SOURCE REVIEW / PV THERMAL INSPECTION PIPELINE

PV thermal defect screening to prioritized work orders

Two-stage localization and 12-class classification with configurable severity, energy-at-risk costing and local O&M reporting.

DOCUMENT	DATE	PREPARED BY	STATUS
TP-006	OCT 2026	SPECTRA GROUP S.A.S.	TECHNICAL SUMMARY

Technical scope

The repository implements an end-to-end screening workflow that converts aerial thermal survey frames into module-level findings and a prioritized repair work order. Its operating logic combines module localization, 12-class anomaly classification, severity assignment and simple energy-at-risk costing. Each finding can retain GPS from image EXIF, safety flags and recommended actions, while local UI and CLI modes keep inference and survey imagery on the user machine. The project is positioned as an O&M triage layer rather than a radiometric diagnostic substitute.

01 Architecture & workflow

Stage 1. Localization uses a near-nadir CV grid by default, YOLO26 for oblique/cluttered scenes, or a precropped input path; module crops are normalized to 40 x 24 pixels.

Stage 2. A 12-class CNN performs module classification. ResNet-18 is the default model; SmallCNN is offered as a lighter, higher-recall alternative.

Triage policy. A YAML configuration maps each class to severity, expected loss fraction, safety risk and recommended action, allowing client-specific dispatch rules without retraining the classifier.

Outputs. work_order.csv, findings.csv, report.html, summary.json and annotated frames support technician dispatch, dashboards and visual QA through local web or CLI operation.

02 Validation & boundaries

Dataset. Raptor Maps InfraredSolarModules: 20,000 real IR module images across 12 classes; reported test results use a held-out stratified set of 3,001 images.

Screening. ResNet-18 reports 92.2% fault recall, 96.1% fault precision and 52.0% review reduction; macro-F1 is 0.687, severity-tier accuracy 0.858 and overall accuracy 0.821.

Localization. Synthetic validation on 288 modules across 12 generated survey frames reports 1.000 recall, 1.000 precision and 0.898 mean IoU; the repository explicitly treats this as an upper bound, not a field result.

Deployment limits. Training reflects one camera fleet; several loss factors are estimates; RMA decisions require independent confirmation. The 8-bit JPEG dataset provides no absolute radiometric delta-T, so IEC 62446-3-style thresholds would require radiometric TIFF input.

SOURCE GSumanth109. pv-thermal-defect-detection, GitHub repository, main branch. MIT License. Accessed 05 Oct 2026. https://github.com/GSumanth109/pv-thermal-defect-detection

SOURCE TITLE pvtherm - thermal defect detection for solar farms