

Universiteit Utrecht

Faculty of Geosciences

Department Energy and Recourses Copernicus Institute

Development of a data analysis methodology to assess PV system performance

Odysseas Tsafarakis¹, Wilfried G.J.H.M. van Sark²

^{1,2}Utrecht University, Copernicus institute of Sustainable Development, Heidelberglaan 2, 3584 CS, Utrecht, The Netherlands ¹E: tsafod@gmail.com, ²E: w.g.j.h.m.vansark@uu.nl

Introduction

Results Story 1 – Shading Fault^[4]

The performance of a PV system is not only depending on the solar radiation, but also on the parts of the system and on their condition during their lifetime, in which operational malfunctions may be occurring^[1]. In the framework of the IEA PVPS Task 13, "performance and reliability of PV systems" a new malfunction detection method was proposed, named as the "Stamp Collection" where its principle is to plot one parameter of the PV system versus another and study their (linear) relation. Unexpected deviations of the slope of the linear regression can be observed and pinpoint the presence of a malfunction^[2].

Problem

This study focused on the <u>Automatic Malfunction</u> <u>Detection</u> in small residential PV systems, without complicated monitoring tools. For this reason the main plot of the "Stamp Collection" was examined the

"System Yield (Y_f) vs Reference Yield (Y_r) "

Malfunctions that are causing <u>variable energy loss</u> and that are linked to the operation of the inverter^[1] are not detectable through the study of Performance Ratio neither with the linear regression of the plot Y_f vs Y_r

The system is affected by partial shade. In figure 1 the power of the system and the tilted irradiance are illustrated, during a clear day (1a) and a day (1b) under the influence of shade (undetected from the solar radiation sensor).

In figure 2, the $Y_f vs Y_r$ plots of these days are compared and the values of PR and LR are presented on table A.



Proposed solution

For the solution of this major problem, the use of the statistical parameter Mean Square Error (MSE) in the plot:

"System Yield (Y_f) vs Reference Yield (Y_r) " was proposed and examined.



Methods

Mean Square Error^[3]

The mean square error (**MSE**) of linear regression (**LR**) is one option to calculate the difference between values disguised by the LR and the right values of the measure that was predicted.



10:30 15:30

Figure 1b

MSE Shading Fault = 26.75 MSE Fault Free

Story 2 – Inverter Power Derating

The examined system consists of two identical inverters, connected with identical PV arrays, the one next to the other. However, inverter power derating causes a noticeable difference in output between these two arrays. In figure 3,

the power vs time plot of the inverters is illustrated, while in figure 4 the " Y_f vs Y_r " "Stamp". The slopes of their LR and their PR are compared in table B.





Results

A statistical tool, such as MSE, as a parameter in PV monitoring can help in the detection of inverter malfunctions (story two) or cases of partially unexpected shadow (story one), which are not often detectable through the already used methods, since their influence on the system varies, according to the available solar radiation ^[1].

References

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