A new way to measure solar panel degradation

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Despite many benefits and relative popularity as a renewable energy source, eventually, the sun does set on even the best solar panels. Over time, solar cells face damage from weather, temperature changes,

soiling, and UV exposure. Solar cells also require inspections to maintain cell performance levels and reduce economic losses.

So, how does one inspect panels in real time, in a way that is both cost-effective and time-efficient? Parveen Bhola, a research scholar at India's Thapar Institute of Engineering and Technology, and Saurabh Bhardwaj, an associate professor at the same institution, spent the last few years developing and improving statistical and machine learning-based alternatives to enable real-time inspection of solar panels. Their research found a new application for clustering-based computation, which uses past meteorological data to compute performance ratios and degradation rates. This method also allows for off-site inspection.

Clustering-based computation is advantageous for this problem because of its ability to speed up the inspection process, preventing further damage and hastening repairs, by using a performance ratio based on meteorological parameters that include temperature, pressure, wind speed, humidity, sunshine hours, solar power, and even the day of the year. The parameters are easily acquired and assessed, and can be measured from remote locations.

Improving PV cell inspection systems could help inspectors troubleshoot more efficiently and potentially forecast and control for future difficulties. Clustering-based computation is likely to shed light on new ways to manage solar energy systems, optimizing PV yields, and inspiring future technological advancements in the field.

"The majority of the techniques available calculate the degradation of PV (photovoltaic) systems by physical inspection on site. This process is time-consuming, costly, and cannot be used for the real-time analysis of degradation," Bhola said. "The proposed model estimates the degradation in terms of performance ratio in real time."

Bhola and Bhardwaj worked together before and developed the model to estimate solar radiation using a combination of the Hidden Markov Model and the Generalized Fuzzy Model.

The Hidden Markov Model is used to model randomly changing systems with unobserved, or hidden states; the Generalized Fuzzy Model attempts to use imprecise information in its modeling process. These models involve recognition, classification, clustering, and information retrieval, and are useful for adapting PV system inspection methods.

The benefits of real-time PV inspection go beyond time-sensitive and cost-efficient measures. This new, proposed method can also improve current solar power forecasting models. Bhola noted that the output power of a solar panel, or set of solar panels, could be forecasted with even greater accuracy. Real-time estimation and inspection also allows for real-time rapid response.

"As a result of real-time estimation, the preventative action can be taken instantly if the output is not per the expected value," Bhola said. "This information is helpful to fine-tune the solar power forecasting models. So, the output power can be forecasted with increased accuracy."

More information: Parveen Bhola et al, Clustering-based computation of degradation rate for photovoltaic systems, *Journal of Renewable and Sustainable Energy* (2019). DOI: 10.1063/1.5042688