

# Projet SmartDrone4PV



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## SMARTDRONE4PV PROJECT



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Electrical Engineering Department, EMI, Morocco  
ETAFAT Company, Morocco  
IRESEN, Research Institute for Solar Energy and New Energies, Rabat, Morocco

**End-to-end solution for defect detection on large-scale PV installations**

### 1. ADVANCED UAV PHOTOGRAHMETRY

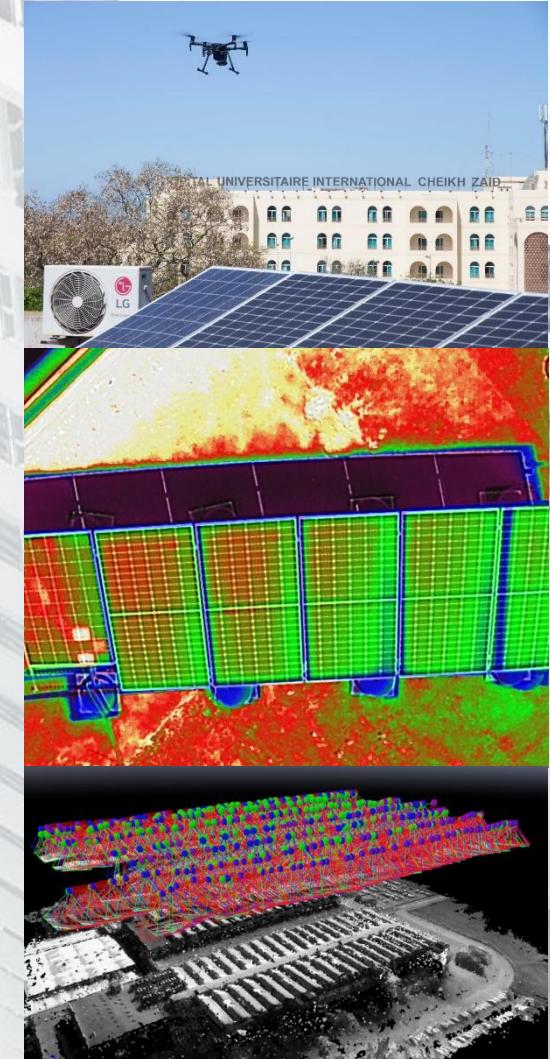
for RGB, long-wave and short-wave thermal infrared image acquisition

### 2. DEEP LEARNING SOLUTIONS

for defect detection and classification on the used imagery types

### 3. BIG DATA ANALYTICS

to handle the huge datasets that are generated by large-scale PV plants



## MEET THE TEAM

### SMARTDRONE4PV PROJECT



[www.smartdrone4pv.com](http://www.smartdrone4pv.com)



