

What is PV panel defect detection?

The task of PV panel defect detection is to identify the category and location of defects in EL images.

What data analysis methods are used for PV system defect detection?

Nevertheless, review papers proposed in the literature need to provide a comprehensive review or investigation of all the existing data analysis methods for PV system defect detection, including imaging-based and electrical testing techniques with greater granularity of each category's different types of techniques.

How a deep learning algorithm can detect a solar panel defect?

With the deepening of intelligent technology, deep learning detection algorithm can more accurately and easily identify whether the solar panel is defective and the specific defect category, which is broadly divided into two-stage detection algorithm and one-stage detection algorithm.

What are the challenges of defect detection in PV systems?

Main challenges of defect detection in PV systems. Although data availability improves the performance of defect diagnosis systems, big data or large training datasets can degrade computational efficiency, and therefore, the effectiveness of these systems. This limits the deployment of DL-based techniques in practical applications with big data.

What is PVL-AD dataset for photovoltaic panel defect detection?

To meet the data requirements, Su et al. [18] proposed PVEL-AD dataset for photovoltaic panel defect detection and conducted several subsequent studies [19,20,21] based on this dataset. In recent years, the PVEL-AD dataset has become a benchmark for photovoltaic (PV) cell defect detection research using electroluminescence (EL) images.

How machine vision is used in photovoltaic panel defect detection?

Machine vision-based approaches have become an important direction in the field of defect detection. Many researchers have proposed different algorithms [11, 15, 16] for photovoltaic panel defect detection by creating their own datasets.

Solar energy serves as a representative of renewable energy sources, and defects in photovoltaic panels are crucial factors affecting the solar power generation system. To enhance the power generation efficiency of solar energy, a defect detection algorithm for electroluminescence images of photovoltaic panels based on YOLOv7-SE-DS-NWD is proposed. First, in YOLOv7 (you ...

An enhanced YOLOv5 algorithm (EL-YOLOv5) fused with the CBAM hybrid attention module to ensure product quality is proposed, which achieves good performance on both the public and actual solar panel defect

datasets. Defect detection of solar panels plays an essential role in guaranteeing product quality within automated production lines. However, ...

The results of comparative experiments on the solar panel defect detection data set show that after the improvement of the algorithm, the overall precision is increased by 1.5%, the recall rate is ...

automated PV panel defect detection methods have become a hot area in research and industry. These methods utilize computer vision, image processing, and data analysis techniques to enable the detection and classification of PV panel defects in an efficient and accurate manner at the same time. With the development of convolutional neural ...

on PV panel defect detection and (2.2) the development of target detection based on the YOLO algorithm. 2.1. PV Panel Defect Detection With the progress in energy structures, photovoltaic power generation, considered the most promising approach, is developing rapidly and playing a significant role in energy security,

This paper develops an automatic defect detection mechanism using texture feature analysis and supervised machine learning method to classify the failures in photovoltaic (PV) modules. The proposed technique adopts infrared thermography for identifying the anomalies on PV modules, and a fuzzy-based edge detection technique for detecting the ...

The global shift towards sustainable energy has positioned photovoltaic (PV) systems as a critical component in the renewable energy landscape. However, maintaining the efficiency and longevity of these systems requires effective fault detection and diagnosis mechanisms. Traditional methods, relying on manual inspections and standard electrical ...

A multi-stage model based on YOLOv3 for defect detection in PV panels based on IR and visible imaging by unmanned aerial vehicle. Author links open overlay panel Antonio Di Tommaso 1, ... automatic detection of anomalies in PV panels based on deep learning algorithms is now becoming a hot research topic. This work proposes one of the first UAV ...

This study utilizes publicly available solar panel datasets, as well as datasets collected from actual photovoltaic production lines. These datasets are annotated accordingly and used to train the ...

Aiming at the current PV panel defect detection methods with insufficient accuracy, few defect categories, and the problem that defect targets cannot be localized, this paper proposes a PV panel defect detection model based on the YOLOv7 algorithm. Firstly, the activation function in the downsampling convolution of the model is replaced with ...

Photovoltaic Panel Defect Detection Method Combining High-Pass Filter and MSRCR Algorithm with Improved Region Growth Abstract: Solar photovoltaic cells are rapidly rising in the energy field with

environmental protection, renewable, low maintenance cost, and strong scalability. However, cracks, missing corners, stains, and other defects will ...

