Live-line working in distribution network automation

Article Overview

Live-line working in distribution networks is increasingly automated using robots and advanced control systems to perform maintenance on energized lines safely and efficiently.

Overview of Live-Line Working

Live-line working refers to performing maintenance or operational tasks on energized power distribution lines without interrupting the electricity supply. This approach is critical for maintaining continuous power supply, especially in urban areas or regions with high reliability requirements. Traditional live-line work involves high-altitude, high-voltage, and high-difficulty operations, requiring skilled personnel to use insulated tools and aerial devices while managing significant physical and mental stress .

Automation and Robotics in Live-Line Operations

Recent advancements in robotics and automation have transformed live-line working. Robots can now perform tasks that were previously hazardous for human operators:

o Robotic arms and dual-arm systems can remove fuse cutouts, perform bypass operations, and even trim trees near power lines with millimeter-level precision .
o Biomimetic climbing robots are designed to ascend poles autonomously, navigate obstacles, and execute live-line tasks, reducing the need for expensive aerial lift devices and highly skilled operators .
o Integration with big data and 5G technology allows ground technicians to monitor and control robots in real time, using high-definition video feeds and 3D modeling for precise path planning .

Benefits of Automation

Automated live-line working offers several advantages:

o Enhanced safety: Eliminates direct human exposure to high-voltage lines and hazardous environments .
o Increased efficiency: Robots can complete tasks faster, with Shenzhen reporting a 40% improvement in task efficiency using robotic systems .
o Precision and reliability: Advanced visual recognition and motion control systems allow robots to operate with sub-millimeter accuracy, ensuring reliable maintenance .
o Flexibility: Modular and climbing robots can operate in complex terrains such as mountains, paddy fields, or areas inaccessible to vehicles .

Technological Components

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Key technologies enabling automated live-line work include:

o Insulated aerial devices and platforms for traditional robotic support .
o Visual recognition and 3D modeling for identifying operating points and planning motion paths .
o Dual-arm robotic mechanisms for dexterous manipulation of components .
o Simulation and control software to test and optimize robot movements before deployment .

Applications and Future Trends

Automated live-line working is being deployed in cities like Shenzhen, where robots have successfully performed live-line disconnections and maintenance tasks. Future trends include:

o Wider adoption in developing countries to overcome skill shortages and reduce operational risks .
o Integration with AI and predictive maintenance to further optimize distribution network reliability.
o Expansion to complex environments where traditional human operations are impractical. Automated live-line working represents a major step forward in distribution network automation, combining robotics, real-time monitoring, and advanced control systems to improve safety, efficiency, and reliability in power distribution networks .

For the power system, the use of power distribution live-line operation robots (PDLOR) has improved the automatic operation and

The structure size of the whole machine, the modular design method and the integration method of the system are

The live working of the distribution network has become an important means to ensure the reliability of power supply

Aiming at the high danger and high intensity of live working in 10kV distribution network, the paper proposed a live

In this study, we propose an intelligent PDLOR system based on stereo camera; it is used to replace front-line workers

This paper proposes a hybrid arm-based live-line auxiliary working robot for live working in a distribution network. One

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This marks the first live-line operation in Shenzhen"s power distribution network conducted by a robot, a milestone

Integrating simulation modeling, visual recognition, and motion control, this advanced robot excels in live-line

This paper studies and designs the appearance structure, hardware composition, software system, operation process

This research proposes an intelligent power distribution live-line operation robot (PDLOR) system based on a stereo

The distribution network live working robot based on remote operation technology solves the problems of limited

In this paper, we propose a dual-arm collaborative live-line working robot system for the distribution network, with design

Live-line working robot on distribution network always is a hot topic of research. However, limited by structural dimensions and safety

Excellent reference outlining the technical basis and working principles of live-line working, with current application technology, tools

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Live working on power distribution lines is an effective way to improve the reliability of power supply. The aerial lift

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