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**Machine Learning**

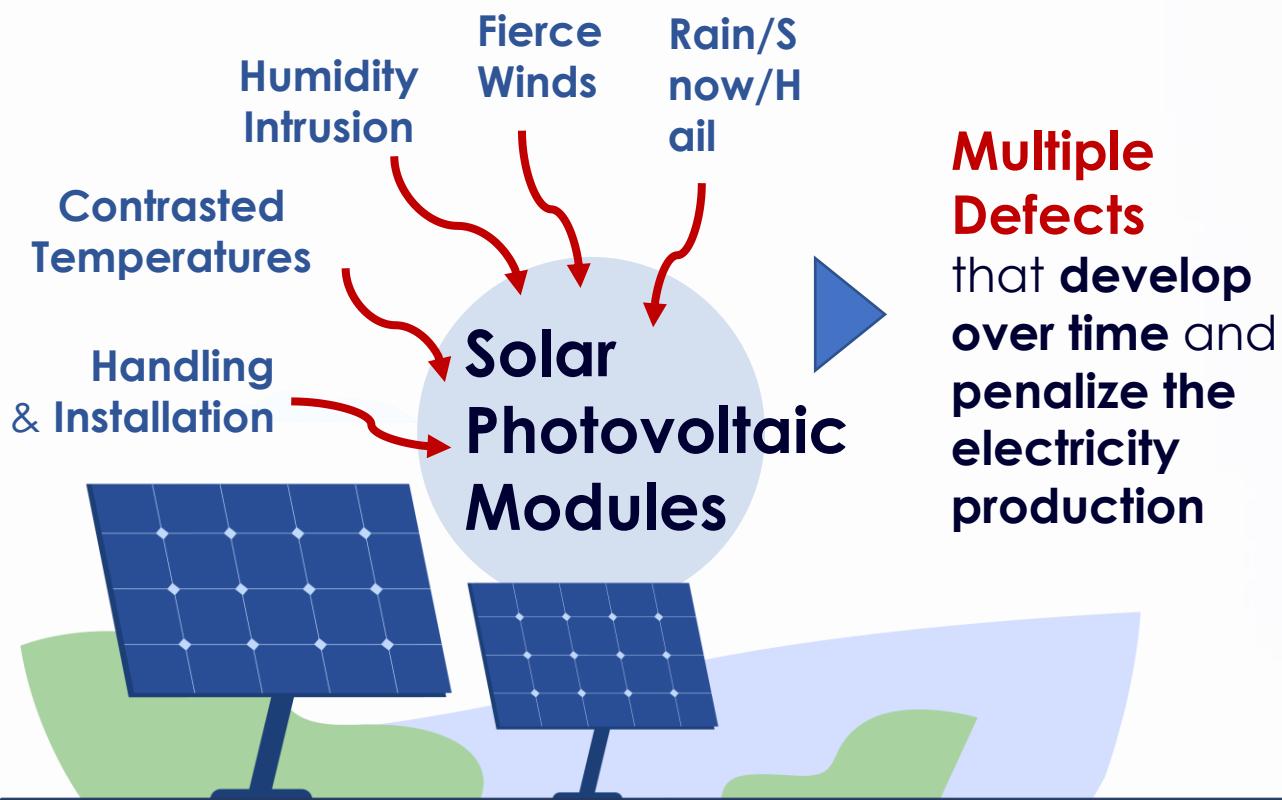


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**Machine Learning**



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**Deep Learning**

## CONTEXTE



- Enables contactless, fast, reliable characterization of PV Plant
- with proven efficiency and cost-effectiveness

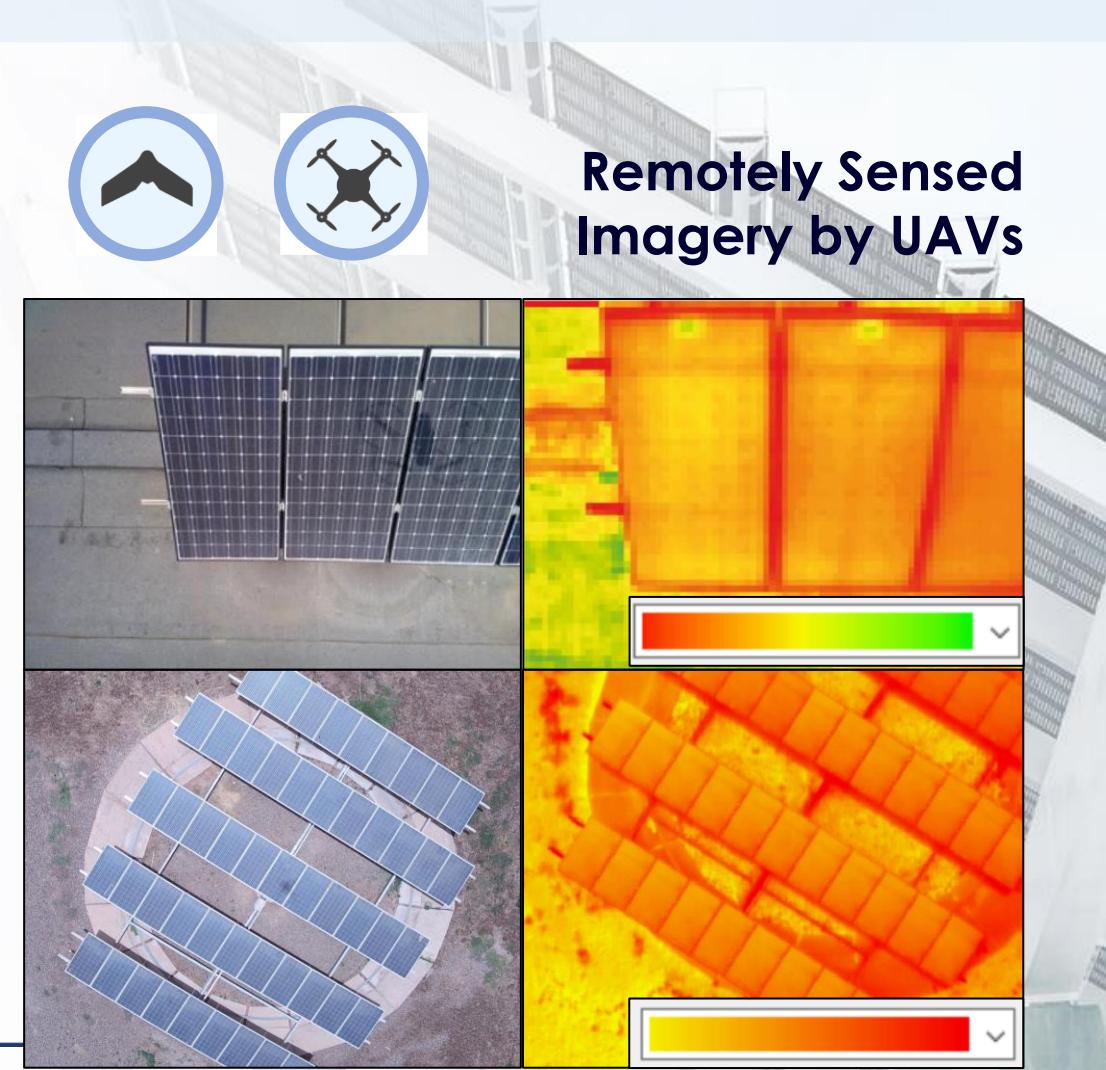


FIGURE 1.  
Thermal + RGB images of a PV strings acquired by a UAV.

## ARCHITECTURE DE LA SOLUTION

### I.1. UAV image acquisition

- RGB + Thermal infrared simultaneous imagery of the PV plant to inspect ;
- UAV equipped with a dual-sensor camera.

