# Field Insights on Optimizing Diffuse Light Tracking Performance

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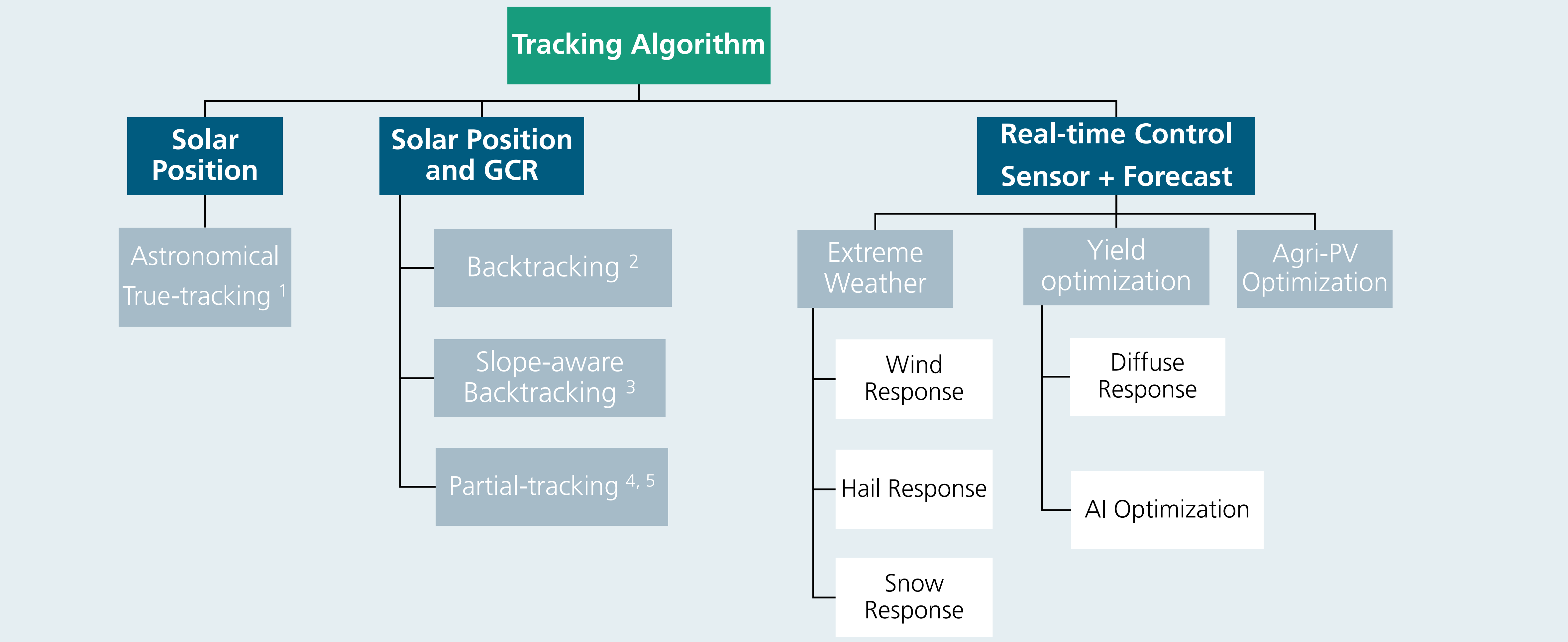
**www.ise.fraunhofer.de**

# Introduction

## HSATs Tracking Algorithms Overview




J. S. Stein et al., "Best Practices for the Optimization of Bifacial Photovoltaic Tracking Systems," International Energy Agency - Photovoltaic Power Systems Programme, 2024, vol. IEA-PVPS T13- 26:2024
https://iea-pvps.org/wp-content/uploads/2024/08/IEA-PVPS-T13-26-2024-REPORT-Bifacial-Tracking_FINAL.pdf

# Introduction

## Extreme Weather Response

IEA PVPS

**Wind Response**
- Most common extreme weather response
- Based on anemometer measurements
- Threshold varies from 15 to 22 m/s (based on system type and mounting)
- **Stow position** varies from 5 to 30° toward wind direction

