m \in M, n \in N, X_u m + Y_u \leq y_u, u = 1,2\}, \\ D(m) &= \{n: n \in N: Y_2 n \leq y_2 - X_2 m\}, \end{aligned} \tag{6}$$

where $D(m)$ is the feasible domain of the underlying problem.

$$D(m) = \{m: m \in M: \exists n \in N, X_u m + Y_u n \leq y_u, u = 1,2\}, \tag{7}$$

where $D(m)$ is the projection of the top-level decision space.

$$P(m) = \{n \in N, n \in \arg\min [f_2(m,n): n \in D(m)]\}, \tag{8}$$

where $P(m)$ is a reasonable set of responses to lower-level problems.

$$IE = \{(m,n): (m,n) \in D, n \in P(m)\}, \tag{9}$$

where $IE$ is the inducible region.

$$\min_{m \in M} f_1(m,n,l) = \lambda_1 m + \mu_1 n + \omega_1 l, \tag{10}$$

where $M$ is the index set conditions.

$$F(i,j) = \min_{m \in M} \left\{ -h(m) + \sum_{u=1}^{p} \left[ -2 i_u \sqrt{g_u(m)} \right] \right\}, \tag{11}$$

where $F$ is the convex subsets of spaces.

$$\phi(G_v) = \frac{1}{2}(x_v + y_v), \phi(G_v)_2 = \left[\phi\left(G_j\right)_1\right]^2 = \frac{1}{4}(x_v + y_v)^2, \tag{12}$$

where $\phi(G_v)$ is the selected rectangle.

A decision-making system is a type of application that helps people analyze commercial data so that decision-makers can make commercial plans easily and correctly. Decision support system data is presented to decision-makers in graphical form. After inputting the decision problem, a formula is formed, and the system uses the branch-and-bound algorithm to obtain the optimal solution according to the formula. The flow chart of the system is shown in Figure 2.

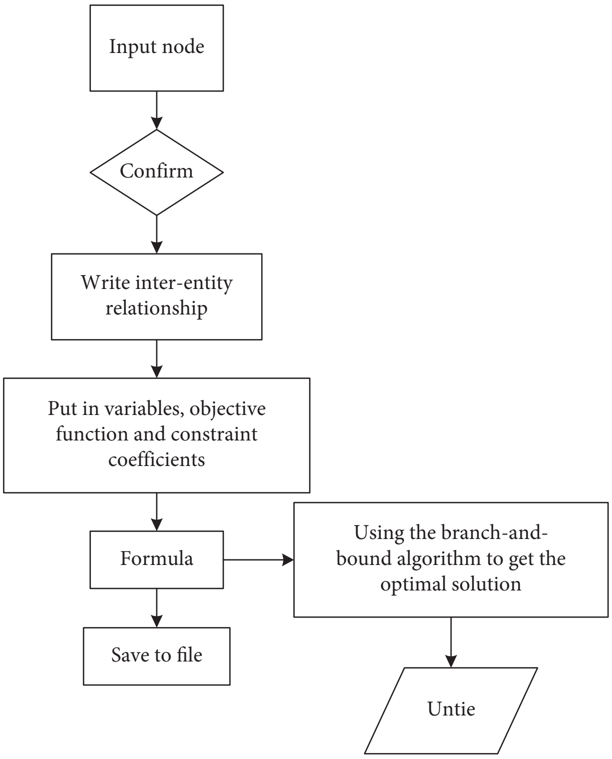

Figure 2: Flowchart of the system.

Using the above algorithm and the flow of this algorithm, the zero point prediction is carried out for the fault current phase-controlled breaking.

*2.2. Prediction of Fault Current Phase-Controlled Breaking Zero Point.* A controllable protection circuit uses a phase control method to control the direct current at the charging end. Check because the protection unit uses a thyristor with a control function. In this type of circuit, as long as the phase angle after starting and turning on the thyristor is properly controlled, the average of the DC voltage can be controlled. This is called phase management.

Short circuit faults are common faults in circuit systems. In the event of an error, the mains resistance will decrease, and the short-circuit operation will directly and significantly increase the value of the short-circuit current, which has a huge impact on the safe and sustainable use of the appliance. A short circuit is a short circuit between all phases or between phases and ground except for the normal circuit system. In the normal operation of the circuit system, except for the zero point, the phases or ground phases are isolated. If for some reason the insulation is damaged and a line is formed, it is called a short-circuit disturbance in the circuit system.

