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Trackers in Photovoltaic Applications: Technological Challenges and Innovation Opportunities

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Topics

Trackers in Photovoltaic Applications:

- **Technological Challenges** → **Extreme Weather Risk & Mitigation Solution**
- **Innovation Opportunities** → **PV Plant New Requirements: new tracking strategy**

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Agenda

1 **INTRODUCTION**
About Us & Topics Explored

2 **EXTREME WEATHER RISK**
Mitigation Solution

3 **PV PLANT NEW REQUAREMENTS**
Integrated tracking strategy

4 **CONCLUSIONS**
Future R&D trends

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About Us: …*from Convert Italia to Valmont Solar*

1946

Valmont Industries Founded,

Irrigation systems

1970's

Valmont Utility begins service

1981

Convert Italia SpA founded

2007

First plant with Convert-1P Single Axis Trackers.Tuscania

2018

Valmont purchases Convert Italia

2019

Expansion into North America

2022

Valmont Solar Brand Launched

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78 YRS

Financial Stability

40+ YRS

Modernizing the Grid

18+ YRS

Solar Tracker Technology

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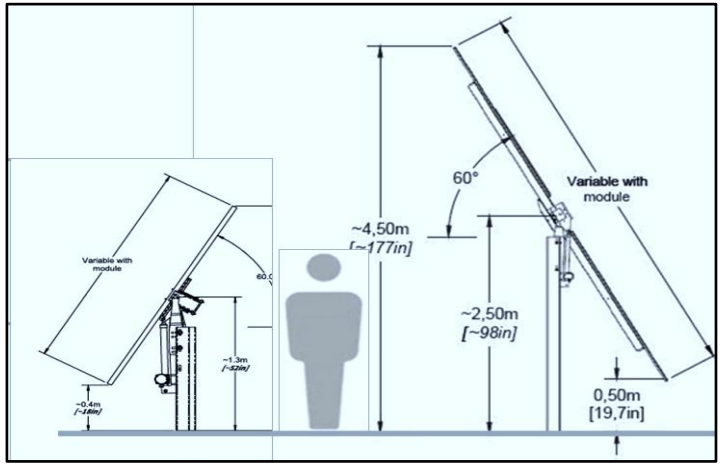
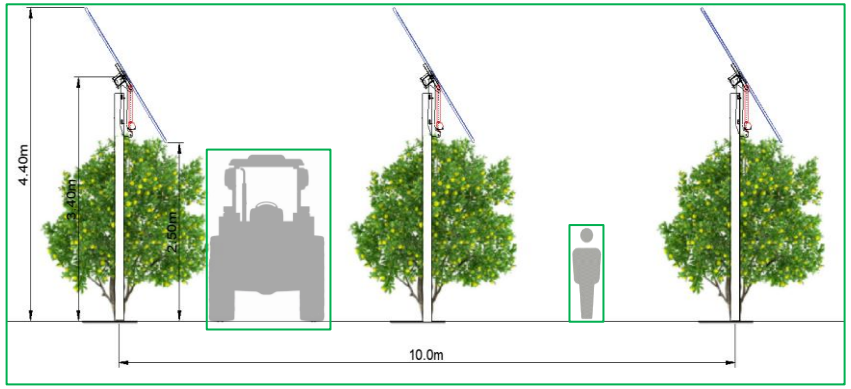
About Us: *Valmont Solar Products*

STANDARD Convert-1P and 2P Tracker



Innovative Agricultural Applications



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Extreme Weather Risk & Mitigation Solution

Hazards :

- **External loads**: wind, snow, storms,..
- **Ground movements**: landslide, earthquake, ….
- **Weather events**: hail, flood, …,
- **Time:** aging, gear wear of driving devices, …
- **Aggressive environment**: corrosion, ice,….

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Extreme Weather Risk & Mitigation Solution

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Need of cost-effective solutions:

low contribution on LCOE index

Mitigation:

- **Use of consolidate knowhow**;
- **Use of available international standard**
- **Appropriate use of available field experiences**
- **Accurate models of tracker – environment interaction**:
  - Computational Fluid Dynamics (CFD) Analysis
  - F.E. Stress Analysis of tracker components.
  - Corrosion, Environment Agressivity …….
- **Laboratory & Full /Mid-scale lab test:**
  - Wind-tunnel test
  - Tests on components in climatic chambers
  - Corrosion,…..
- **Flexibility to govern the tracks: redaction of time to go in stow-position.**
- **Up-Grade of existing standard**