**Flood Response**
- Advanced tracker control system
- Based on sensor measurements
- Move to **stow position** when above a certain threshold

**Snow Response**
- Quite extensively implemented
- Based sensor measurements
- Move to **full tilt** position when snow is detected to avoid accumulation

**Hail Response**
- Often based on manual override
- When automized is based on nowcasting techniques [6]
- Move to **full tilt** position when detected or expected

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# Introduction

## Diffuse Tracking

- On clear-sky days beam irradiance is the primary solar components
- Classical tracking algorithms are optimized only for these conditions

- On cloudy days, diffuse irradiance prevails
- Horizontal position of the solar panels maximizes radiation capture from the sky dome
- Different studies assessed the **theoretical potential** → Ranging from **0.5% to 3%** yearly [7-10]

- Lack of common understanding of required conditions to apply diffuse optimization
- Few field implementations → needed to assess **practical potential**




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# Diffuse Tracking
## Experimental Setup

**DeepTrack Project in collaboration with Zimmermann PV-Steel Group**

- Trackers for **diffuse algorithm testing** to assess real potential
- **90 kWp** installed in Merdingen Germany (Outdoor performance Lab)
- System divided into two groups:
  - **Group 1**: control group following a standard backtracking strategy
  - **Group 2**: following a diffuse tracking strategy

String 2 and string 8 studied to:
- Avoid self shading
- Evaluate energy gains

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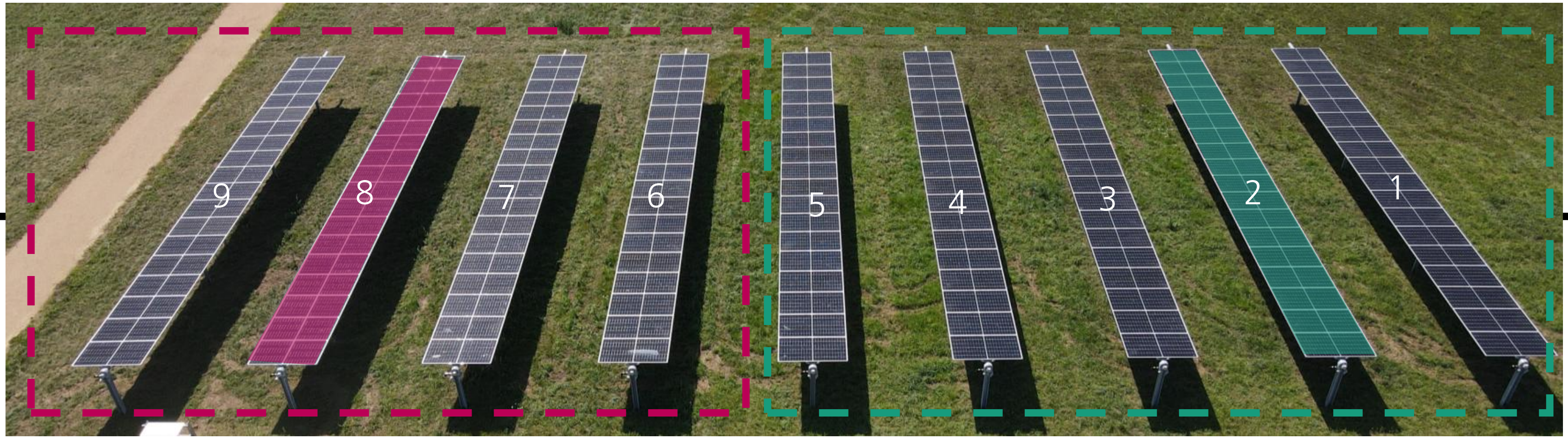


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# Diffuse Tracking

## Experimental Setup

ZIMMERMANN
PV-Steel Group

### Monitoring System

- Tracked Reference Cell for every PV row

- EkoTracker
  - GHI, DHI and DNI

- Lufft WS100
- Lufft WS200
- Horizontal Reference Cell
- Sunto Sensor (GHI, DHI and DNI)

