Solargis PV Components Catalogue

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Abstract

Reliability of technical specifications of photovoltaic (PV) components is one of the key factors in ensuring the accuracy of PV energy yield simulations. At present, the technical specifications are available through various simulation software tools, specialised databases, or the user has to find them and enter into the software on their own. The technical specifications are often not verified or validated, and can be subject to errors. Solargis has designed the PV Components Catalogue (PVCC) to address this issue, by embedding a rigorous process of verification and validation of component specifications submitted into the database. This process involves several automated checks, and an expert review supported by simulations of the components in real-world PV power plant configurations. The PVCC can thus indicate incorrectly entered parameters and resolve any issues with the originator. As a result, the expert public can have higher confidence in the accuracy of the component specifications offered by the PVCC.

Introduction

When undertaking performance simulations of a photovoltaic (PV) power plant, input data quality is crucial to ensure reliability of the results. This includes the parameters of the power plant components which are simulated, such as PV modules and inverters. At present, the parameters of these components are typically available from the internal databases of the simulation software, independent third-party databases, or component manufacturers. However, the data in these databases is usually not quality assured and if unavailable, users must supply the component parameters to the simulation software themselves. The quality and integrity of the input data can thus not be guaranteed. Errors in parameters can negatively affect the calculated performance, energy yield, and financial indicators of PV projects.

