Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M20-210P^
Published: 3/5/2021

Detection and Classification of Faults in Photovoltaic Arrays Using a Graph-Based Classifier

Inventors

Jie Fan
Sunil Rao
Gowtham Muniraju
Andreas Spanias
Cihan Tepedelenlioglu

Contact

Shen Yan
shen.yan@skysonginnovations.com

In the last decade, new solar photovoltaic (PV) cell technologies have emerged for grid-connected systems. However, automatic fault detection and accurate diagnostics for PV array systems are still challenging problems. Even with over-current protection devices (OCPD), ground fault detection interrupters (GFDI), and smart monitoring devices (SMDs) with data transmission capabilities, PV array systems are often unable to diagnose outside a limited set of commonly occurring faults. To complicate matters further, traditional fault detection and classification methods require large amounts of labeled data for training. In utility-scale solar arrays, obtaining such data for various fault classes is especially resource-intensive.

Researchers at Arizona State University have developed a system to detect and identify faults in photovoltaic (PV) arrays. This is accomplished by a graph-based semi-supervised classifier that uses multiple features obtainable in real-time from utility-scale PV arrays. These features processed with a graph topology result in increased accuracy of fault classification.

Four commonly occurring PV faults are identified by the classifier: shaded modules, degraded modules, soiled modules, and short circuit conditions. The solar PV array is interpreted as a connected graph while associated graph signals represent the measurements of the PV modules. First, the classifier is trained on the data available from the labeled nodes. The constructed graph is then used to propagate information from labeled samples to the unlabeled samples. Since graph-based methods are semi-supervised, this method requires lower computational cost than conventional supervised machine learning (ML) classifiers and Artificial Neural Networks (ANNs).

An illustrative block diagram of a graph-based semi-supervised fault classification and diagnosis.

Related Publication: Fault Classification in Photovoltaic Arrays Using Graph Signal Processing

Potential Applications:

- Solar array maintenance
- Utility-scale photovoltaic arrays

Benefits and Advantages:

- Requires minimal training and computation cost when compared to existing methods
- Outperforms traditional algorithms for fault detection accuracy and successfully classifies more faults and shading conditions in the same framework
- Performs both fault detection and classification, key to ensuring efficient maintenance and optimal performance