- POAscan by PV Performance Labs
  - Gpoa at all angles (0°-360°)




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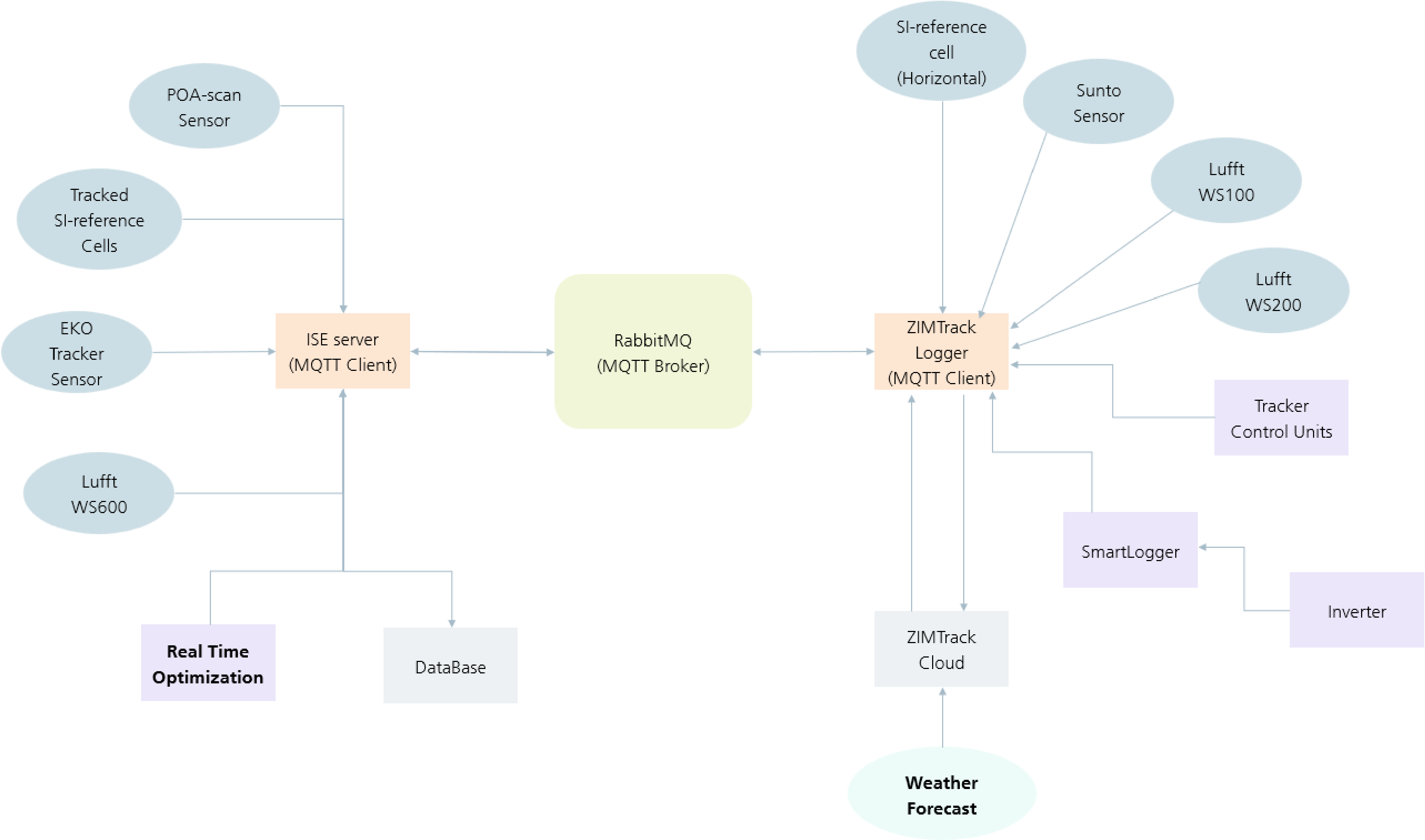
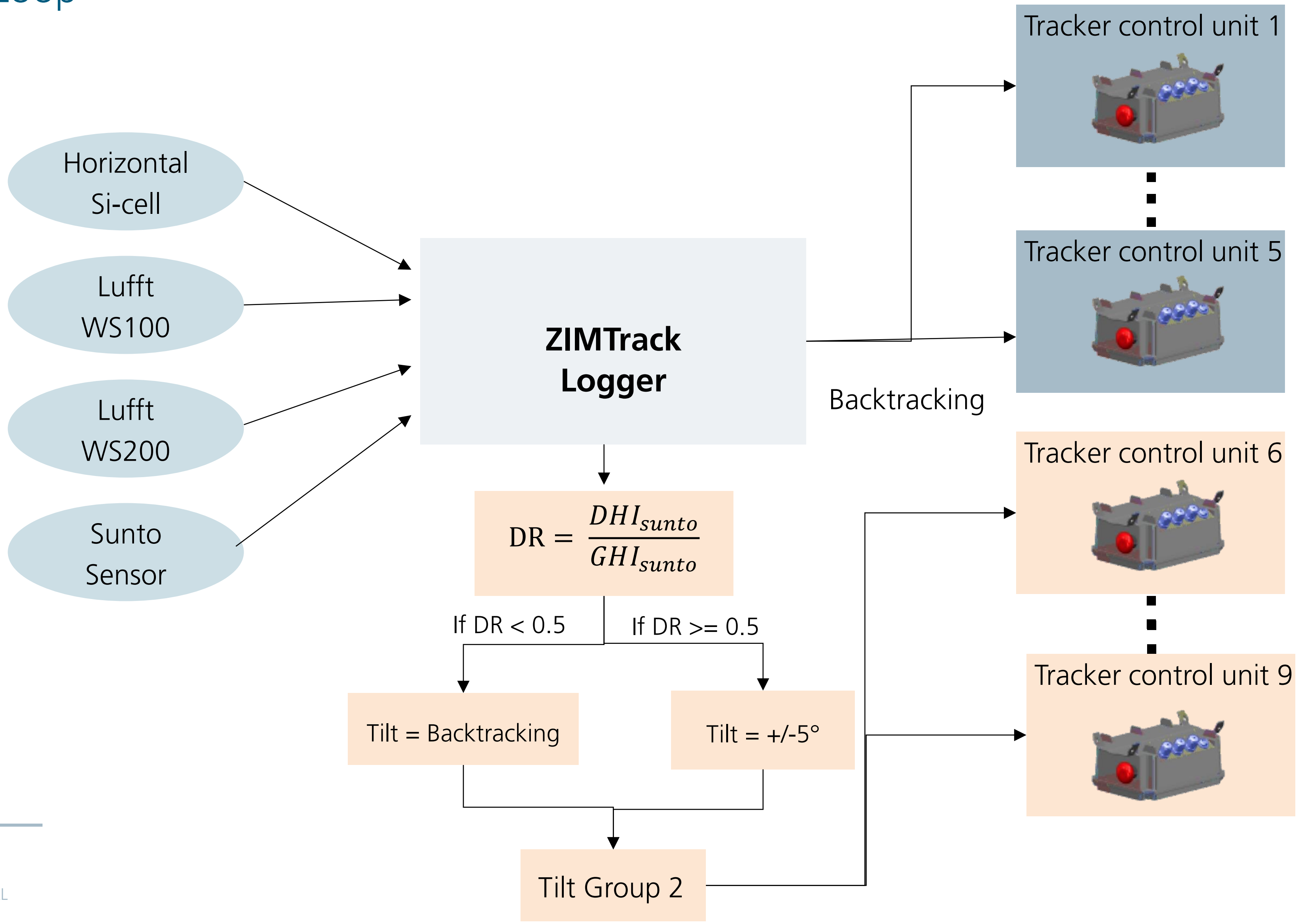
# Diffuse Tracking
## Methodology