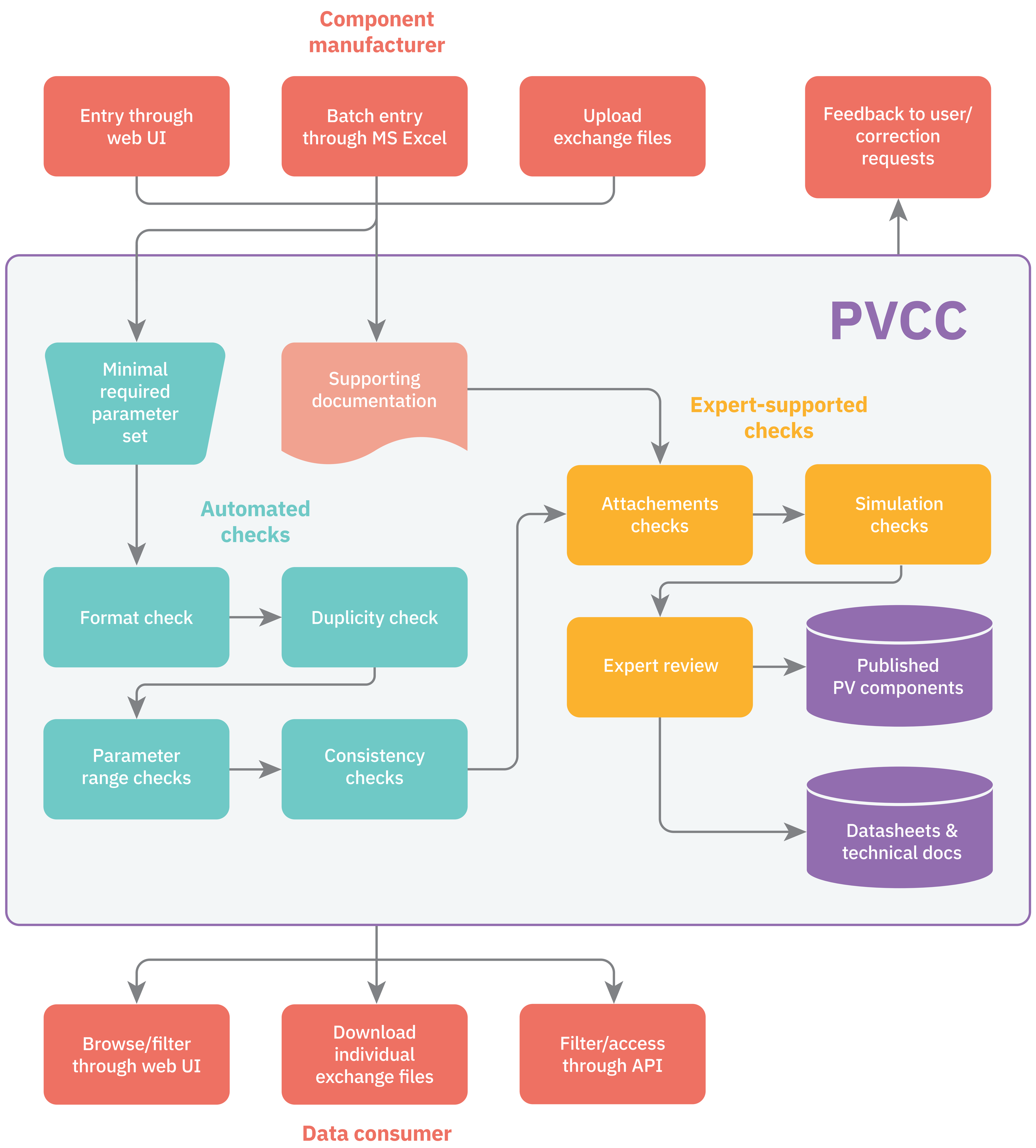

Figure 1: Schematic representation of the PVCC, its input and output options, and the parameter verification and validation chain.

Implementation

To address the above issues, Solargis designed the PV Components Catalogue (PVCC). The main objective of the PVCC is to improve access to verified technical specifications of PV hardware required in PV simulation tools. To this end, the PVCC is designed as an open-access solution, where PV component manufacturers and expert public can contribute to building the catalogue and use it.

The PVCC has separate sections for different key PV components. In the first iteration, PV modules and inverters are implemented. Next, support for PV trackers, battery systems and transformers is planned. Each component type has got its specific requirements and processes, but the overall functional flow is depicted in Figure 1.

The parameters recorded for each component are a superset of parameters required by Solargis Evaluate, PVsyst, NREL SAM, and the IEC 61850 standard. A smaller subset of parameters constitutes the minimum required set, which must be entered to allow submission of a component record into the PVCC. The minimum required parameters are necessary to perform the simulations, and exclude e.g. market or supplementary component information.

Entry into the PVCC is allowed through a web interface, where an individual component can be specified, or as a bulk upload through a predefined template. The PVCC can also parse common simulator exchange files of the widely-used simulators - e.g. PAN or OND files.

Access to the database records is provided via download of individual exchange files, in formats of the 3 aforementioned simulators, or through an automated process using an API. Both the web UI and API offer the option of filtering components based on user-set parameter criteria. Using the API, PVCC can be integrated with a simulation environment, and can support the quality and integrity of PV performance simulations, in line with its main objective.

Verifications and validations

The key issue the PVCC is addressing is the quality and reliability of the PV component specifications used in PV performance simulations. To this end, Solargis has implemented a robust verification and validation process for components being entered into the database.

Due to the expected volume of the processed components, the verification and validation process is automated where possible. There are some parameters, features, and behaviours, where an automated process is not sufficient yet, and a human expert judgement is required. Even these checks are supported by automated calculations and simulations to provide data, on which the expert can base their judgements. Similarly, for efficiency purposes, the verification and validation process works in layers, such that the component must satisfy all lower-level checks before proceeding further in the chain.

The first automated checks focus on basic integrity of the PVCC. The parameters being entered are checked for correct format, and the whole component is compared to existing components to prevent duplication of entries in the database.

Next, parameter range checks are performed. Here, two methods are applied:

Absolute range check verifies that each parameter value is within its pre-defined boundaries. These boundaries are set wide enough to account for the parameter spread resulting from different component technologies (e.g. crystalline silicon PV modules vs. thin film PV modules). This verification is mostly focused on uncovering erroneously entered parameter values (e.g. decimal point shift).

Specific range check verifies the parameter value against values of similar components already in the database. This verification takes into account different ranges for different types of components, and is mostly focused on identifying potentially incorrect component parametrisation.

