

8th PV Performance Modeling and Monitoring Workshop Highlights

Our 8th workshop returned to Albuquerque, NM, where the series of these events began. Presentations from industry experts covered a broad range of topics relevant to PV performance modeling and to PV system monitoring as well as the 2nd meeting of the PVLib User's Group. All of the presentations can be downloaded here: <https://pvpmc.sandia.gov/resources-and-events/events/2017-8th-pv-performance-modeling-workshop/>

Session 1. Solar Resource Data and Uncertainty

- Uncertainty in the solar resource data used for PV performance prediction intuitively translates to financial risk for the plant's owners and investors. On this topic, Artur Skoczek of SolarGIS provided an excellent summary of the methods behind the SolarGIS solar radiation uncertainty map. In separate presentations, John Gaglioti of GroundWork Renewables and Skip Dise of CleanPowerResearch shared insights describing how this link can be quantified. They connect reductions in the uncertainty of solar resource data to P50/P90/P99 values for annual energy production.
- Solar resource data is used to estimate future production from fleets of plants and as a reference to compare with monitoring data. For these applications, Will Hobbs of Southern Company illustrated a method to scale from pyranometer measurements to plant-scale irradiance data, and Greg Kimball described methods to use clear-sky irradiance and temperature models to identify and mitigate monitoring sensor drift.

Session 2. Modeling Details and Calibration

A technical advance in PV module modeling was proposed by Kyunmin Lee of CFV Solar Laboratory, who argues for modeling temperature dependence of series resistance and shows how diode model accuracy can be improved. Mark Campanelli of Intelligent Measurement Systems provided an alternate approach to fitting diode models by reformulating the diode model and simultaneously fitting to IEC 61853-1 test data. Mark Mikovski of SunPower introduced a python package for modeling mismatch in PV systems, and Janine Freeman of NREL described how SAM uses IEC 61853-1 data in PV system modeling.

Session 3. Modeling Software Updates

A staple of PVPMC workshops, modeling updates were provided for:

- PV*SOL, by Steffen Lindermann of Valentin Software
- Helioscope, by Teresa Zhang of Folsom Labs
- SAM, by Janine Freeman of NREL and Geoff Klise of Sandia
- PVsyst, by Bruno Wittmer of PVsyst
- PlantPredict, by Kendra Passow of First Solar

A notable newcomer to PVPMC is Aurora Solar, who provides an online PV modeling service by subscription.

Session 4. PV Monitoring and Plant Operations

The monitoring and operations session showcased innovative and exciting methods for deriving insight from monitoring data, and for quantifying the value of monitoring:

- Mike Deceglie of NREL described how the Sun-VOC method applies to analysis of PV monitoring data to identify increases in resistance losses in the system, which could be precursors to connector failures or fire risk.
- Nathan Charles of Enphase showed how power data from micro-inverters can be used to pinpoint incorrect system data, e.g., installer data entry errors, and to identify degradation and/or system failures over time.
- Jurgen Sutterlueti of Gantner Instruments described effective practices for structuring and managing data from PV plant monitoring to deliver value to operators.
- Rob Andrews of Heliolytics showed how to estimate the cost of DC capacity losses for systems where inverter clipping is significant.
- Kate Klise and Birk Jones of Sandia, respectively, described updates to PECOS, an open-source python package for analysis of monitoring data, and provided an overview of machine learning applied to PV modeling.

Session 5. Bifacial PV Performance and Modeling

Sandia, NREL and the University of Iowa are collaborating to measure bifacial PV module and system performance and to improve bifacial PV modeling. The project team provided updates on these efforts, including observed performance for several small bifacial PV systems and accuracy of various models for predicting bifacial PV output.

Workshop Summary Discussion

We invited workshop attendees to comment on the workshop format, content and value. One key message we heard is that the workshop provides a focused, affordable venue for industry to keep abreast of developments in PV system modeling. Other opportunities, such as the IEEE PVSC conference series, are more broad in scope and are difficult for many workshop attendees to justify.

PVLib User's Group Meeting

We solicited comments and requests from the user community on PVLib for Matlab and python. Among the items of broad interest were:

- Extending the list of module temperature models coded in PVLib
- Adding degradation, soiling and snow loss models
- Adding energy storage performance modeling
- Improving tutorials, examples and documentation
- Creating code unit tests for Matlab to aid with installation checkout
- Engagement with the open software community through various conferences, online communities and journals

We anticipate using the user group discussion to open requests for PVLib development and enhancement.