# Diffuse Tracking

## Control Loop

ZIMMERMANN PV-Steel Group







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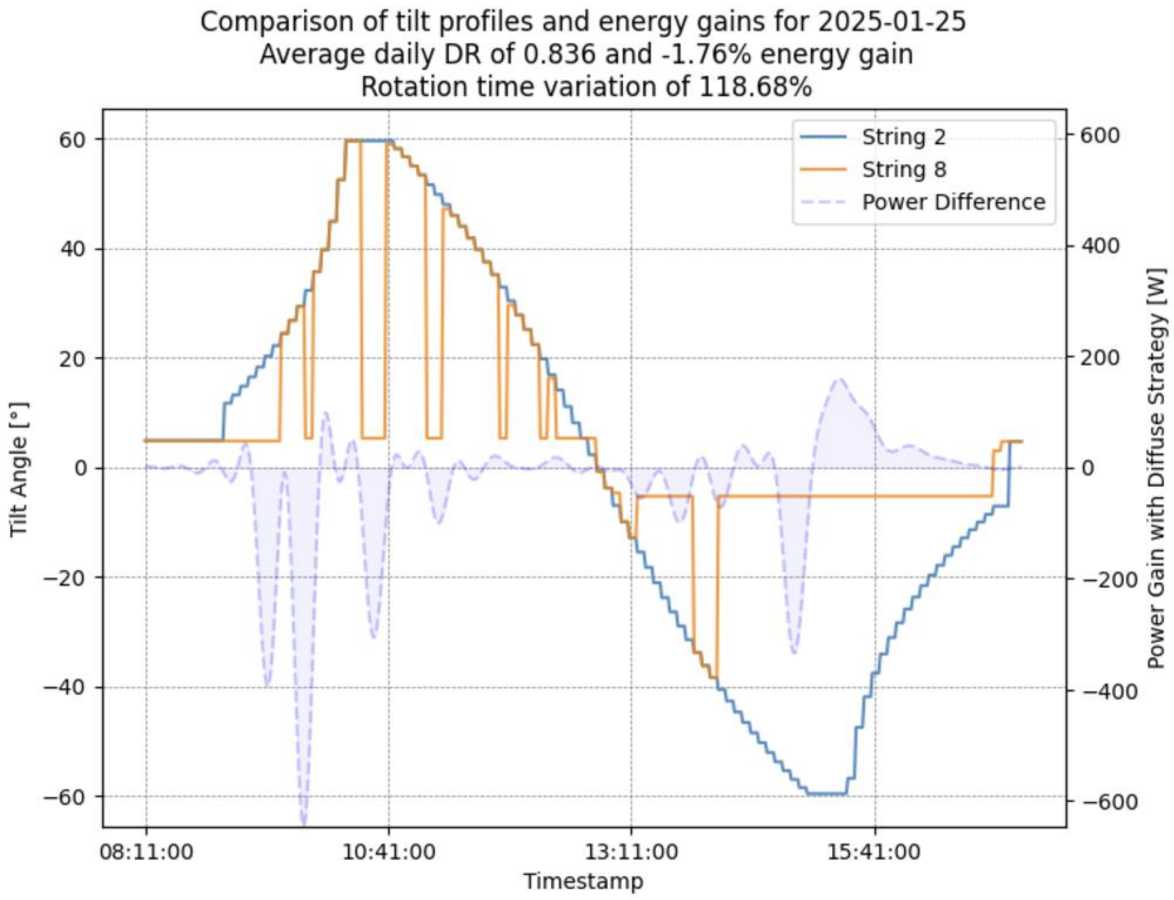
# Diffuse Tracking
## Limitations

- In its current implementation the algorithm has some strong limitations:
  - It depends on the DR computed from the Sunto sensor which is subject to measurement uncertainty
  - It does not yet take into account **weather forecasts** so leads to:
    - ➢ Excessive additional rotation time
    - ➢ Wear and tear of motors
  - Subject to transmission network and trackers movement delays