The verification ranges have to account for the possible parameter value spread. This is illustrated in Figure 2, where the spread of the whole sample of the parameter values is wider by several orders of magnitude compared to the interquartile range (i.e. most of the sample).

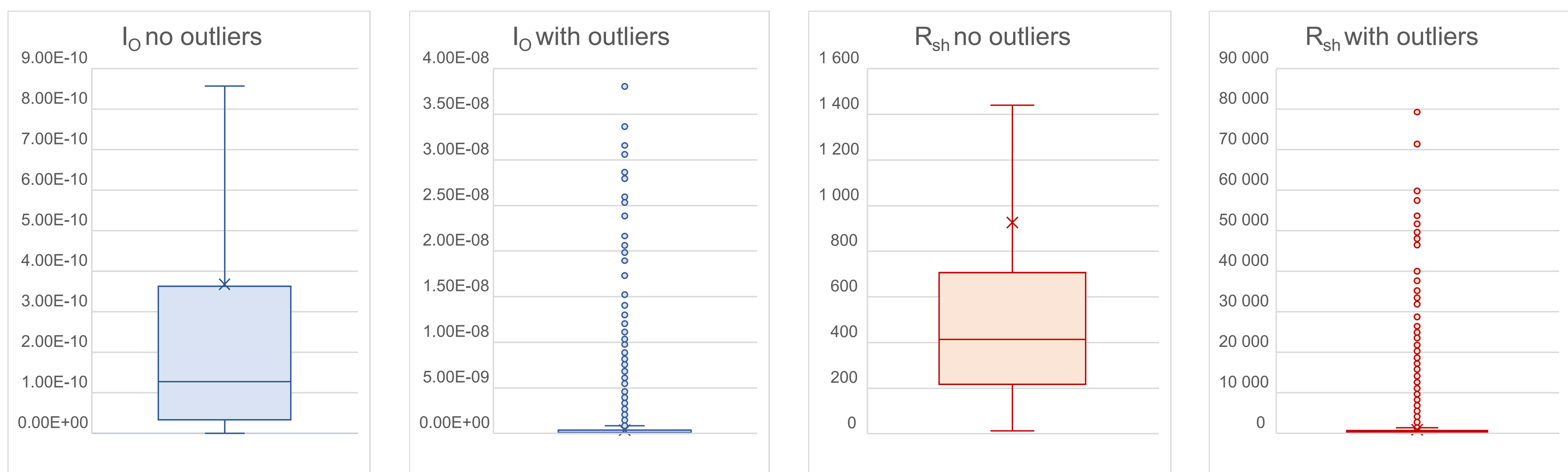

Figure 2: Spread of values of the reverse diode saturation current (I_O) and shunt resistance (R_{sh}) parameters in the California Energy Commission database of PV modules [1].

As the last fully automated check, parameters are checked for consistency. Some parameters are related by well-described mathematical relationships, which are verified. Any inconsistency indicates incorrectly parametrised component, or erroneously entered parameter value.

After the automated checks are successfully complete, the expert-supported checks are performed. Firstly, the attachments (e.g. datasheets, drawings, manuals) to the component submission are verified.

Next, the simulation-supported verification and validation is performed. The component is simulated using the Solargis Evaluate PV simulation model in a set of real-world PV power plant configurations. Solargis model time series data (solar and meteorological) is used as input. The results of the simulation, together with data from previous checks, are evaluated by an expert reviewer. Based on this data, the reviewer is able to build a complex picture of the component, and identify any outstanding inconsistencies or suspicious parameters. Any issues are communicated with the originator of the component, and when they are all resolved, the component and its supporting documentation are published in the PVCC.

Discussion

The issue of accuracy of the PV component models used in PV system simulations and the impact on yield simulations has been highlighted in the past [2], [3], [4]. The PVCC addresses part of this large issue, by creating an open database of PV components, where specifications are assured by a rigorous verification and validation process. Users of PV simulation software and expert public will thus have access to component models with higher confidence in their accuracy. Further work is needed in the development of component parametrisation methods, and validation of the resultant models against simulation or real-world data.

References

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