Conventional integrated protection systems operate simultaneously on multiple connections for single- and three-phase problems. In order to achieve full efficiency of phase selection, it is necessary to develop independent phase selection control systems with three independent operating phases. The operating system should collect voltage and current signals in real time and determine the type and phase of the fault based on the error signal. Once a specific error type and a specific fault phase are identified, the data for that fault phase is deleted, and the error manager resets the waveform and resets the fault phase data. The error manager should perform waveform recovery and zero detection based on the fault phase data. If the short-circuit type and phase separation are not determined correctly, subsequent calculations will be incorrect, resulting in incorrect circuit breaker operation. If the short-circuit current type and phase separation are incorrectly determined, subsequent calculations will be incorrect, resulting in incorrect circuit breaker operation.

The controller detects parameters such as system voltage and current in real time, predicts the optimum operating phase based on reference signals, and monitors the operating time of the monitor by increasing the ambient temperature, control voltage, and other factors. Phase management techniques include phase separation techniques and combined techniques. The primary use of controls used to select electrical system components is to replace seals, transformers, vacuums, and power cords. During electromagnetic current changes, overvoltages and overflows may occur, which may cause hazards and damage to equipment and installations. Phase-controlled switching technology, known as high-voltage, high-current continuous switching technology, actively eliminates the effects of these transients by controlling the switching time of the circuit breaker at the zero-voltage and zero-current points.

The main advantages of fault current phase-controlled opening and closing are reduced contact wear and extended circuit breaker service life. The life of a molded case circuit breaker is mainly influenced by the energy provided when the contacts are opened and the electrochemical corrosion on the circuit breaker contacts. When using phase-controlled opening technology, the opening phase of the circuit breaker is controlled to separate the energy of the microarc from the fault current, which can effectively improve the final breaking performance of the circuit breaker and reduce system disturbances during circuit breaker operation.

To achieve an open operation controlled by the target phase, zero current must be predicted, and the point of optimal zero current must be as close as possible to the time of occurrence of the short circuit. However, phase-controlled circuit breakers must be tightly integrated into the protection system so that the open command is not delayed beyond the shortest time needed to reach the optimal arc time to record. In the case of high-speed protection, this time may be shorter, so phase analysts must make zero predictions in the short term. However, due to the complexity of the short-circuit current and the DC component, the faulty current is not always in the zero order, which makes this task difficult. In addition, there are always some errors, and there may be a series of errors of different types during the error period. In a three-phase system, the effect of the phase disturbance on the input current error and the return of the current in the other two phases must be taken into account, making it difficult to accelerate the current projection of zero. Thus, rapid and accurate analysis of wrong current

Table 1: Relative probability of various types of short-circuit faults.

| Range of occurrence | Relative frequency (%) | Short circuit type | Relative odds (%) |
|---|---|---|---|
| On the 110 kV line | 78.5 | Three-phase short circuit | 6.5 |
| Generators with a capacity of more than 6,000 kW | 6.5 | Two-phase short circuit | 4.5 |
| 110 kV transformer | 6.8 | Single-phase short circuit to ground | 82 |
| 110 kV busbar | 8.2 | Two-phase short circuit to ground | 7 |

