PV Simulation Study of Bifacial Photovoltaic Systems on Single Axis Trackers

Version 4, August 3, 2023

Introduction

The International Energy Agency Photovoltaic Power Systems Program (IEA PVPS) Task 13 (Activity 2.3) working group is conducting a study of best practices for bifacial PV tracking systems. As part of this activity, we are organizing a blind PV performance modeling study to compare different modeling tools and their performance predictions for varying system design parameters.

We invite participants to simulate a set of seven imaginary PV systems for which the system design and weather data have been provided. Results of these simulations are submitted to an individual on the IEA study team. Anonymized results will be combined and analyzed to show similarities and differences between models. Each participant will be assigned a participant number, which will be used to identify their results. Except for a single individual on the analysis team who receives the results, the identities of the participants will be kept hidden from the rest of the analysis team. This process has worked well for the blind modeling studies run by the PV Performance Modeling Collaborative (PVPMC) and will be managed in the individual.

Results will be summarized in a final report published by the IEA PVPS Task 13. Participants will have the option to be acknowledged in this report.

Schedule

- **July 7, 2023**: Modeling exercise and accompanying datasets released.
- **October 1, 2023**: Modeling results are due (DO NOT WAIT UNTIL THE LAST MINUTE!!!).
- **October 2023**: Initial results and participant numbers will be shared with participants.
- **November 2023**: Final results shared with all participants.

Modeling Exercise Instructions:

There are seven annual 8,760-hour simulation scenarios that are requested of each participant. The table below describes the differences between each scenario. If you are only able to run some of these scenarios, please submit the ones you can.

Scenarios

Scenario number	Scenario name	GCR*	Albedo	Hub Height	Configuration	Ground surface
1	Ref-A	0.4	0.2	1.5 m	1-Up portrait	Horizontal
2	A1	**0.25**	0.2	1.5 m	1-Up portrait	Horizontal
3	A2	0.4	**0.5**	1.5 m	1-Up portrait	Horizontal
4	A3	0.4	0.2	**3.5 m**	1-Up portrait	Horizontal

5	A4	0.4	0.2	1.5 m	1-Up portrait	**10% grade* down to the East**
6	A5	0.4	0.2	1.5 m	1-Up portrait	**10% grade* down to the SW**
7	Ref-B	0.4	0.2	3.5 m	**2-Up portrait**	Horizontal

* A GCR of 0.4 for the Trina Vertex module (length = 2.384m) corresponds to a row-to-row spacing or pitch of 5.96m. For a GCR of 0.25 the pitch is 9.536m. For a 2-Up portrait system with a GCR of 0.4 the pitch is 2*5.96m = 11.92m.
**10% grade = slope angle of 5.71 deg from horizontal (*atan(0.1)*)

- **Module:** Trina Vertex 650 W (TSM-DEG21C.20).
- **Array:**
  - 1-up Portrait: 5 rows, each with 25 modules (Figure 2)
  - 2-up Portrait: 5 rows, each with 25 x 2 = 50 modules (Figure 4)
- **Torque tube diameter** = 15 cm. (round)
- **Maximum tracker rotation angle =** 55 deg
- **Backtracking is enabled.**
- **Location:** Albuquerque, New Mexico USA (35.05°, -106.54°)
- **Meteo Data:** PS3 file (Phase2_meteo_hourly_psm3format.csv)
- **Results to report:** An excel spreadsheet template is provided to collect results for submission. The model results needed for the template include:
  - Average front and rear irradiance (nominal, not including reflection (IAM), shade or soiling losses) for every hour.
  - Module temperatures for the middle and end modules in the middle row (Figure 2 and Figure 4 shows these in green) for every hour
  - DC Power from middle row strings every hour
  - Tracker angle every hour (You are free to use optimized tracking algorithms (e.g., diffuse tracking) if this is part of your standard practice.)
  - ***If the simulation model used takes too much time to run an entire year for each scenario, you have the option to just run the following 6 days:***
    - January 3, 2022 (clear day)
    - December 27, 2022 (cloudy day)
    - March 24, 2022 (clear day)
    - March 22, 2022 (cloudy day)
    - June 15, 2022 (clear day)
    - June 21, 2022 (cloudy day)

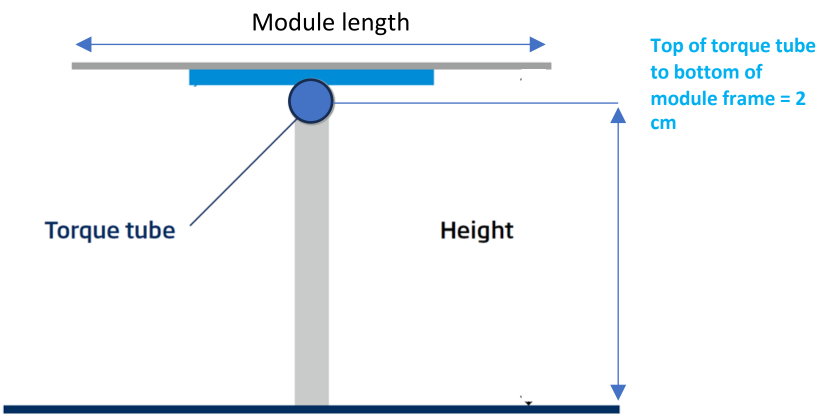

Figure 1. IP Tracker dimensions. The module is shown horizontal in grey. The blue section represents the mounting structure.