In view of the problems existing in the above defect detection methods, a solar panel defect detection algorithm YOLO v5-BDL model based on YOLO v5 algorithm is proposed. It enables the network to identify and classify a variety of defects, improve the accuracy of defect detection, reduce the rate of false detection and missed detection, and enable the network to combine ...

Photovoltaic (PV) system performance and reliability can be improved through the detection of defects in PV modules and the evaluation of their effects on system operation. In this paper, a novel system is proposed to detect and classify defects based on electroluminescence (EL) images. This system is called Fault Detection and Classification ...

Despite the existence of high universal standards (such as the IEC, NEC, and UL), undetected flaws endure to cause major difficulties in solar power plants [8]. There are several fault detection methods for the solar power plants accessible in the literature, each with a distinct level of accuracy, network provided, and algorithm intricacy.

The detection of PV panel defects needs imaging-based techniques [6]. Currently, the primary imaging methods include infrared thermography (IRT), electroluminescence (EL) [7], and light beam induced current (LBIC) [8]. However, IRT [9] is limited in detecting minor internal defects such as star cracks due to image resolution ...

Photovoltaic (PV) panels are prone to experiencing various overlays and faults that can affect their performance and efficiency. The detection of photovoltaic panel overlays and faults is crucial for enhancing the ...

The photovoltaic (PV) system industry is continuously developing around the world due to the high energy demand, even though the primary current energy source is fossil fuels, which are a limited source and other sources are very expensive. Solar cell defects are a major reason for PV system efficiency degradation, which causes disturbance or interruption ...

automated PV panel defect detection methods have become a hot area in research and industry. These methods utilize computer vision, image processing, and data analysis techniques to ...

However, the rapid growth of PV power deployment also brings important challenges to the maintenance of PV panels, and in order to solve this problem, this paper proposes an innovative algorithm based on PA-YOLO.

Compared to other methods, the proposed VarifocalNet has the highest detection accuracy and has a faster

detection speed than other methods except for the DDH-YOLOv5 method and the improved YOLOv7 method. Detecting and replacing defective photovoltaic modules is essential as they directly impact power generation efficiency. Many current deep ...

Tommaso et al. [19] proposed the detection of panel defects on photovoltaic aerial images based on the YOLO-v3 algorithm and computer vision techniques, which demonstrates the portability of different panel defects. Although the aforementioned studies provided effective suggestions for improving the accuracy of the model, the embedding of ...

The results of comparative experiments on the solar panel defect detection data set show that after the improvement of the algorithm, the overall precision is increased by 1.5%, the recall rate is increased by 2.4%, and the mAP is up to 95.5%, which is 2.5% higher than that before the improvement.

Potential future directions are identified to address the limitations of PV defect detection systems as illustrated in Fig. 12. As defect detection algorithms can be computationally demanding, especially with large datasets, model acceleration is considered a key area for enabling efficient real-time monitoring.

Photovoltaic (PV) panel surface-defect detection technology is crucial for the PV industry to perform smart maintenance. Using computer vision technology to detect PV panel surface defects can ensure better accuracy while reducing the workload of traditional worker field inspections. However, multiple tiny defects on the PV panel surface and the high similarity ...

To improve the speed of photovoltaic module defect detection, Meng et al. 24 proposed a YOLO-based object detection algorithm YOLO-PV based on YOLOv4 for detecting photovoltaic module defects in ...

Dust detection in solar panel using image processing techniques: A review ... defect detection rates, near zero false alarm rates and robustness against motion blur. ... Detection Algorithms for ...

Improved Solar Photovoltaic Panel Defect Detection Technology Based on YOLOv5 Shangxian Teng, Zhonghua Liu(B), Yichen Luo, and Pengpeng Zhang ... solar cells, among which YOLOv5 algorithm worked best, with a leveling accuracy of 88.2%, which ensured the detection speed while maintaining good accuracy.

The maintenance of large-scale photovoltaic (PV) power plants is considered as an outstanding challenge for years. This paper presented a deep learning-based defect detection of PV modules using electroluminescence images through addressing two technical challenges: (1) providing a large number of high-quality Electroluminescence (EL) image generation ...



Photovoltaic panel defect detection algorithm

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