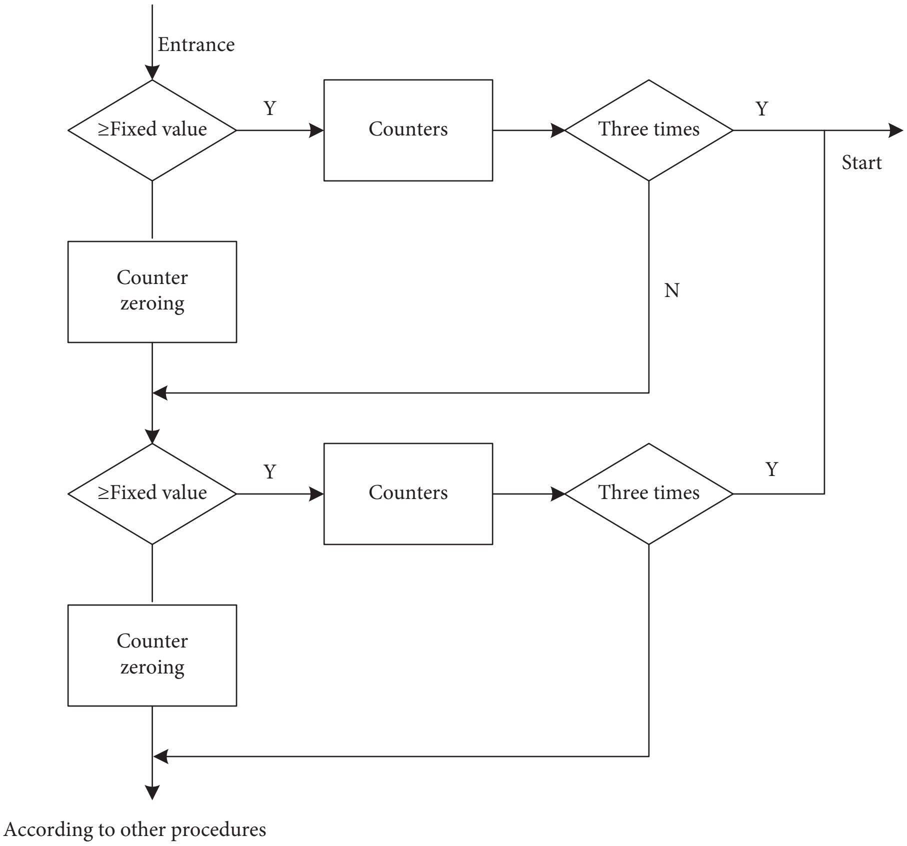

Figure 3: Phase current sudden change amount to start the original action logic.

characteristics and zero current projections is an important issue to be addressed in phase-controlled current disconnection, which is a major constraint to phase-controlled short circuits in high-voltage distributors.

This is always the best time to turn on the switch. Thus, by adjusting the isolation phase of the contact of the circuit breaker so that the time from arc to zero to the failure current is as short as possible, the wear of the contact in the fracture chamber can be effectively reduced mechanically and thermally. The electrical life of the circuit converter can be shortened, and the characteristics of the circuit can be improved. In the event of a short-circuit current, it is desirable to turn it on immediately when the current is greater than zero, which corresponds to the response time of the protection system, the operating time of the converter circuit, and the minimum arc time. Theoretically, the best reference point for a phase control error is zero, but it is difficult to predict directly because irregular short circuits cross the zero point due to large variations of the short circuit and DC components.

In particular, the lack of phase fault circuits requires phase monitoring to enable the management system to quickly and accurately detect the current fault signal, detect and process the test signal, and provide reliable and temporary error control. Therefore, implementing a single-phase array requires reliable detection and processing of fault current signals. The user must quickly obtain the current error variables when processing the calculated error current signal, accurately predict the zero point of the current error and the time to receive the rescue command based on the current parameters of the error break, and obtain reliable and on-time relief of the optimal phase sequence. Send a rescue signal to open the breaker at a predetermined speed. To predict the current error, a mathematical model must first be developed to describe the current error. Most people think that the current error cannot be described in the mathematical model due to the many short circuits, but it is used to determine system parameters. If only zero current is predicted without adjusting the system parameters, there can be many errors,

Table 2: The purpose, advantages, and optimal switching phase of the phase control switch.

| Content | Purpose of usage | Advantage | Best switching phase |
|---|---|---|---|
| No-load transformer closing<br>Shunt reactor closing | Suppression of magnetizing inrush current | Omit closing resistor<br>Improve voltage stability | Neutral grounded, phase voltage peaks, neutral insulated |
| Capacitor combination switch | Inrush current suppression<br>Suppress overvoltage | Reduce contact wear<br>Reduce maintenance costs<br>Lower insulation level | The neutral point is grounded, the voltage of each phase is zero, and the neutral point is insulated |

although there are different types of errors, all of which can develop continuously in the first part, depending on the requirements for accuracy.

When designing a switch, the firing rate of the contacts is primarily determined by the spark energy in the arc. Other things being equal, the arc time can be adjusted to reduce the arc energy acting on the contacts. In the event of a fault, the switch shall detect the current signal flowing through it, analyze it with an appropriate method, and initiate fault management if a fault is detected. If an active circuit breaker is detected, its position at the time of the fault should be determined, and a jump command should be issued to interrupt the phase control at the optimum time, that is, when the optimum arc time is reached. The phase control rectifier circuit requires a large output voltage adjustment range and a small pulse, which affects the power supply and current, in addition to the transformer needs attention. A phase-controlled rectifier circuit is a circuit that controls rectification by controlling the number of phase inputs on the AC side. In the thyristor protection section, the control function is controlled.

There are two types of short-circuit faults: the first is the generation of three-phase short-circuit faults, from two-phase single-phase short-circuit faults to a three-phase short circuit fault, mostly three-phase. The circular fault of the instantaneous electrical system connected with such a short circuit is asymmetric. Make a three-phase short circuit; time is not limited; it is long and short. The second is the three-phase symmetrical short circuit, which is the main cause of lightning damage. For example, if the ground resistance of the tower is high, the luminosity of the upper shield is low, and lightning to the ground, the maximum potential of the tower increases, and the insulation strength of the ceramic tower increases. In a three-phase symmetric short circuit, the electrical system is in a symmetrical state. The operating system mode shows a three-phase short circuit fault, but the system is least affected by a two-phase short circuit fault and a short circuit fault. The relative chances of different types of short-circuit faults are shown in Table 1.

