

Algorithm Added to Relay Protection



Overview

Artificial intelligence algorithms enhancing relay protection and. In this research project, Artificial Intelligence (AI) algorithms applied to the relay.

Key Takeaways

Relay protection algorithms are designed to detect faults in electrical networks quickly and selectively, using both traditional and modern digital methods to ensure system stability and minimize damage.

Overview of Relay Protection

Relay protection algorithms are essential for detecting abnormal conditions such as short circuits, overloads, or voltage dips in power systems. Their primary goals are speed, selectivity, and reliability. Fast operation reduces thermal stress and voltage dips, while selective operation ensures that only the faulty section is isolated, minimizing supply interruptions to healthy parts of the network.

Traditional Relay Protection Algorithms
Time-Graded Protection: Relays are set with staggered operating times so that the relay closest to the fault operates first. This is commonly implemented using overcurrent relays with definite or inverse time characteristics. **Inverse Time Protection:** The relay operates faster for higher fault currents, making it suitable for radial networks with varying short-circuit currents.

Definite Time Protection: Operates after a fixed time regardless of fault current magnitude, often used in simpler network configurations. Proper grading time between consecutive relays is critical to maintain selectivity and avoid unnecessary delays in fault clearance.

Modern Digital and Intelligent Algorithms

With the advent of digital substations and intelligent electronic devices (IEDs), relay protection algorithms have evolved to handle multi-parameter inputs such as current, voltage, resistance, and phase angles. Modern approaches include: Machine Learning-Based Algorithms: Techniques like k-nearest neighbors, logistic regression, and support vector machines are used to recognize emergency modes and adapt protection settings dynamically.

Simulation-

Based Algorithms: Model experiments allow the creation of triggering rules that improve sensitivity and fault recognition in complex network configurations. Deep Learning Approaches: Algorithms such as Faster R-CNN are applied for image-based monitoring of relay components, enhancing inspection efficiency and reliability.

These methods enable adaptive protection, where the system can adjust to changing network conditions, including distributed generation and renewable energy sources, ensuring faster and more accurate fault detection.

Key Considerations

Selectivity: Ensures only the faulted section is disconnected. Speed: Faster operation reduces damage and prevents cascading failures. Sensitivity: Ability to detect low-magnitude faults or abnormal conditions.

Adaptability: Modern algorithms can adjust to network changes and complex configurations.

Conclusion

Relay protection algorithms have progressed from time-graded and inverse-time methods to intelligent, multi-parameter digital systems. The integration of machine learning and deep learning allows for enhanced fault recognition, faster response, and adaptive protection, which is crucial for maintaining the stability and reliability of modern electrical networks.

Article Content

Artificial intelligence algorithms enhancing relay protection and ...

In this research project, Artificial Intelligence (AI) algorithms applied to the relay protection of high and low-voltage distribution networks are investigated.

Algorithm for Formulating Requirements for Relay Protection Project ...

Abstract: The implementation of digital normative and technical documents (DNTD) in the electric power industry, especially in the field of relay protection (RP), significantly increases the efficiency of design

OpenRelay: Open Source Protection Algorithms for Electric Power

Taking this into consideration, this paper presents an open-source C++ library designed to simulate the operation of a digital protection relay. As a result, a solution with very flexible implementation was

Power System Relay Protection Based on Faster R-CNN Algorithm

This article calculates and collects data on relay protection faults, conducts in-depth research on the problem of adaptive relay protection, and achieves satisfactory results.

Algorithm for power transformer relay protection that considers ...

This paper proposes an algorithm for transformer relay protection that utilizes fuzzy logic and analyzes the harmonic components of magnetizing current. This approach allows improving the accuracy of

Adaptive Protection Algorithm Considering N-1 Contingency Situation ...

It is considerably difficult to protect the power system using fixed setting values. Therefore, this paper proposes an adaptive protection algorithm using the setting groups (SGs) of a

Relay Protection and Automation Algorithms of Electrical ...

The application of classical machine learning algorithms in RPA tasks is analyzed, in particular, methods of k-nearest neighbors, logistic regression, and support vectors.

New and traditional relay protection algorithms integration in 6-35 kV ...

We demonstrated the advantages of using new differential-logic and multi-parameter relay protection algorithms, as well as the methods for relay protection tripping parameters calculation.

Direct Current Algorithm for Protection Relays of 6-35 kV ...

The purpose of this study is to investigate and validate a relay protection algorithm that hinges on the isolation of direct current within the zero-sequence current of a compromised outgoing feeder during

Review on Applications of Artificial Intelligence in Relay Protection

Abstract. With the continuous development of power grid sources, networks and loads, the emergence of distributed power sources and new types of loads has brought new challenges to the traditional

Optimal adaptive coordination of overcurrent relays in

Simulations and analyses substantiate the efficacy of the algorithm in optimizing the coordination among overcurrent relays aiming to uphold the

Power System Protective Relays: Principles & Practices

Abstract: Protective relays and devices have been developed over 100 years ago to provide “last line” of defense for the electrical systems. They are intended to quickly identify a fault and isolate it so the

New and traditional relay protection algorithms integration in 6-35 kV ...

Traditional requirements for a relay protection system (selectivity, tripping speed, sensitivity, and reliability) well describe its technical perfection, and, at the same time, they completely abstract away

Digital Implementation of Relay Protection Algorithms. Transformer ...

This research paper focuses on the development of a software implementation of transformer differential protection algorithms, with the aim of further using this technology in a central relay protection server.

Adaptive Protection Algorithm Considering N-1 Contingency Situation ...

The proposed algorithm optimizes not only the setting values of each protective relay but also the combinations of SGs corresponding to each topology. This broadens the searching area for

Direct Current Algorithm for Protection Relays of 6–35 kV ...

The proposed DC algorithm consists of adding for each single feeder a zero-sequence current conversion unit to the earth fault protection relay device. The unit is represented and designed based

Digital protective relaying algorithms and systems — An overview

A particular methodology is proposed if one is to investigate and compare digital algorithms using more elaborate quantitative techniques. The second major topic discussed is related to the

Fault Diagnosis Analysis of Relay Protection System Based on

An improper functioning of systems related to stability of power systems and protective relays through circuit breakers remains a factor that jeopardizes the stability as well as the safety of power systems.

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