TrinaTracker

Smart Tracking Technology

——SuperTrack

Self-recognition
Self-training
Self-optimization

Adapting to complex terrains and various weather conditions

Boosting energy gain by as much as 8% compared with conventional tracking algorithms

Proprietary technology and the power generation model

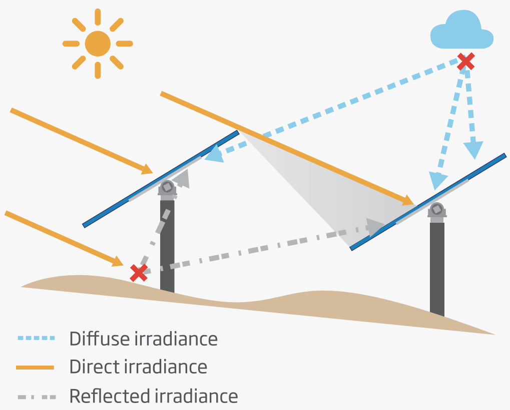
Smart algorithms stimulate the power generation potential of tracking system to ensure a high return on investment of the project

01 While the decline in costs of BOS slows down, the increase of energy yield becomes an effective way to reduce the levelized cost of energy (LCOE)

$$\text{Levelized cost of energy (LCOE)} = \frac{\text{Total cost}}{\text{Total energy yield}} = \frac{\text{Initial investment} + \textbf{Operating expenses}}{\textbf{Total energy yield}\text{ during the life cycle}}$$

- Initial investment: **Decline slowdown, phased rebound**
- Operating expenses: **Steady decline**
- Total energy yield: **Great potential for trackers to increase energy yield**

02 Conventional tracking algorithms (astronomical algorithm + backtracking algorithm) cannot fully optimise tracker's energy generation potential



Globally, there is a shortage of flat terrain resources, and uneven terrain will gradually become the main application scenario. Conventional tracking algorithms cannot reduce energy losses due to row-to-row shading.

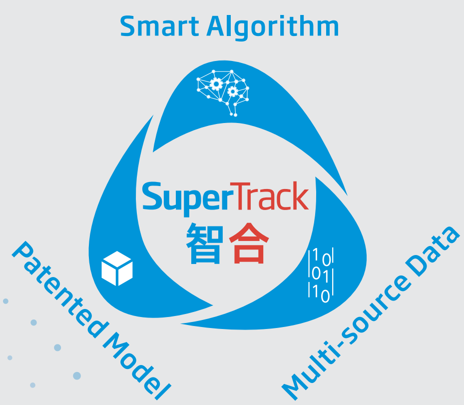
⚠ up to 40% loss of instantaneous power

Conventional tracking algorithms mainly consider direct irradiance, cannot fully utilize diffuse irradiance on a cloudy day or in other conditions with highly diffuse irradiance.

⚠ up to 15% loss of transient irradiance

Conventional tracking algorithms only consider the power generation from the front side of modules, cannot fully optimise module's energy generation potential, while bifacial modules have been commercialized globally.