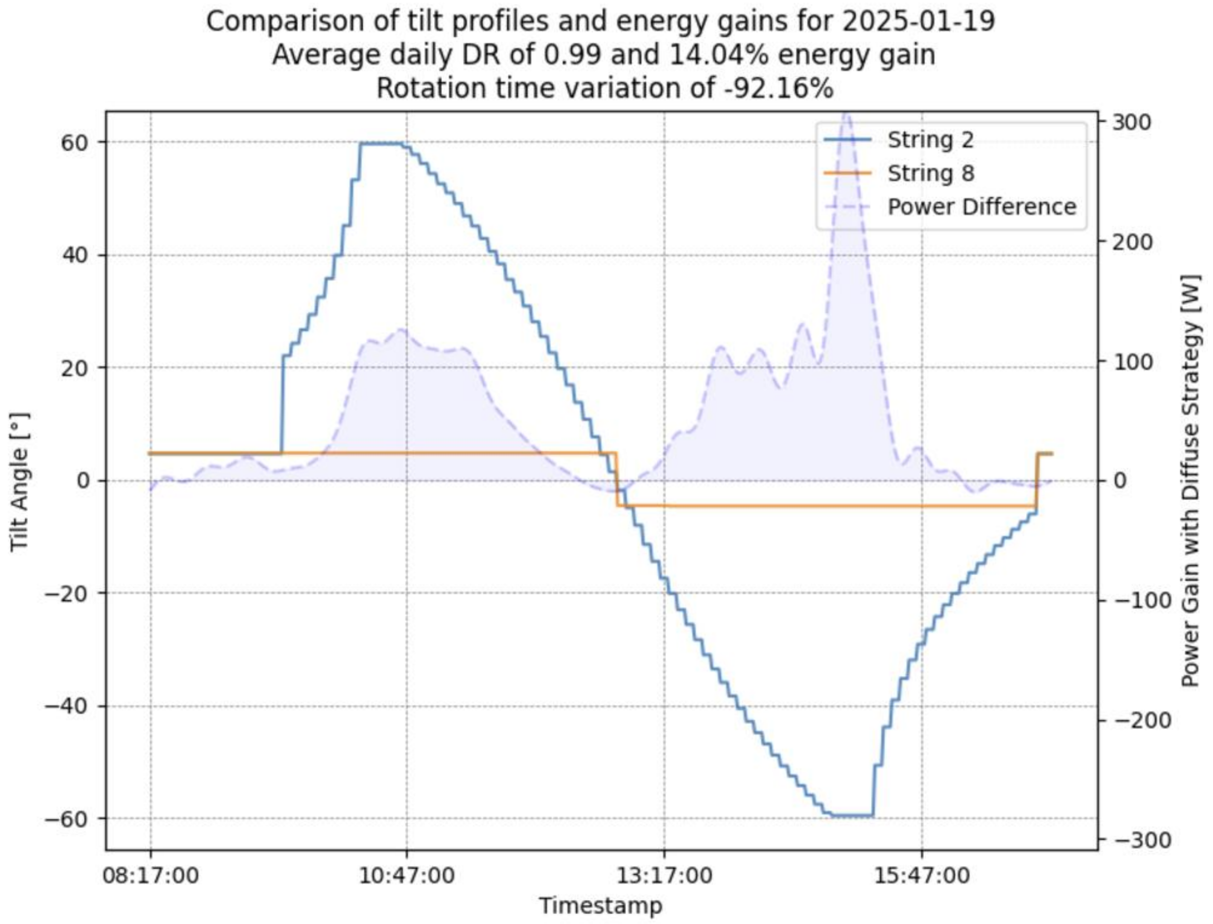


# Diffuse Tracking

## Results

**The performance of the Diffuse Strategy has been studied for the period from the January 12 to January 28, 2025**

- In the period studied, the Diffuse Strategy was activated **59% of the time**
- For an overcast day, the current algorithm leads to daily energy gains **from 5 up to 14%**
- Over the entire period, a **gain of 1%** was measured due to the wide range of DR considered → 25% of the time the strategy results in energy losses
- Positive gains result in a **2.2% increase in yield** which are aligned with previous simulation work
- Gains justify research efforts and interest



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# Thank you!

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