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Photovoltaic Fault Detection Using Feedback-Enhanced Positive Unlabeled Learning

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Despite substantial improvements in solar array efficiency in recent years, accurate fault detection and diagnosis remains an open problem as undetected faults can cause substantial power loss and hazardous conditions. Solar panel arrays can experience several types of faults of varying severity. Some faults, such as those associated with soiled, dirty, or shaded solar panels simply reduce the efficiency of the photovoltaic (PV) array. These can be corrected by identifying and then cleaning the array or removing shading sources when possible. Another type of fault is caused by degradation of panels after extended usage, especially under extreme weather conditions. Solar panels can also experience short-circuit and ground leakage faults which can damage the panels, cause fires, and/or pose risks to maintenance staff. Various machine learning (ML) and signal processing techniques have been developed for solar fault detection and identification in utility-scale PV arrays. However, these algorithms generally need large amounts of labeled training data that is difficult and expensive to obtain. Additionally, these algorithms are typically not fault-specific and generally do not distinguish among different types of faults. There is a need for an effective solution that can detect and accurately classify PV faults with a small amount of labeled data. Researchers at Arizona State University have developed a practical and inexpensive positive unlabeled learning algorithm to detect photovoltaic (PV) faults on solar arrays using limited labeled data. Given only a small amount of PV fault labeled data and common sensor inputs, this solution can effectively and efficiently classify faults in real time. This invention can be used with large-scale utility PV arrays to identify common faults at a fraction of the cost of most solutions. Faults that reduce production and create hazardous conditions can be rapidly detected and addressed effectively.

Related publication: PV Fault Detection Using a Feedback Enhanced Positive Unlabeled Learning Method

Potential Applications:

- Fault detection in utility-scale photovoltaic arrays

Benefits and Advantages:

- Low cost
- Performs both fault detection and classification
- Requires a relatively small amount of labeled data
- Suitable for real-time operation