Raw RGB + thermal images

### I.2. Photogrammetric SfM-MVS postflight processing workflow

- (a) Initial calibration; (b) 3D dense point cloud generation;
- (c) DSM and orthomosaic generation.

RGB + Thermal orthomosaics

### I.3. Automatic generation of image base detection units

- PV modules extracted using a deep learning model ;
- Tiles extracted using a regular grid.

Orthorectified module images + Tiles

### I.4. Defect detection

- DL-based image classification, segmentation and object detection

Defect identification + localization

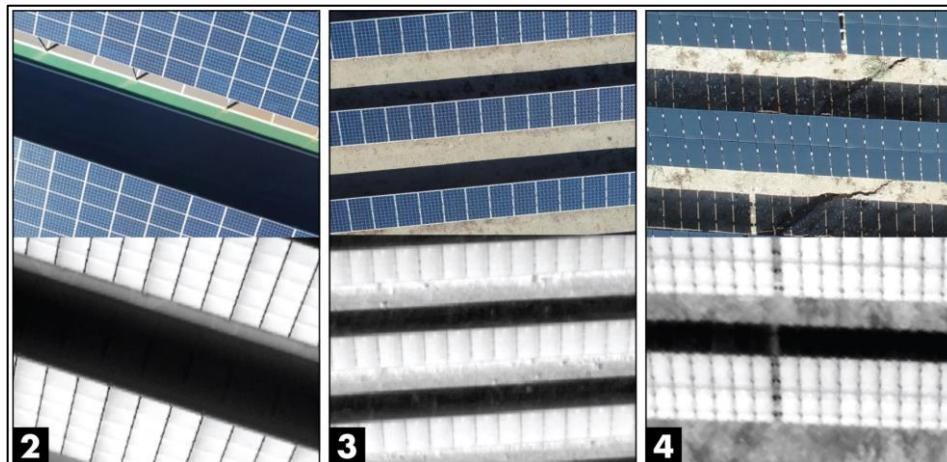
### I.5. Result visualization, reporting and exploitation

- Use of GIS tools within a geoportal ;
- Automatic report generation

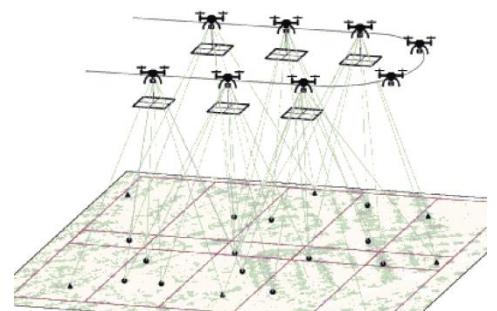
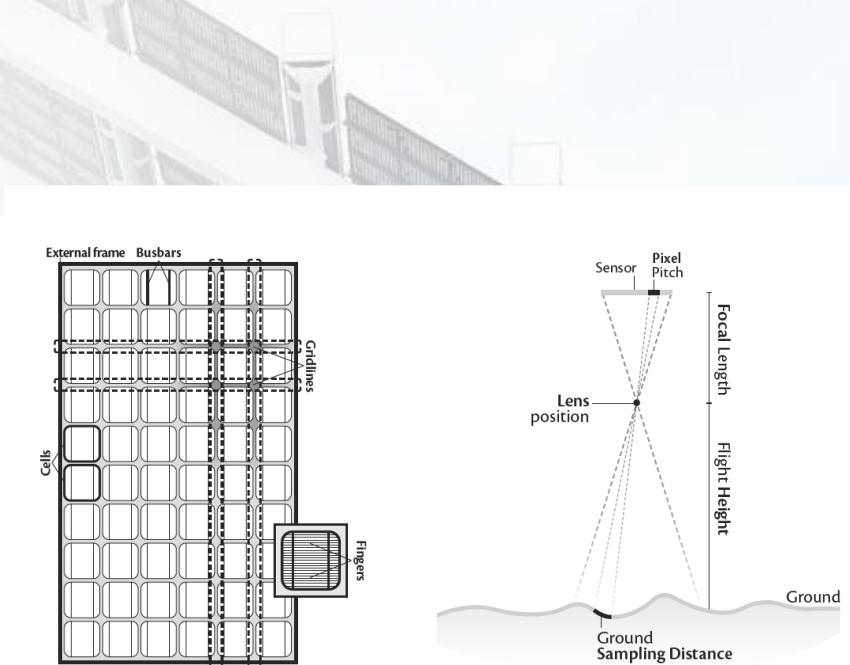
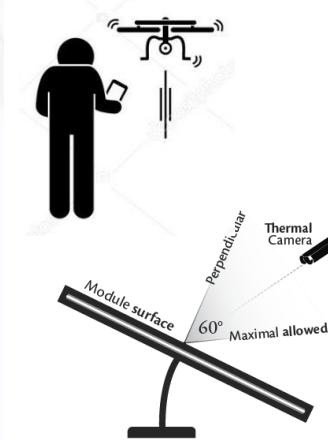
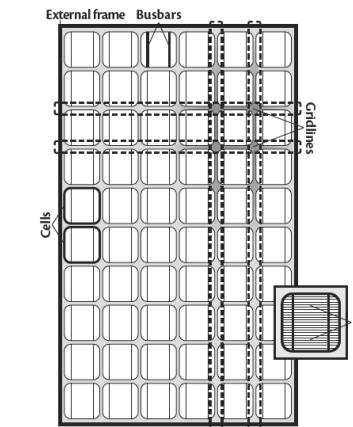
Comprehensive and Intelligent PV inspection