It establishes a uniform symmetrical fault current regardless of whether the load current is negligible or not. But, in some cases, such as in high-load systems, the fault current and prefault current can only exist within a certain range. The fault current can reach the maximum charging current, and the influence of the current amplitude on the current error is more obvious.

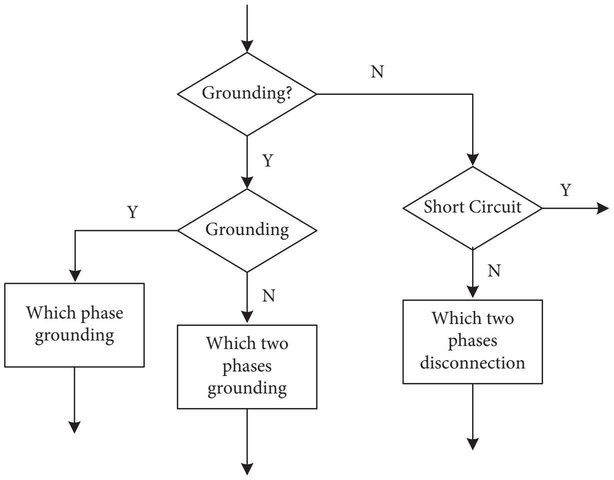

Figure 4: Fault type and phase differentiation judgment process.

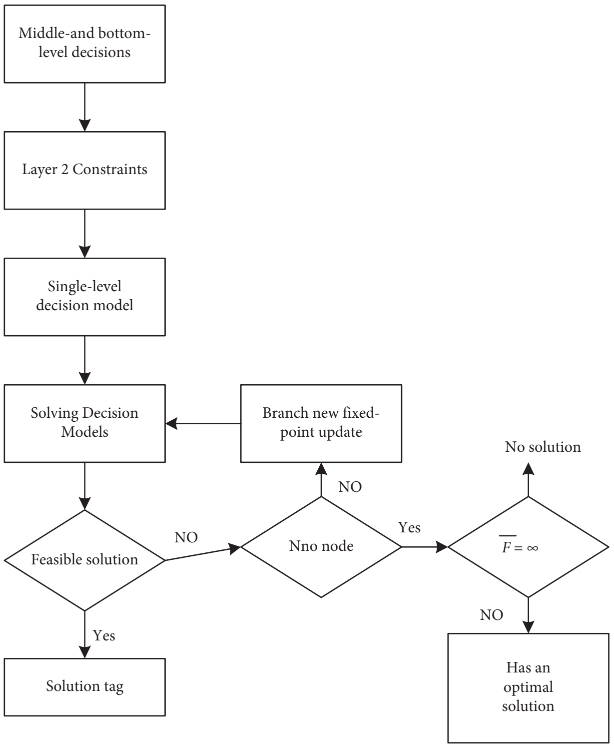

Figure 5: Flowchart of branch bound algorithm.

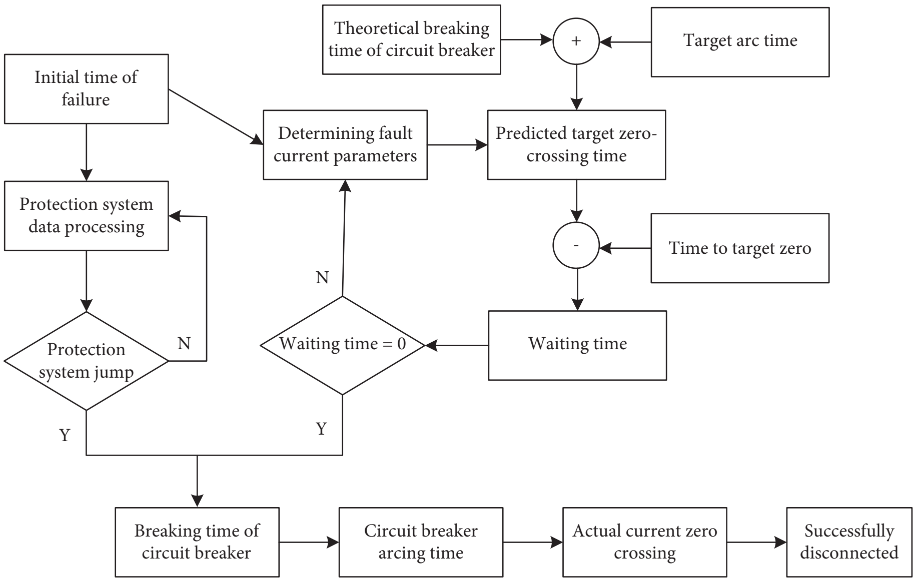

Figure 6: The overall scheme of fault current phase-controlled breaking.

