Static tracking-integrated hybrid micro-concentrator module: a disruptive PV technology

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Outline

- The case for micro-concentrator PV (micro-CPV)
- Insolight hybrid technology
- Hiperion pilot installation
Context

- Shrinking share of PV modules in overall system cost
- Limited impact of further module cost reductions

Alternative: **increase efficiency**
Concentrator photovoltaics (CPV)

- Module efficiency ~35%
Limitations of CPV

- High system cost / Wp
- Cannot collect diffuse irradiation
- Requires sun tracking
- Not suitable for rooftop applications
The case for micro-concentrator photovoltaics

- Reduction of cell size below mm-range
  - Increased optical efficiency
  - Reduced electrical losses
  - Reduced carbon footprint
  - Thin, lightweight modules
• Hybrid CPV/flat-plate architectures for diffuse capture

Nagaoka University of Technology
D. Sato et al., IEEE JPV, 2019
The case for micro-concentrator photovoltaics

- Integrated tracking to avoid the need of external solar tracker structures
- Static mount

Typically through shifting

... solar cell

... or the optical system

Apostoleris (2016) “Tracking-integrated systems for concentrating photovoltaics”
Insolight technology

- Hybrid micro-CPV/flat-plate technology with integrated tracking, and diffuse collection.
Insolight hybrid concept

Direct, $\text{AOI} = 0^\circ$

Direct, $\text{AOI} >> 0^\circ$

Diffuse

Bi-convex Lens

$\approx 1\text{cm}$

Si

III-V
Insolight hybrid concept

- Dual output: CPV + Si
- AOI tracking range limited to 55°
Energy yield increase per m²

- Planar tracking micro-CPV - III-V only
- Planar tracking micro-CPV - III-V/Si hybrid
- Conventional Si PV

Insolight translucent concept

- Diffuse light transmitted through the module
- Dual land use (agro-PV)
Hiperion pilot installation at IES-UPM
Hiperion pilot layout

Electrical cabinet

- Q-relay
- Envoy-S
- Grid connection

Module layout

- 2X U-inverter
- 2X U-inverter
- 2X U-inverter
- 2X U-inverter
- 2X U-inverter
- 2X U-inverter

Workshop on Hiperion hybrid CPV/PV modules
Hiperion pilot monitoring

Insolight solar modules
(solar installation)

gateway
(mini-PC or Raspberry PI)

module data
CAN bus
commands

module & installation data
WLAN/4G
commands

Insolight server

export
module data
send commands

Web interface

Insolight or Customer

Envoy-S
CAN-BUS adapter
PSU units
Ethernet switch
Electric plug and circuit breaker
Voltage sources

Workshop on Hiperion hybrid CPV/PV modules
Workshop on HIPERION hybrid CPV/PV modules pilot installations at UPM and Fraunhofer ISE

Maximizing energy yield in space-constrained PV applications
Additional material
Energy yield increase per $m^2$

![Energy yield comparison diagram](image)

Agro-PV: maximum combined production

Combining Insolight’s and PV Solar Technologies.

Insolight system can be combined with standard PV panels by adding a few stages at the end of the assembly line.
Outdoor performance depends on atmospheric conditions

27-May 28-May 29-May

Tracking Range: ± 55°

$I_{sc}$ (A)

2.5
2
1.5
1
0.5
0

Si

III-V

27-May 28-May 29-May

Workshop on Hiperion hybrid CPV/PV modules