## SOLUTION

### I.1. UAV image acquisition protocol

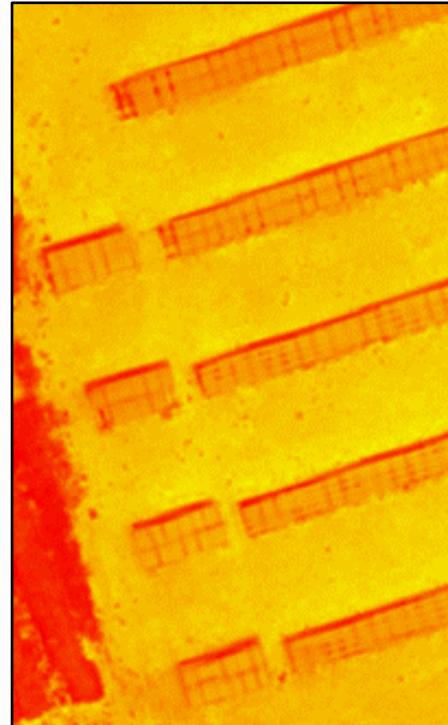


Sample RGB + thermal images taken using a UAV from different PV plants, showcasing PV arrays of different types and under various layouts and backgrounds.

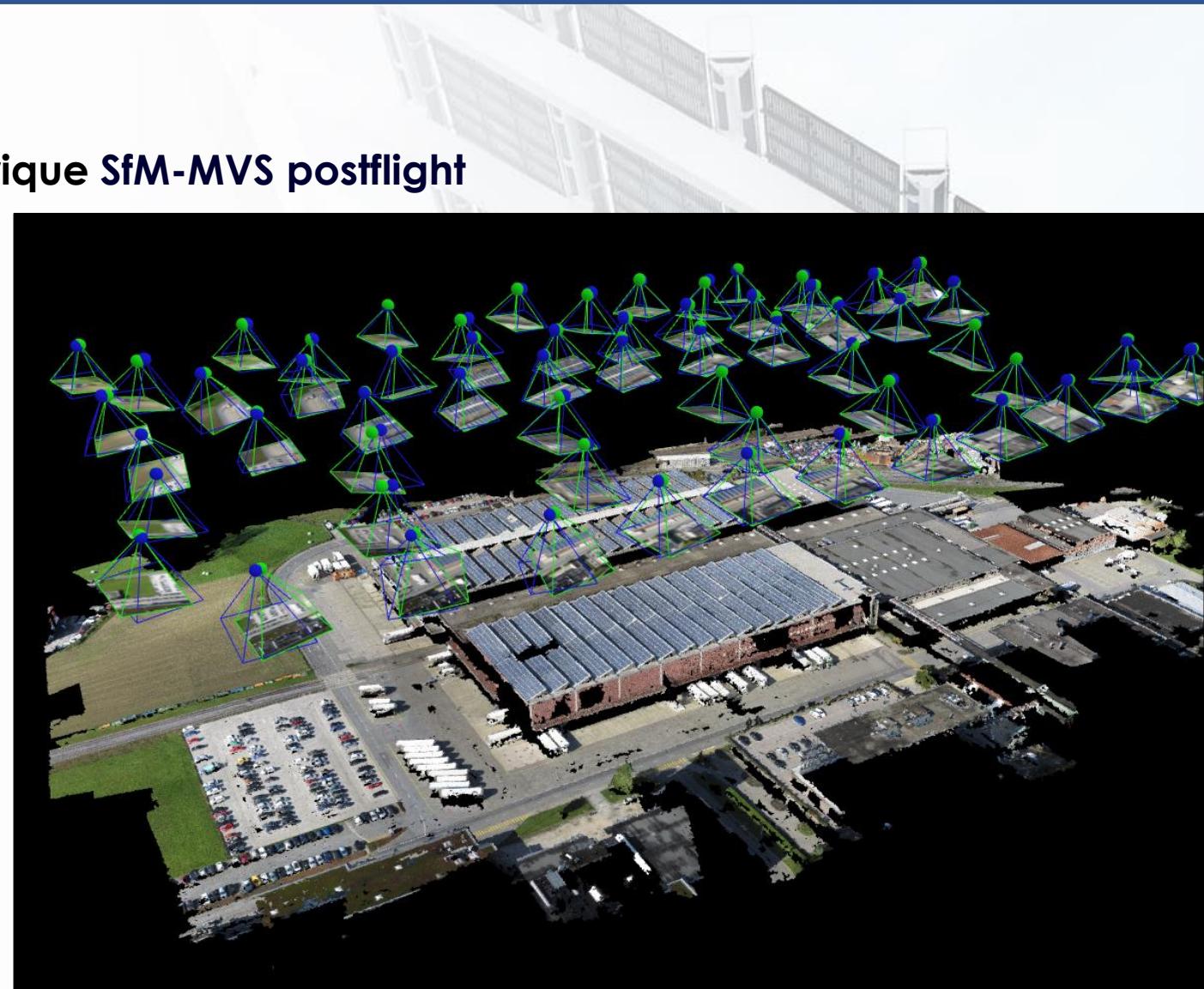


## SOLUTION

### I.2. Workflow Photogrammétrique SfM-MVS postflight



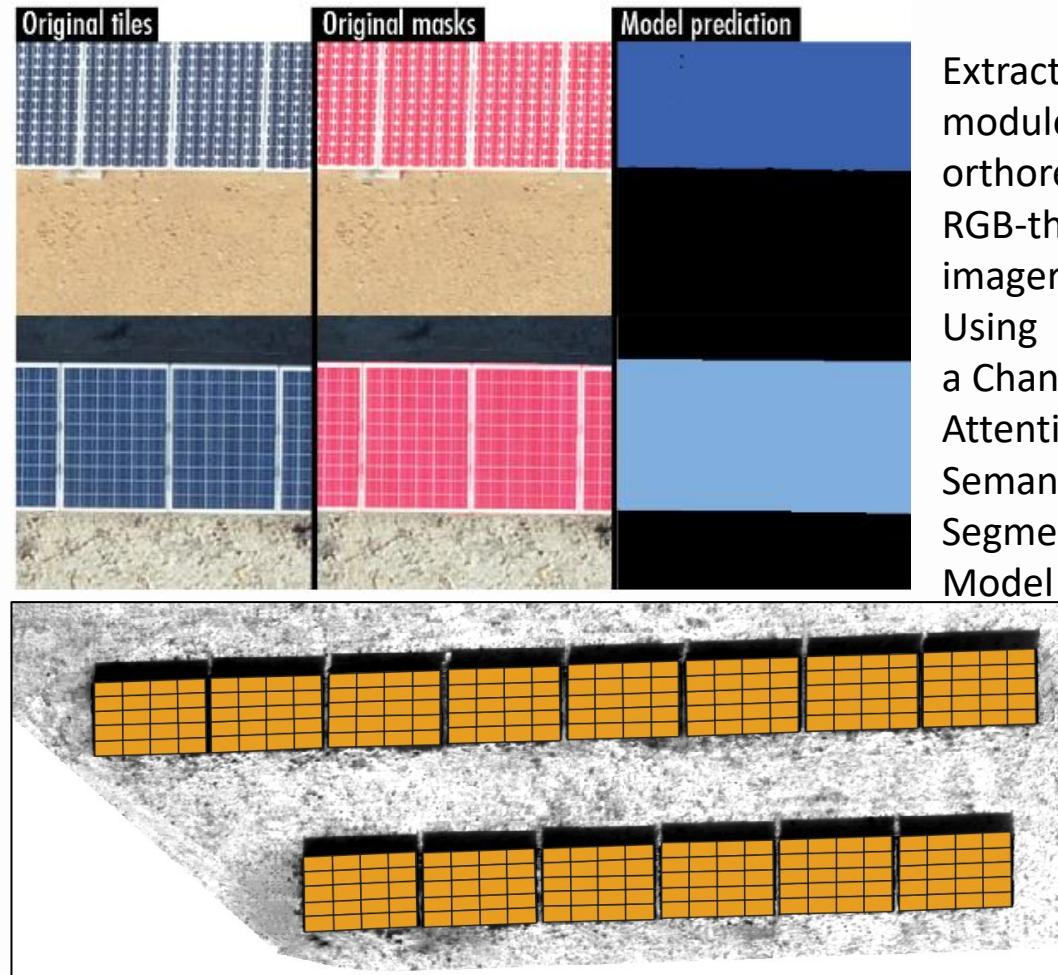
RGB + thermal  
orthomosaics of a PV site