Table 3: Different sampling window values after approximation.

| | Time | | | |
|---|---|---|---|---|
| Sampling window (ms) | 5 | 5 | 5 | 5 |
| r (ms) | 25 | 13 | 8 | 6 |
| Sampling window (ms) | 10 | 10 | 10 | 10 |
| r (ms) | 50 | 25 | 17 | 13 |
| Sampling window (ms) | 20 | 20 | 20 | 20 |
| r (ms) | 100 | 50 | 23 | 17 |

When a fault is detected, the system moves from the sampling self-test and judgment procedure to the fault handling procedure. The principle of phase current sudden change amount is shown in Figure 3.

Two-phase shorts have specific causes and lower ratios. For example, when two-phase conductors are disconnected, the abnormal impact of strong wind on the conductors can cause flashovers, resulting in two-phase short circuits. Symptoms of such short-circuit disturbances can only be eliminated by tripping if preventive measures are taken immediately. If the protection period is longer or the part with the largest short-circuit current trips, the fault can be automatically eliminated. Furthermore, such failures can occur multiple times, sometimes several times a day in a row. The steel pole collided with the transmission line across the river, and the plane collided with the transmission line causing a two-phase short circuit. If it is not eliminated quickly, the two-phase short circuit may be a two-phase ground short circuit or a three-phase short circuit. As shown in Table 2, the purpose, advantages, and optimal switching phase of the phase-controlled switch are shown.

Recurrence and fault changes must also be considered when diagnosing short circuit faults. By transition failure, we mean one fault to another fault, more in a short time.

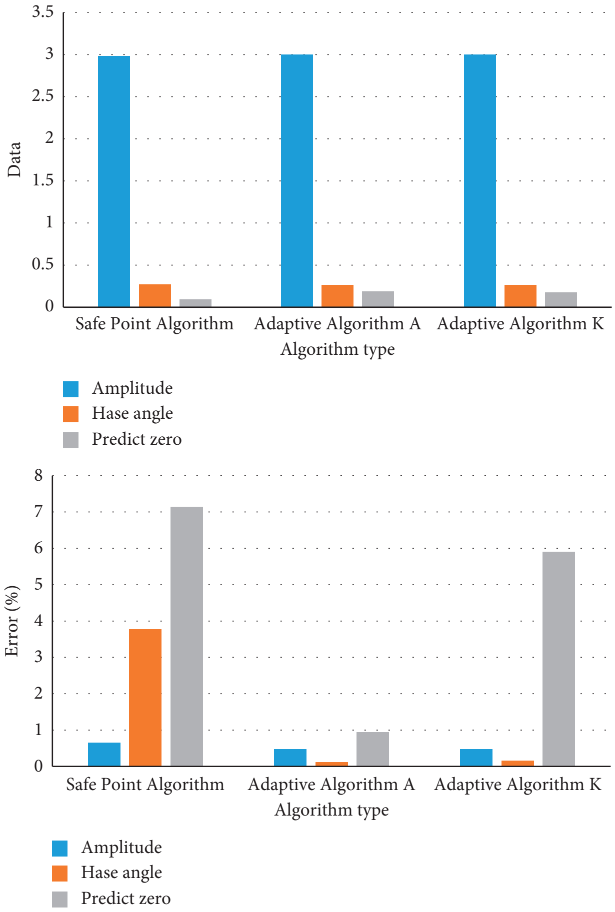

Figure 7: Comparison of the adaptability of safety point and adaptive algorithms.

