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SERENDIPV

COPLASIMON

Collaboration call nº 1

Date 31/07/2023

COLLABORATION CALLS

Bifacial call for data

BIFACIAL PV TECHNOLOGY

Several project partners of SERENDI-PV aim to improve their energy simulation model for bifacial PV modules. Different modelling approaches are being developed and tested.

We will compare the model performance with other software packages and with data from PV systems with bifacial modules. The work on the improvement of the already existing models, as well as on the validation of the models, will be carried out vs real data.

WHAT WILL BE OFFERED?

Several tools are currently under development for the simulation and monitoring data analytics of bifacial PV systems. A beta version of some of these tools will be available from this collaborative platform.

HOW TO COLLABORATE?

We are actively looking for the monitored operational data of bifacial PV systems of different typologies and installed all over the world, in order to further develop and validate our simulation models. We are also looking for reliable albedo data in order to perform these steps. If you possess such data, we will welcome collaboration. If your data are of interest for the research group involved in the bifacial PV modelling, you could receive in-depth analyses for free that will contribute to a better understanding of the performance of your bifacial PV assets.

If you are currently modelling bifacial PV installations, and if you are interested in sharing good simulation practices, and/or simulation codes, we encourage you to use our collaborative tools for development and get involved in bifacial PV modelling with the rest of the team. Interesting comparisons between different approaches could teach us important lessons. The results of these data analyses, as well as the input data, will not be publicly released in order to preserve the critical commercial character of most of such data that will be provided by their owners, and to prevent their competitors from gaining access to the knowledge of the actual performance of their PV plants.

CALL DEADLINE

The call will be closed on the **31st of December 2023**.

PARTNERS' CONTRIBUTIONS

Lucisun

Lucisun is developing a simulation tool for innovative PV technologies, including the bifacial PV systems. The tool is called **Lusim.**

The powerful graphics processing units (GPUs), that have been developed for the video game industry, are applied for complex shading problems applicable to PV systems. An in-depth evaluation of the shading dynamics that affect the direct component of solar irradiance allows for a more reliable PV analysis. This analysis can be conducted at high spatiotemporal resolution for maximum accuracy.

The maximum accuracy is particularly powerful for the analysis of bifacial PV plants, needing to model the light reflection on the back of the panels.

The bifacial simulation takes place in several steps:

1. Definition of the PV system, providing metadata such as the location, the tilt and azimuth.
2. Information on the panel in use
3. Ground and Module meshing are performed on the plant, which is drawn in 3D.
4. Calculation of the View Factors in a numerical way.
5. Calculation of shading on the ground and modules,
6. Calculation of irradiance on both sides,
7. Modelling of the expected energy yield.

The simulations are validated comparing the output with the main market tools and analyzing the differences.

COPLASIMON will release a free version of **Lusim** (proprietary tool from LuciSun), through an interactive web-based 3D graphic interface, targeted at a wide range of stakeholders, and more specifically including research and academy, policy makers, prosumers, and professionals from the PV industry. The interface will contain built-in learning tools that will enhance the training of the users to bifacial PV modelling through their use of the tool. One of the main objectives is also to raise awareness about bifacial PV in general, and to promote good design and modelling practices, while attracting more users from different horizons.

CEA

The CEA is developing a simulation tool for bifacial PV systems, called Trifactors. It uses the 3D View Factors approach to calculate the reflected irradiance in the back of the modules. These factors are geometric quantities derived from the study of thermal radiation. They make it possible to know the share of radiation, in this case luminous, leaving a certain surface and directly reaching another. With this method, side effects are correctly taken into account. This irradiance is then introduced into the algorithms of electrical modelling to determine the electrical production of the system, thus

considering the inhomogeneity of irradiances on both sides of the modules. Recent developments allow us to consider the impact of near obstacles, such as the module supporting structure.