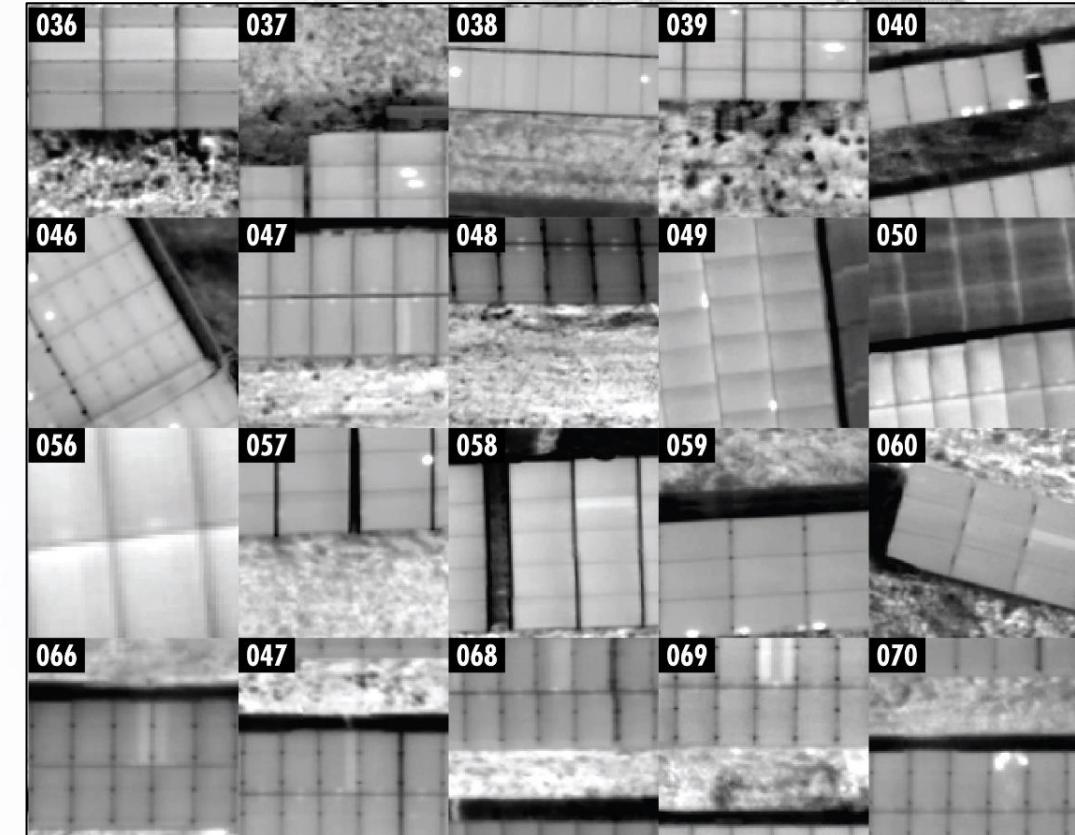
Photogrammetric  
image processing

## SOLUTION

### I.3. Détection automatique des panneaux PV



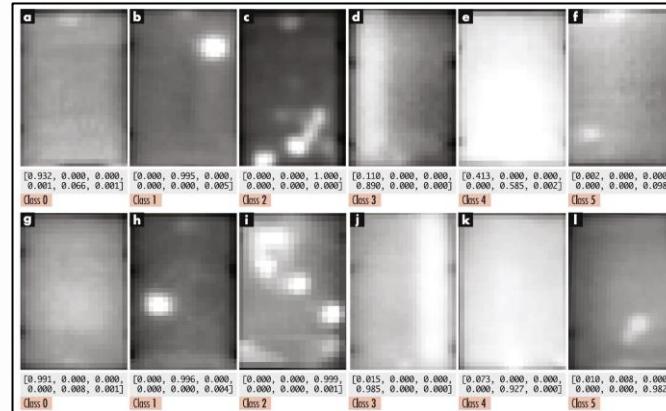
Extracted PV  
modules from  
orthorectified  
RGB-thermal  
imagery  
Using  
a Channel-Based  
Attention Deep  
Semantic  
Segmentation  
Model



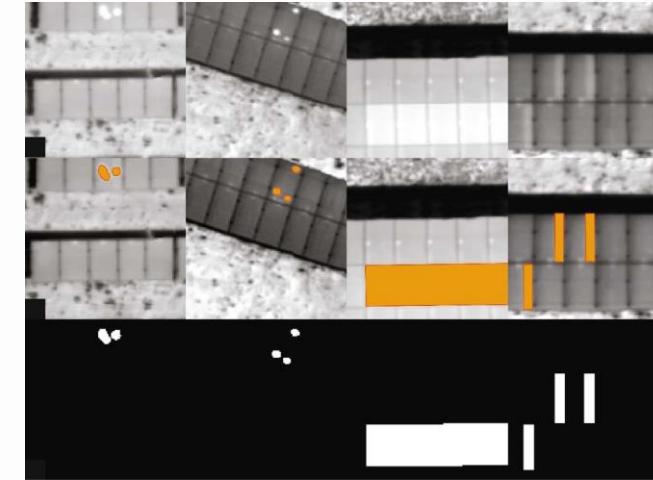
Extracted tiles from orthorectified thermal  
imagery

## SOLUTION

### I.4. Détection intelligente des défauts des panneaux PV



Defect detection using image classification on thermal imagery.



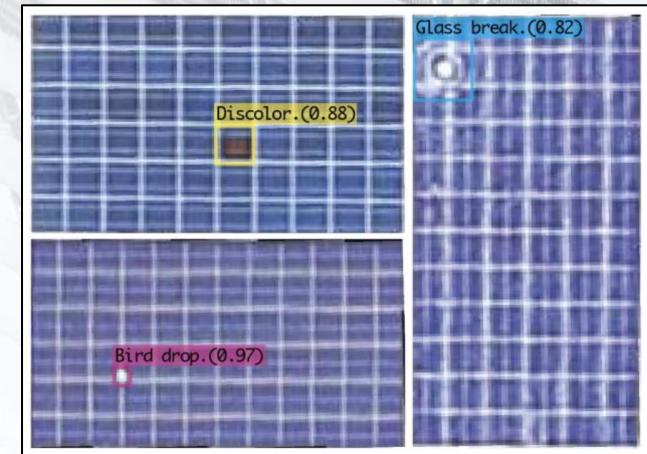
Defect detection using image semantic segmentation on thermal imagery.