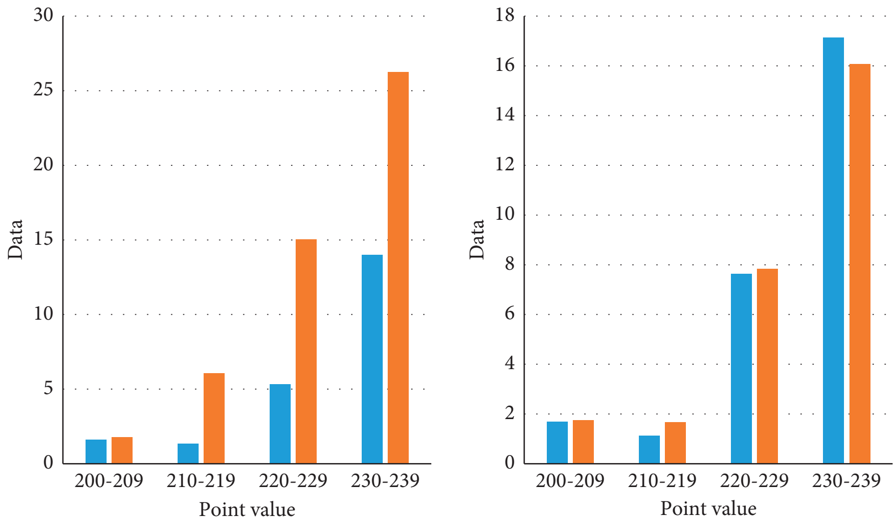

Figure 8: Simulation results.

For example, after a lightning strike damages the phase, the phase can be corrected again in a short period of time. A phase-to-phase short circuit can become a short circuit between phase and ground. Faults can also start as a two-phase short and become a two-phase grounded short. The repetitive nature of the fault indicates a fault in the transmission line, and in the short term, when reconnection is successful, a new fault is likely to occur in place, especially under adverse weather conditions.

The most common steps in power system operation are replacing capacitor banks, replacing reactor assemblies, replacing discharge power lines, and replacing discharge transformers. During this operation, transient phenomena such as overvoltage or draw currents may occur, which interfere with the operation of equipment and electrical systems. The phase switching technique is controlled by checking the use of power switches and disconnecting contacts to reduce or eliminate this short circuit risk to near zero voltage or current.

Switching techniques that control multiple stages operate in the traditional field, where reference signals are common. Among them is the largest density converter, which costs more than 60% of the total. This is largely due to the need for sealing systems, which means that capacitors are used more frequently in the network and are easier to connect than switching technologies that control other phases.

First, check the short circuit in the ground connection. If there is a short circuit fault in the earth connection, check whether there is a single-phase earth and which part is earth. It is known that two-phase earth faults occur in the system, and it is necessary to define a specific fault phase in more detail. If there is no earthquake, it must first be determined whether it is a three-phase short circuit. If no three-phase short circuit problem occurs, it is possible to determine which two-phase short circuit is clearer.

## 3. Experimental Simulation and Result Analysis

Increasing the breaking capacity of circuit breakers, reducing thermal load requirements in the circuit breaker cell, and mechanical load requirements in the drive are particularly important in improving the short-circuit resistance of electrical installations. The fault type and the phase separation judgment process are shown in Figure 4.

Controlled breaking of fault currents initially requires the control system to quickly and accurately detect interfering signals, analyze and process samples, and provide a reliable and timely jump control. Thus, the starting point for completing the phase control switch is the detection and operation of reliable error signals. When processing and calculating error signals, the control unit should obtain the current error parameters quickly. According to the fault current isolator, after receiving the jump command, one can accurately predict the zero point of the wrong current to reach the optimum gate. To provide reliable and timely phase range, the ignition signal and control switch contacts start to rotate at a certain speed within the optimal initial phase range. Figure 5 shows the flow chart of the branch-bound algorithm.

Most people think that the fault error is different, but there may be some DC components that can continue in sequence, and the original concept can be adopted according to the requirements of calculation accuracy. As shown in Figure 6, the overall scheme of fault current phase-controlled breaking is shown.

In order to convert the formula into a form that is easier to carry out in matrix algebra operations, the exponential part is expanded according to the Taylor expansion and approximated. Different sampling window values are shown in Table 3.

The fault current usually contains a large-amplitude attenuated DC component, and the adaptability of the safety point algorithm and the adaptive algorithm is compared. The simulation results are shown in Figure 7.