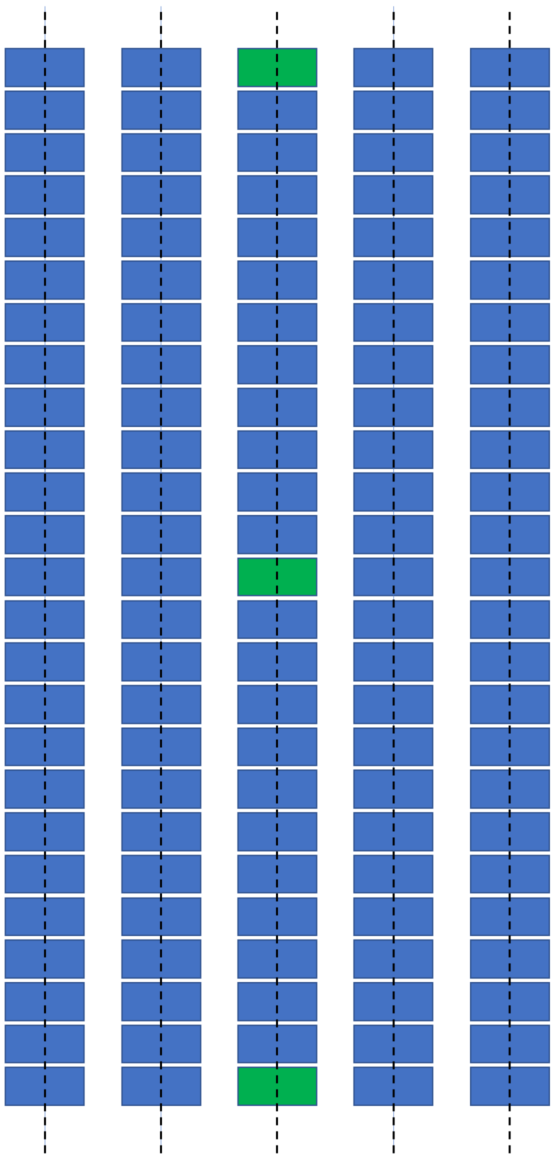

Figure 2. Field layout for 1P Trackers. Front and rear irradiance is calculated for green modules. Gap between modules along the row is 2 mm

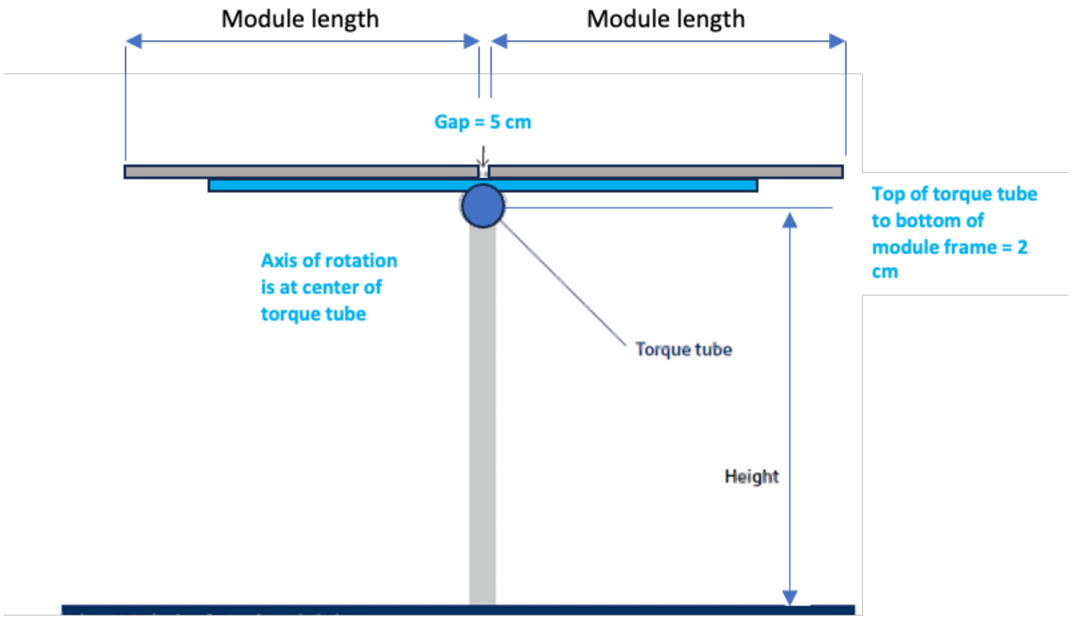

Figure 3. 2P Tracker dimensions. The modules are shown horizontal in grey. The blue section represents the mounting structure.

Figure 4. Field layout for 2P Trackers. Front and rear irradiance is calculated for green modules. Gap between modules along the row is 2 mm. Gap between modules across torque tube is 5 cm.