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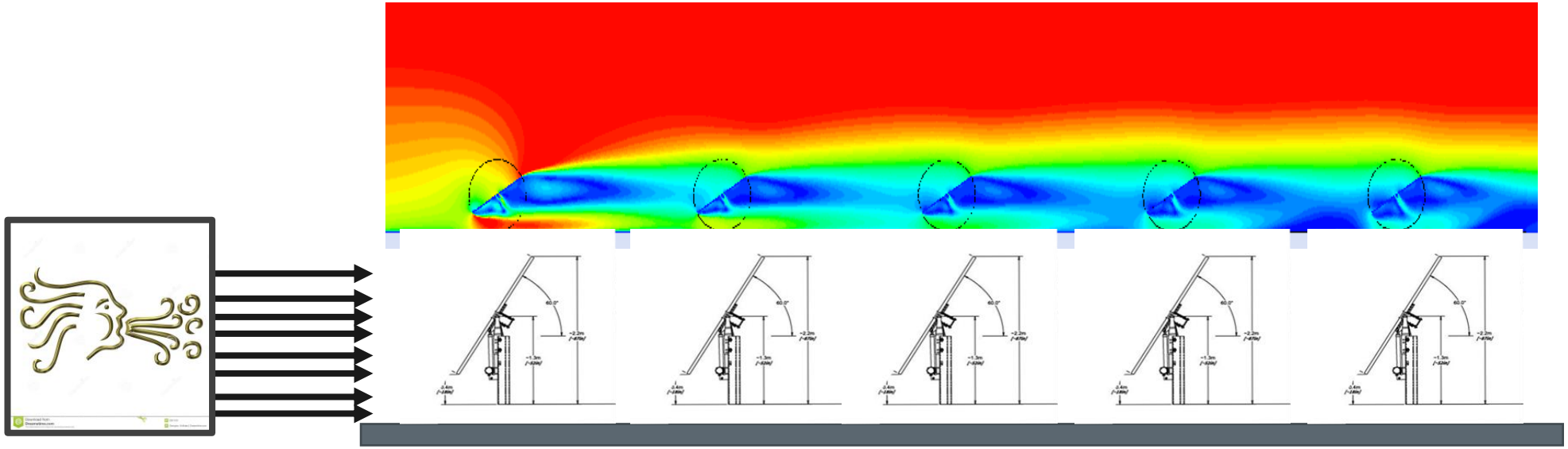
Wind Hazard: Base Knowledge



Wind Static Loads &
Static strength:
Pressure and moment coefficient vs tilting of modules

Aero-elastic Phenomenon &
Dynamic Instability:
Torsional instability, Flutter, Galloping

Wind Hazards: Available Approach

State of Art & Limits to overcame:

- ✓ **Absence of a specific standard** for tracker design, only building codes could be considered;
- ✓ **Code procedure does not adequately describe** the wind interaction among trackers and air flow,

Conservative approaches are available

New Approach:

- ➢ **A CFD and Wind Tunnel tests are the only way to "fill this gap of knowledge".**

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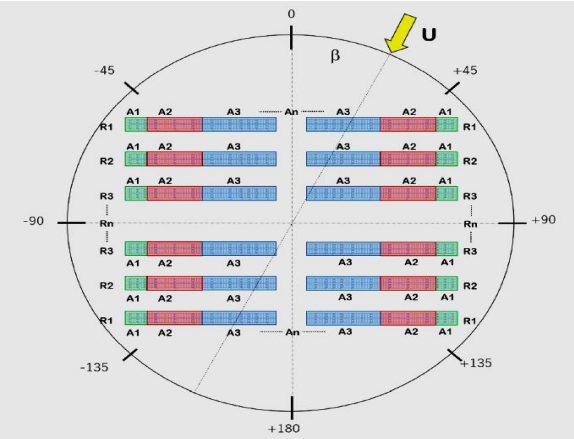
Wind Tunnel Test – Wind Static Loads

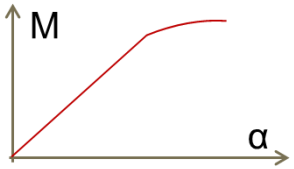


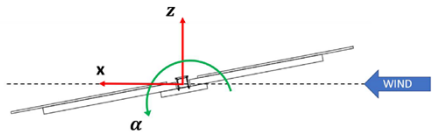
Measured parameters

- ✓ Pressure and moment coefficient vs orientation of modules and tilting,
- ✓ Sensitivity of wind loads if changing the distance among trackers
- ✓ Shielding effects of windward structures