SuperTrack Smart Tracking Algorithm

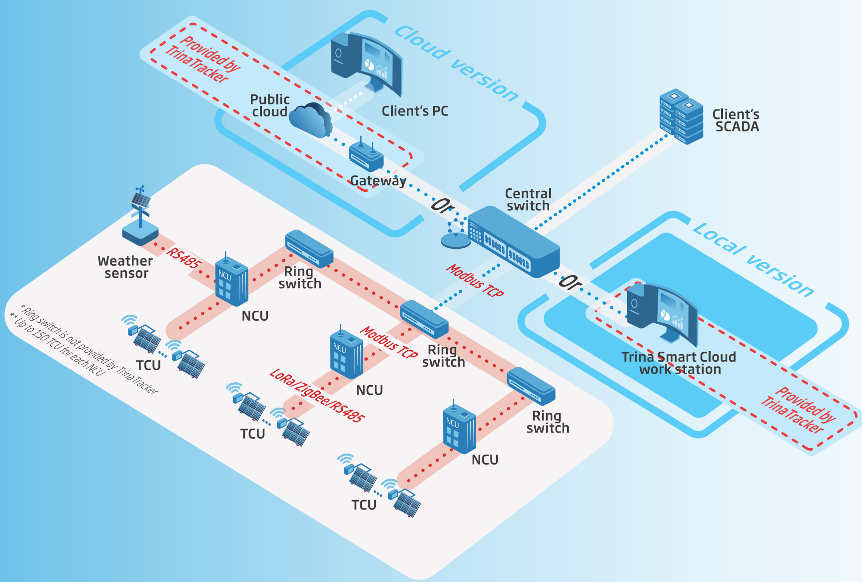


TrinaTracker has developed the smart tracking technology - SuperTrack, which includes smart algorithms(**STA**&**S-BA**), multi-source data and patented models.

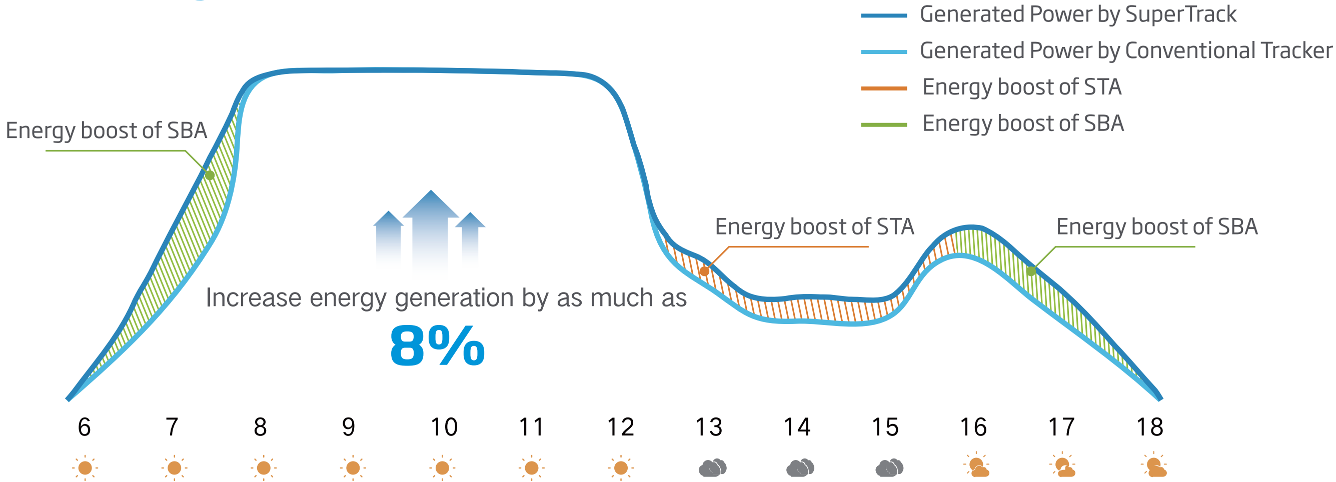
SuperTrack can calculate the optimal power generation angle of the bifacial module in real time for different weather conditions, and identify the characteristics of the complex terrain in an intelligent way, independently optimize the angle of backtracking in each row, avoid row-to-row shading, and fully optimise the power generation potential of tracker. Compared with conventional tracking algorithm, boosting energy generation by as much as **8%**.

Smart Control System

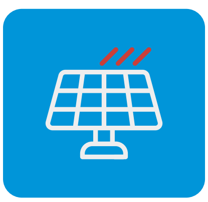
TrinaTacker smart control system includes the tracker, the tracker control unit (TCU), the network control unit (NCU), the SuperTrack smart tracking algorithm, Trina Smart Cloud platform. It is flexibly compatible with plant level SCADA, inverters and other equipment, creating an integrated solution for the PV tracking system.