A bifacial simulation takes place in several successive stages:

Initial sequence:

1. Definition of the PV system at a given site,
2. Ground and Module meshing,
3. Calculation of the View Factors.

Then, the following steps, performed at each time step:

4. Calculation of shading on the ground and modules,
5. Calculation of irradiance on both sides,
6. Calculating the IV curve of each cell,
7. DC System Power Generation Calculation (from measured meteorological data or TMY data imported from PVGIS database).

The simulations are validated on small systems under test in CEA's facility and on larger PV plants.

Solargis

Within the scope of the SERENDI-PV project, Solargis is developing tools for data analysis – including from bifacial power plants. The aim of these tools is to identify anomalies in real measured PV production data which indicate issues with the power plants itself. In this way, Solargis is offering a powerful tool to aid Operations and Maintenance (O&M) understand the performance of the plant and take appropriate actions to maximize the production.

The analytical tools rely on the state-of-the-art PV yield simulator developed and operated by Solargis. The simulator uses ray-tracing technology with superior accuracy when compared to traditional view factor modeling. This technology is especially important when simulating bifacial PV yield, as it allows detailed modeling of the shading on the rear side of the panel, and hence an accurate calculation of the bifacial yield.

Similarly important in the process is the Solargis data quality checking (QC) service. This has been part of the Solargis product portfolio for years, and has been continuously upgraded, including within the scope of the SERENDI-PV project. The QC service investigates the measured data, flags any erroneous values and can also fill gaps. One of our algorithms can also estimate the configuration of the PV plant, if configuration details are not available or are suspected to be incorrect. In the result, only valid, high-quality measurements are used in the analysis, improving its accuracy and the quality of the conclusions.

SERVICES OFFERED

Lucisun

LuciSun offers the possibility to run a simulation with Lusim tool on your PV plant and estimate the energy production over a given period. The required information and data to model a bifacial PV plant and run a simulation are the following ones:

- Description of the PV plant:
  - GPS coordinates,
  - geometric dimensions (height, length, pitch between rows …),
  - module layout,
  - ground albedo,
- photos of plant,
- PV module reference (datasheet),
- Global horizontal irradiance GHI, Global tilted Irradiance GTI and Diffuse horizontal irradiance DHI if available,
- Ambient temperature measurement and other environmental parameters if available

The outcome will be presented in a short report and the QC procedure will be provided on the dataset underlying the presence of incorrect instruments.

CEA

CEA offers the possibility to run a simulation with Trifactors tool on your PV plant and estimate the energy production over a given period. The required information and data to model a bifacial PV plant and run a simulation are the following ones:

- Description of the PV plant:
  - electrical architecture,
  - GPS coordinates,
  - geometric dimensions (height, length, pitch between rows …),
  - module layout,
  - ground albedo,
- photos of plant,
- PV module reference (datasheet),
- Global horizontal irradiance GHI, or even better Diffuse horizontal irradiance DHI if available,
- Ambient temperature measurement,
- When relevant, dataset length of 30 days.

The outcome will be presented in a short report.

Solargis

Solargis offers its data analysis service in return for the right to use the data in the development of our models, possibly including the right to include the data in published research (in the form of conference presentations, and scientific articles).

The required inputs are high-quality ground measured data, in the form of sub-hourly time series:

- PV power output (PVOUT),
- Solar resource: plane-of-array irradiation or global irradiation (horizontal, and direct normal or diffuse)
- Meteorological variables: temperature, wind, precipitation, humidity, snow, … – IF AVAILABLE
- "Operational" variables: soiling, module degradation – IF AVAILABLE

Furthermore, technical details of the PV plant (location, components, configuration, layout) and instruments (model, configuration, calibration, location) from which the measurements are provided are necessary.

The offered outputs are:

- Quality-controlled time series data with flags identifying erroneous or suspect values
- Solargis simulated PV yield time series, in the same time range as your time series
- Short report explaining and discussing the faults and features identified in the data

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