**103 PV installations**

**93.44%**

**28 PV installations**

**94.52%**

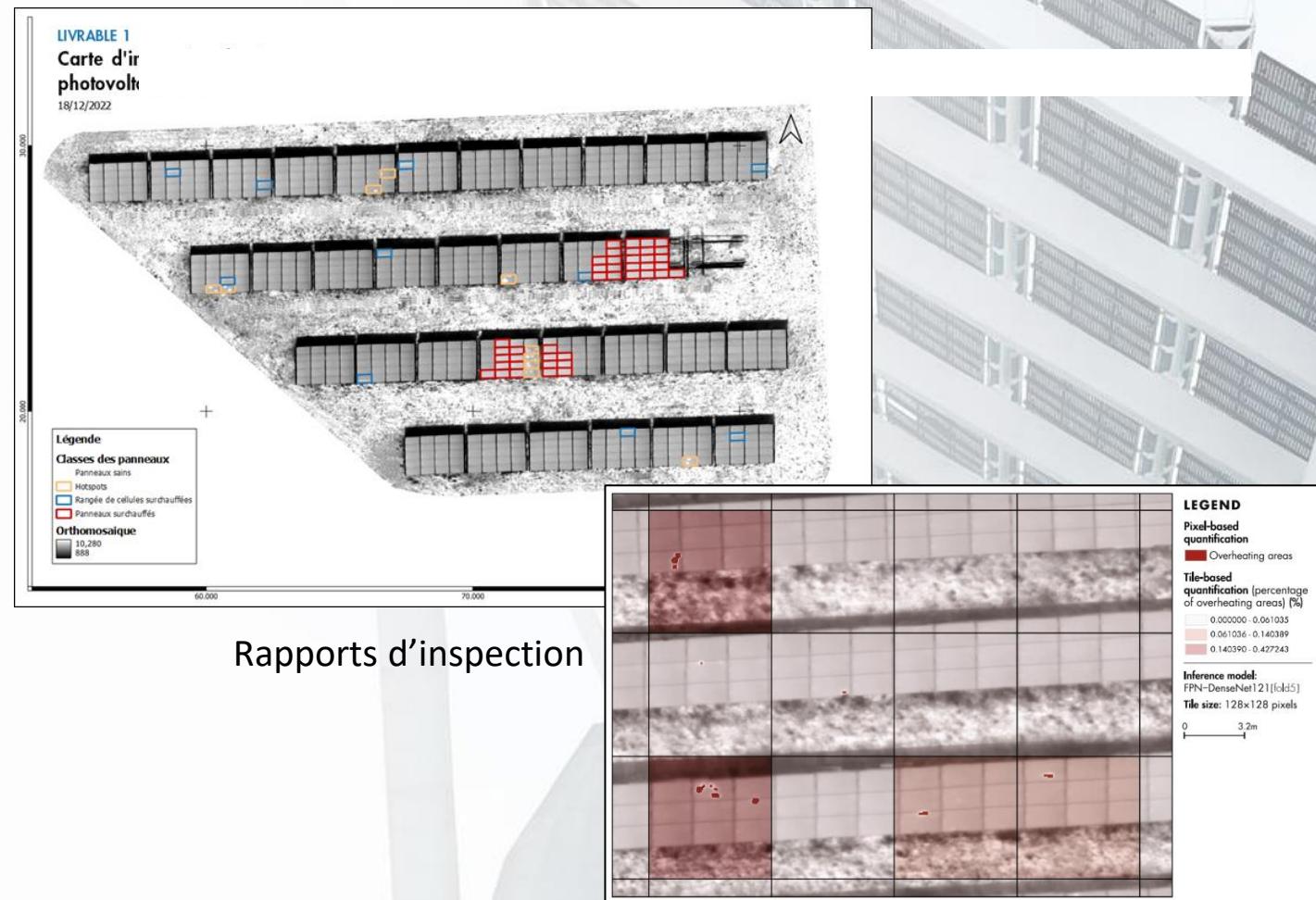


Defect detection using object detection on RGB imagery.

## SOLUTION

### I.5. Plateforme intelligente de monitoring PV

The screenshot shows the PVGeoportal website interface. At the top, there's a navigation bar with links: ACCUEIL, POTENTIEL DU SITE PV, MONITORING ET INSPECTION, GUIDES PDF, and CONTACT. Below the navigation, the main heading reads "PLATEFORME INTELLIGENTE POUR ASSURER LE MONITORING DES INSTALLATIONS PHOTOVOLTAIQUES". A large satellite map of a solar farm is displayed, with a callout box labeled "Complexe solaire". In the bottom left corner, there's a detailed inset map of a specific panel, with a legend indicating "Point: 30m\_auto\_RGB (1036).jpg" and coordinates "Lat: 32.2233892213333" and "Altitude: 495.235992431641".