Smart Algorithms



Core Values



High energy yield

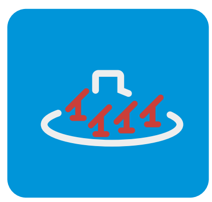
- Compared with conventional tracking algorithm, SuperTrack can increase power generation by as much as 8%

High adaptability

- Meeting the diversified needs of customers
- Adapting to complex terrain and various weather conditions

High intelligence

- Self-recognition, Self-training, Self-optimization
- Proprietary technology and the power generation model



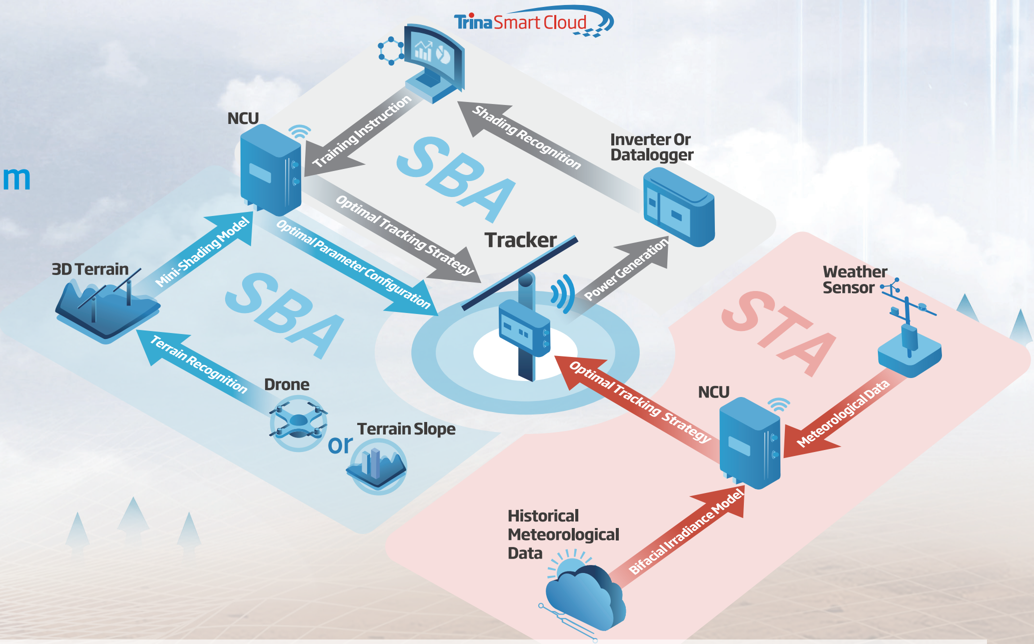
High stability

- Long-term practice
- Reducing the rotation of the tracker

SuperTrack

Smart Tracking Algorithm Logic Diagram

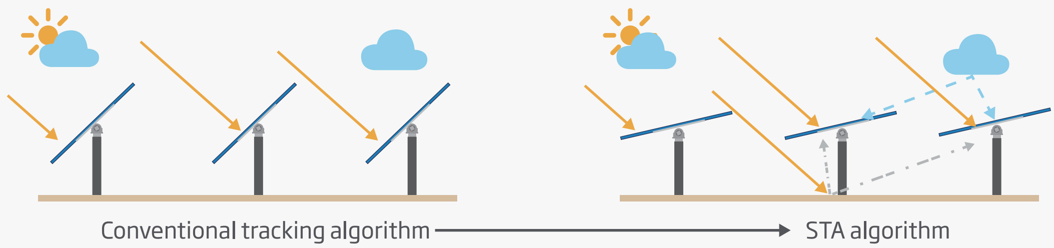
STA:Smart Tracking Algorithm
SBA:Smart Backtracking Algorithm



Core Algorithm

01 Smart Tracking Algorithm (STA) - improve power generation on cloudy days or in other conditions with high diffuse irradiance.

The proprietary technology, the Bifacial irradiance Model and the deep learning model are utilized to identify the power generation characteristics of the bifacial modules under the influence of multiple parameters. The data of meteorology and system operation is utilized to optimize the tracking angle real-time, so as to improve power generation on cloudy days or in other conditions with high diffuse irradiance.