Wind Tunnel Test - Aeroelastic instability

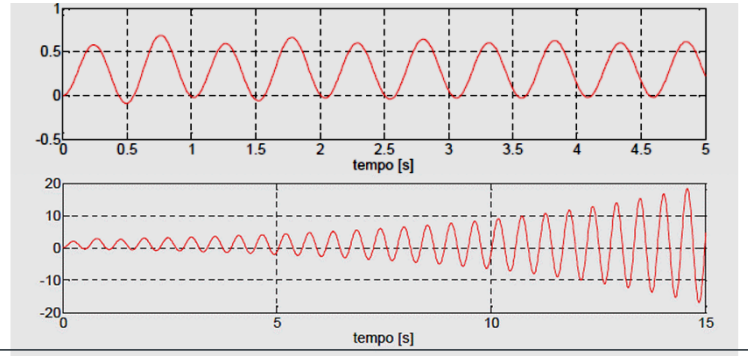
Torsional static instability:
Divergence



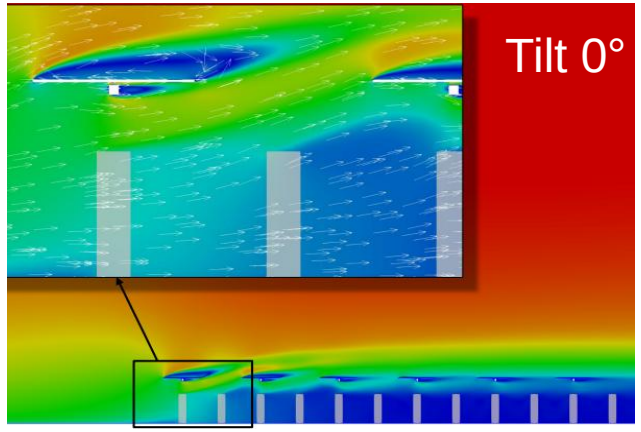


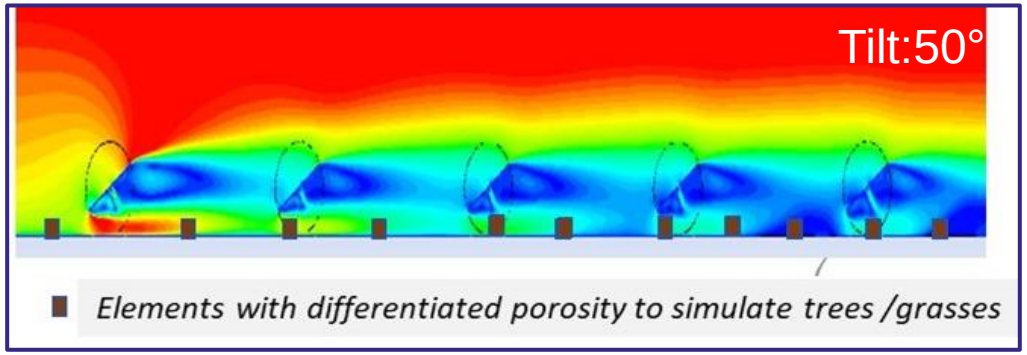
Galloping

Flutter



Evaluation of the presence of crops under the trackers.





The fruit trees' "barrier" effect below the tracker typically can reduce the wind load by a factor of 10 to 25%

Flexibility to tracks to achieve the stow- position.

Need:

- In strong winds, hail, floods, snow, the key **to maximizing the mitigation effect is to reduce the time needed to bring the tracker into a safe** position. (stow position).

Approach:

Innovative H&S driving and monitoring system:

- ✓ To **increase flexibility** to govern the tracks, as **redaction of time to go the stow- position**.
- ✓ To **assure a independent powering** of each trackers.
- ✓ To **monitoring each single motor**(position of actuator and power need for the drive).

Solution Proposed by Valmont Solar:

- **Development of a Self-power / storage,** on each single motor/driver.
- **Up – grade of SCADA, increasing wireless connections.**
- **Improve the number of weather sensors.**
- **Cyber Security System** (CSS) for the required communication

A time reduction to go to a safe position is expected

PV Plant New Requirements: Integrated tracking strategy

External Data Base Platform

NEW SCADA + A.I.

Tracking Program for bifacial panels: irradiation / albeto variable coefficient

Tracking Program for AGRIPV: balance between energy produced and agricultural production

Tracking Program for different injected power scenarios on electric network: need to reduce the actual productivity

Current Tracking Strategy
Clock tracking control to **Maximizes** the energy produced

Acquisition & management of data:

- ✓ *AGRI_PV* data from sensors ground & air: temperature, humidity, ecc
- ✓ Irradiation / albeto data from sensors
- ✓ Weather *data*
- ✓ Drive monitoring data

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Conclusions: Future R&D trend

Technological Challenges:

- Extreme Weather Risk & Mitigation Solution
- PV Plant New Requirements,

Innovation Opportunities and R&D trend:

- **Development new Knowhow**, by also lab. test in medium and large scale ,
- **Identify new solutions**, as sensors, design of trackers,…
- **Application of new technologies**, such as artificial intelligence,
- **Improvement of existing standards and codes**, allowing the full utilization of new knowledge acquired.

Thank You

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