## DISSEMINATION

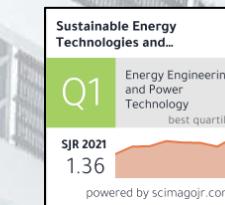
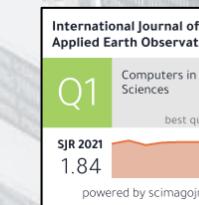
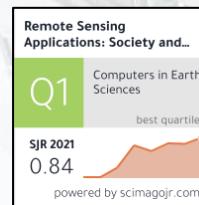
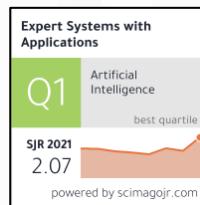
1

Brevet déposé



1

Thèse de doctorat soutenue



4

PFEs

4

Articles journaux Q1



2023 International Conference on Power and Renewable Energy Engineering  
(20-22 October 2023, Tokyo, Japan)



FUTURE ENERGY SOLUTIONS  
Vaasa, Finland (12-14 June 2023)



5

Articles conférences (scopus/IEEE)



2022 The 6th International Conference on Green Energy and Applications

6

Présentations orales



2022 IEEE Mediterranean and Middle-East Geoscience and Remote Sensing Symposium



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## PERSPECTIVES

**Edge-IA  
for  
Real-time processing**

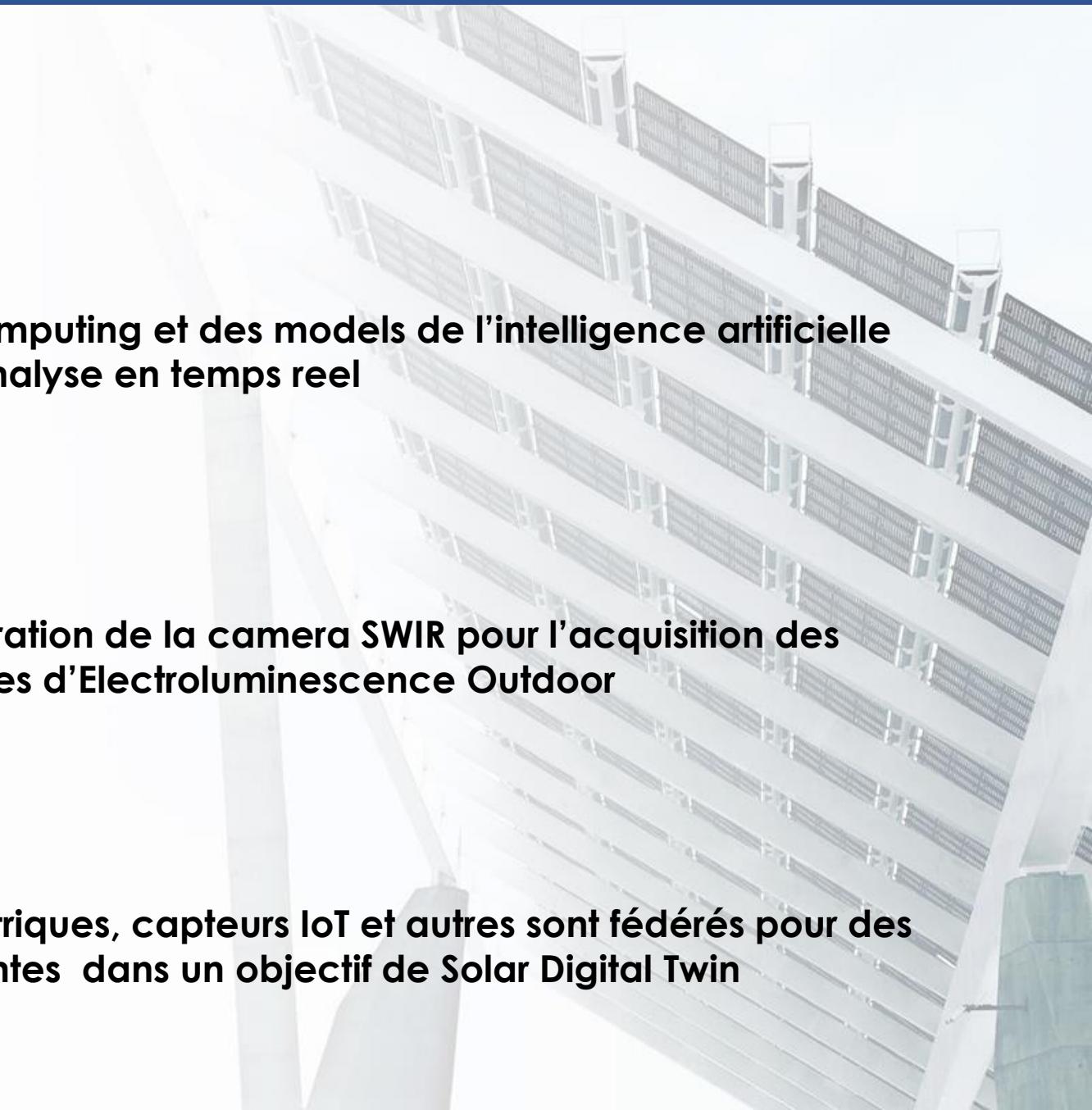
Intégration du edge computing et des models de l'intelligence artificielle pour la detection et l'analyse en temps reel

**Integration de  
nouveaux capteurs  
Imageurs**

Intégration de la camera SWIR pour l'acquisition des images d'Electroluminescence Outdoor

**Federate Learning**

Données drone, électriques, capteurs IoT et autres sont fédérés pour des décisions plus efficientes dans un objectif de Solar Digital Twin





**MERCI.**

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