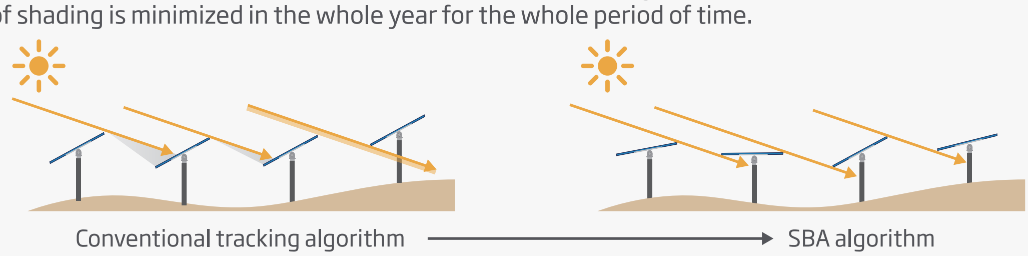


1. The bifacial irradiance model fully considers 12 key factors that have an impact on energy yield
2. Analyzing the power generation performance of the modules from multiple dimensions to ensure the optimal energy yield throughout the entire life cycle
3. Reducing the rotation of the tracker to effectively extend the service life of the motor and the tracker

02 Smart Backtracking Algorithm (SBA) - reduce generation losses due to row-to-row shading, which are more significant on complex terrains.

The data of system operation has been performed by disturbance training and (or) utilizes terrain topography data to identify shading and construct three-dimensional terrain. Based on the machine learning algorithm and the Mini - Shading Model, it outputs the optimal backtracking angle group through iterative decision-making and effectively enhances the power generation at the stage of backtracking.

Considering the height difference between the rows in the east-west and north-south directions, the optimized slope angle model is used to follow the azimuthal changes of the sun's rays throughout the day, simulate the shading situation in different seasons, and compute the optimized slope angle clusters in different seasons, to ensure that the loss of shading is minimized in the whole year for the whole period of time.



1. Multiple technologies to intelligently identify the real terrain
2. Automated training and learning without human involvement
3. Secondary precise optimization of the backtracking angle based on the power generation characteristics of the modules affected by shading

Case Study

CGC appraisal
Energy gain on typical cloudy day 12.86%
Overall gain 3.06%

Project location	Shaanxi, China	Test period	May 2020 – August 2021
Project capacity	30MW	Latitude and Longitude	35.16°N, 109.17°E
Challenge	Uneven terrains causing severe shading between blocks		

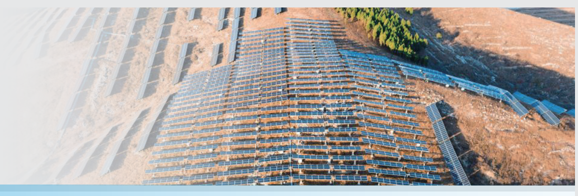
UL Solutions appraisal
Energy gain on typical cloudy day 9.15%
Energy gain on typical sunny day 2.87%
Overall gain 2.21%

Project location	Campiña, Spain	Latitude and Longitude	37.59°N, 4.64°W
Project capacity	11.65MW	Challenge	High labor cost, variable weather

'Our independent review of the Campiña experiment data shows a 2.21% positive bias towards the SuperTrack test group.'

— Ding Yifeng, Renewables, Software & Advisory, China Country Lead

SGS appraisal
Overall gain 3.24%



Project location	Shandong, China (Retrofit)	Test period	November 2023 – October 2024
Project capacity	21MW	Latitude and Longitude	36.67°N, 119.17°E
Challenge	Widely dispersed project sites, long distances between blocks, complex road conditions, and significant maintenance difficulties, communication failure causing tracker malfunction		

'Thanks to digital monitoring methods and intelligent tracking technology, operation and maintenance personnel can timely check the status of the trackers for troubleshooting, greatly improving operation and maintenance efficiency, and bringing improvement in energy generation efficiency.'

