SYSTEM FOR PV POWER GENERATION AVERAGE MODULE ANALYSIS

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Предложено, реализовано и протестировано приложение, основанное на методе расчета производительности PV электростанции на уровне массива панелей. Результаты тестирования показали следующее. Расчет на уровне массива панелей позволяет получить достаточно точные результаты по значениям Pmpp для массива, но для определения дефектных панелей с какими-то электрическими неисправностями в конкретном массиве необходим дополнительный анализ на уровне конкретных панелей.

Application uses statistical data from PV power plant located in Nurnberg, Germany during June - November period, 2018.

Global solar energy market growth resides around 30% per year. Under optimal conditions, the world's solar generation plant capacity could reach up to 1,270.5 GW by the end of 2022 [1].

Digital Twin API [2] for module-by-module calculations is based on input telemetric data. Input data includes the following parameters: voltage, current, temperature, irradiation from devices, temperature from devices, timestamp.

The output contains the following params: maximum power point (MPP), voltage and current at MPP, series and parallel resistance, short circuit current and open-circuit voltage params.

The idea is to compare the results of calculations by each module and by each string (which is faster but may be less accurate).

Input params for module-level calculation were: module voltage, string current, module temperature, and irradiation. The time alignment between the module readings and the SR05 pyranometer, made using the timestamps of the individual data points.

Input params for average module calculation (based on string-level measurement) included average module voltage U_{avg}, string current, and average module temperature T_{avg} , temperature, and irradiation from SR05 pyranometer.

$P_{mpp\ diff}$ parameter was used for various P_{mpp} calculations comparison:

$$P_{mpp\ diff} = \frac{\sum_i^n P_{mpp\ module\ i}}{n} - P_{mpp\ string},$$

where $P_{mpp\ module\ i}$ – maximum power of module, $P_{mpp\ string}$ – maximum power of average string. $P_{mpp\ diff}$ results during August for each String are presented on fig. 1.

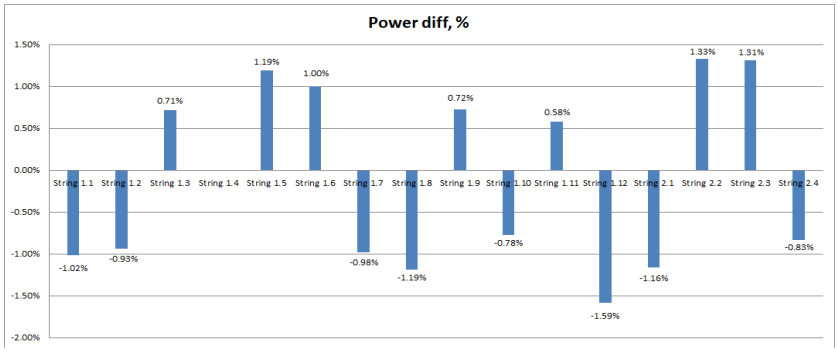

Figure 1 – Difference between the power, produced by Strings during August (by individual modules and by average module calculation)

The string's state could be estimated with 0,6 - 3,5% variation using average module analysis. It could be used during analysis of the actual PV plant's state by comparing real parameters with those calculated from virtual laboratory.

References:

1. *M. Schmela, A. Beauvals // Global Marker Outlook For Solar Power 2018-2022 // SolarPower Europe, Brussels, 2018*

2. *Asimov R.M., Valevich S.V., Kruse I., Asipovich V.S. Virtual laboratory for testing of solar power plants in big data analysis // Collection of materials of the V International Scientific and Practical Conference «BIG DATA and ADVANCED ANALYTICS», March 13–14, 2019, Minsk, BSUIR, pp. 61–65.*