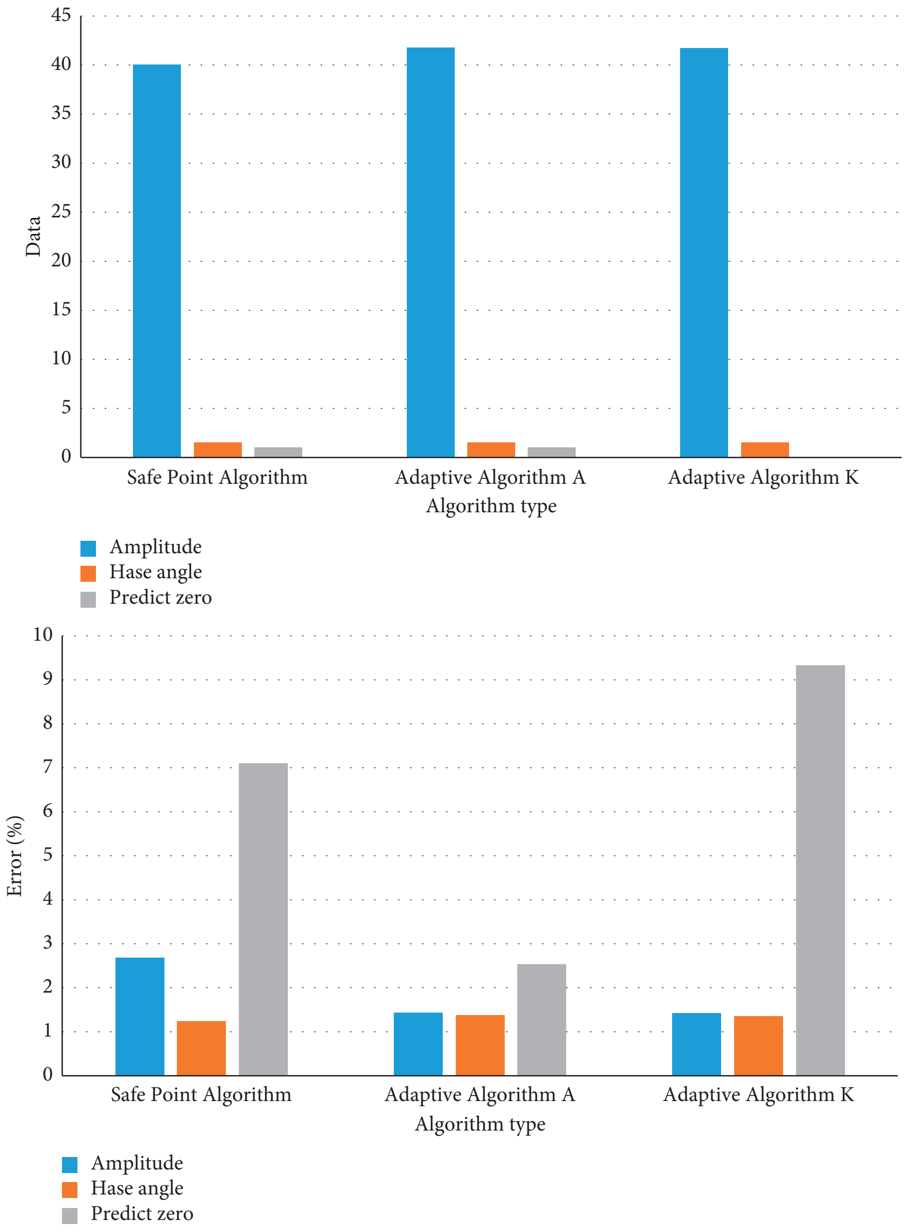

Figure 9: Simulation results of single-phase short-circuit fault model.

It can be seen that the algorithm adapted to the single-phase short-circuit fault current represented by the expression has a clear advantage in predicting zero current relative to the safety barrier, and the error is minimal.

A single-phase short-circuit current model was developed, and the algorithm was tested with simulation data. The results are shown in Figure 8. From the data in the figure, it can be seen that as the point value increases, the value of the simulation data increases accordingly, with a very large increase when the point value is 230–239 and no significant difference at lower point values such as 200–209.

Figure 9 shows the simulation results of the single-phase short-circuit fault model. It can be seen from the figure that the simulated data is similar to the results obtained by the single-phase short-circuit current model expression, and the adaptive algorithm has obvious advantages, and the errors are relatively small.

The data collected by the oscilloscope is reproduced and analyzed to obtain characteristic waveform parameters. Circuit simulation results and vibration data are displayed. From Figure 10, it can be seen that the system in this paper can accurately predict the zero value with the predicted