— The power station operation and maintenance company

Gain Potential Assessment and Third-party Review

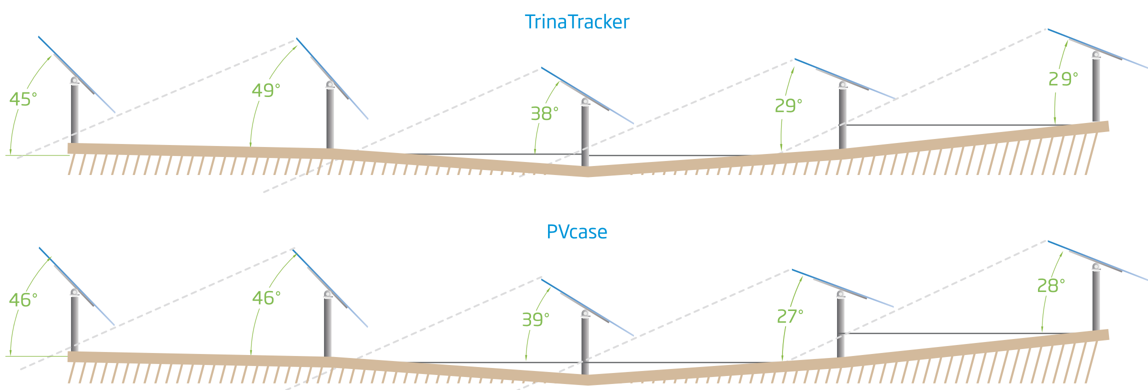
TrinaTracker has innovatively created SEB Power Generation Simulation Software, which takes into account overcast weather and complex terrain, and simulates power generation gain of smart algorithms. Unlike with traditional simulation software, users need only input additional terrain information to obtain SuperTrack power generation gain evaluation.

Cooperation with PVcase

SuperTrack has received endorsements from numerous third-party consultants in the industry and has also partnered with the simulation company PVcase. For this joint work, a typical uneven terrain was selected to compare and evaluate the optimization effects of SuperTrack and PVcase's upcoming terrain-aware backtracking algorithm.

In this rugged terrain, shading occurs during both the morning and evening phases.

Comparison of optimized tracking angels between TrinaTracker and PVcase under the same terrain



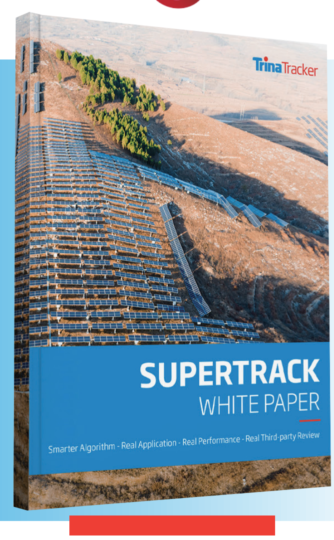
The result was that the optimal tracking angles simulated by both SuperTrack and PVcase were largely consistent, effectively minimizing power generation losses caused by shading. Through this collaboration, Trina and PVcase compared their independently developed smart algorithms, demonstrating that the highly consistent optimization results validate the rationality and effectiveness of their solutions for complex terrain.

Conventional tracking algorithms can lead to energy generation losses for photovoltaic (PV) plants in complex terrain and under high diffuse irradiance weather conditions like overcast weather. To address these issues, TrinaTracker launched its smart tracking algorithm, SuperTrack, in 2022. Following continuous technological improvements and project application accumulation, TrinaTracker released the latest white paper in November 2024. This document details the latest technology of SuperTrack, real applications, and third-party review.

SuperTrack employs two algorithms: STA for high diffuse irradiance weather and SBA for complex terrain, addressing the challenge of low energy generation in photovoltaic plants under these conditions.

In recent years, global consultant Wood Mackenzie has observed an increasing trend of tracker manufacturers adopting advanced control systems to enhance energy generation. As the core product in TrinaTracker's digital and intelligent trackers, SuperTrack is at the forefront of improving photovoltaic plant efficiency.

Since its launch, SuperTrack has been deployed in 123 projects across 25 countries, with the application scale of 6.7 GW, enhancing daily operations and boosting the investment returns of photovoltaic plants for customers. The white paper includes several classic case studies, quantifying SuperTrack's energy generation gains and featuring evaluations from clients and third-party consultants.



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