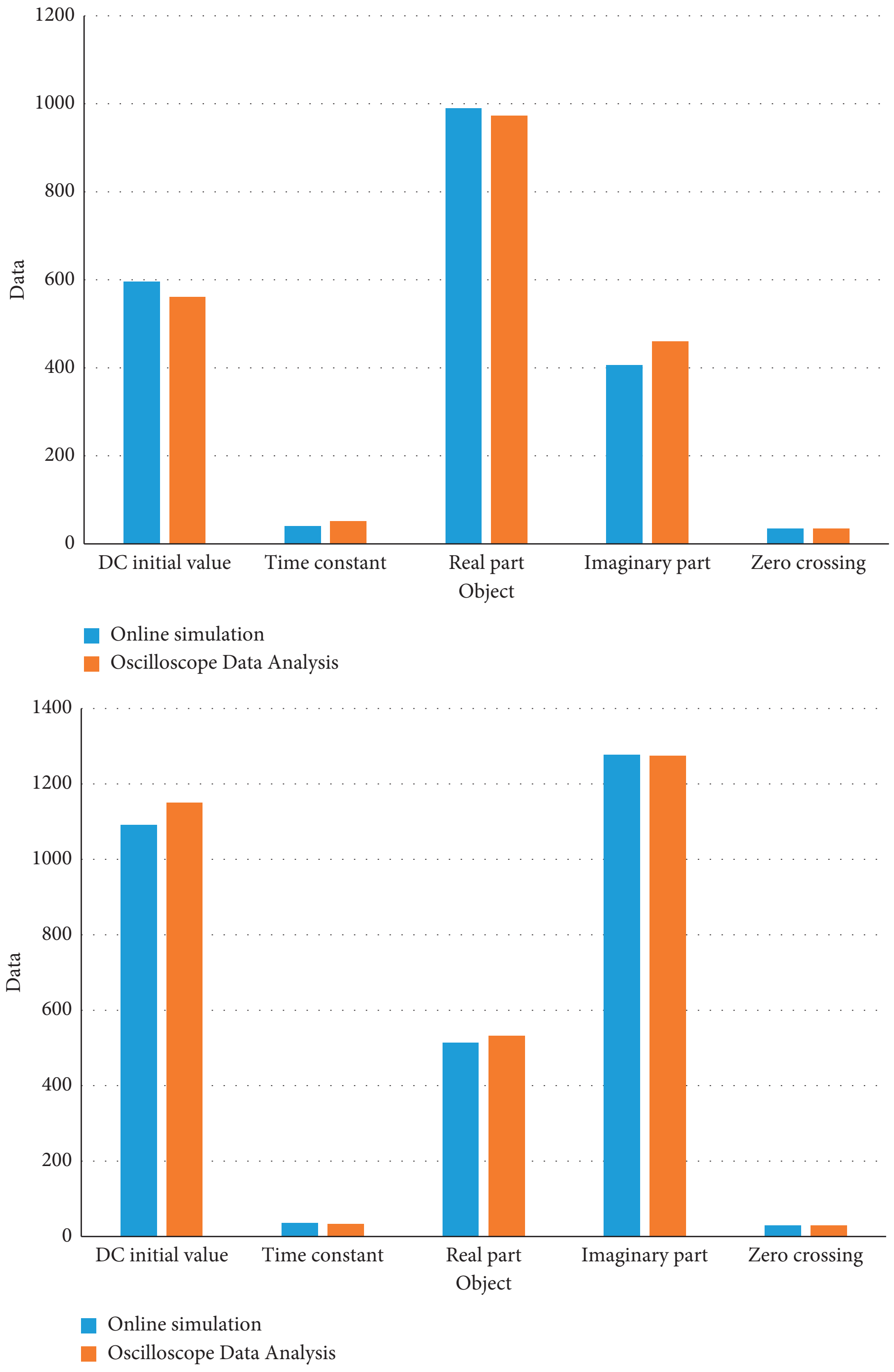

Figure 10: Comparison of online simulation results and oscilloscope analysis results.

values of 34.52 ms, 34.46 ms, 29.9 ms, and 29.84 ms, respectively.

## 4. Conclusion

Phase selection management technology is one of the latest developments in intelligent switching devices. Phase selection of conventional devices is widely used in electrical systems, but efficient and highly available step systems for current faults are not yet available. To solve this problem, this study presents a detailed algorithm: the branch definition algorithm, and the experimental part shows the flexibility of the two algorithms in different simulations and data processing and provides a favorable basis for algorithm selection and their step distribution. For phases that require system design, it is possible to accurately predict the zero point of phase-controlled phase error. This article makes a preliminary study of the predictions. Due to the limited data level and education level, it is inevitable that there will be research gaps. At the current stage of health assessment, the assessment is not detailed enough; it only shows the changes in the relevant indicators and the lack of internal evaluation in the analysis. At the stage of theoretical research, the grip of the theory is not deep enough. The complete realization of fault phase selection also needs to study the factors such as multiphase selection strategy, postopening zero point prediction, mechanism action characteristics, and arc characteristics.

## Data Availability

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

## Conflicts of Interest

The author declares that there are no conflicts of interest.

## Acknowledgments

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