

# Applications of Thermal Drones

Energy Assessments for Efficiency and Reliability

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# Introduction

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## Why Thermal Drones?

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Thermal drones utilize infrared technology to detect heat variations, offering significant advantages:

- Non-intrusive inspections
- Enhanced safety and accessibility
- Rapid data collection
- Cost-effective assessments

## Technology Overview

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# Thermal Imaging Basics

Thermal imaging detects infrared radiation emitted by objects:

- Captures temperature variations
- Highlights thermal anomalies indicating defects
- Effective even in low-light or obstructed environments

# Drone Hardware and Software

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Essential components include:

- UAV (drone) platforms
- Infrared sensors and cameras
- Image processing and analysis software
- Flight management systems

## Processing Pipeline

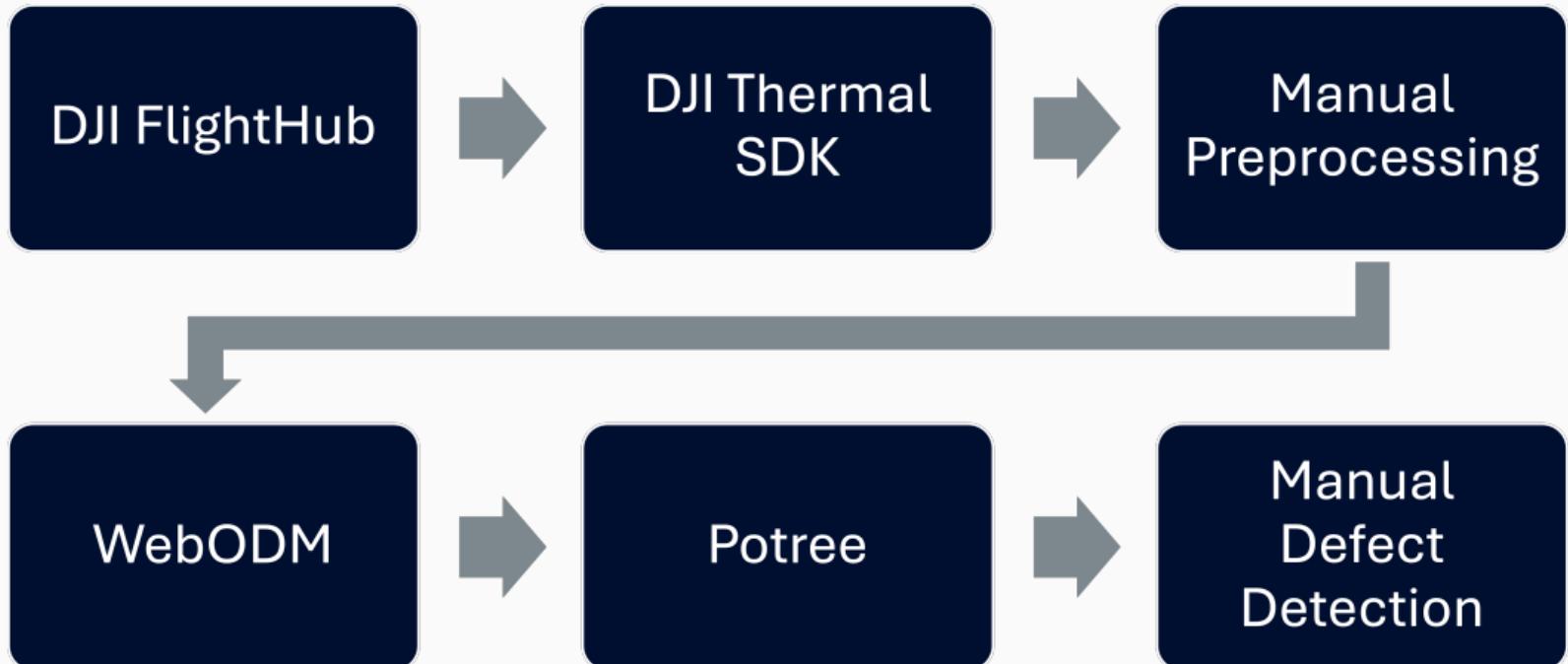


Figure 1: Drone Imagery Processing Pipeline

Machine Learning enhances defect detection through:

- Automated identification of anomalies
- Improved detection accuracy and reliability
- Predictive maintenance capabilities
- Integration with existing data management systems

## Applications in Energy Assessments

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# Solar Panel Inspections

Common defects identified:

- Cell defects and microcracks
- Hotspots and PID (Potential Induced Degradation)
- Dust and shading issues



Figure 2: Thermal Image of PID (left) and Internal Short (right)

# Building Energy Efficiency

Thermal drones aid in detecting:

- Heat loss in buildings
- Insulation inefficiencies
- HVAC system performance

Leads to targeted energy-saving interventions.

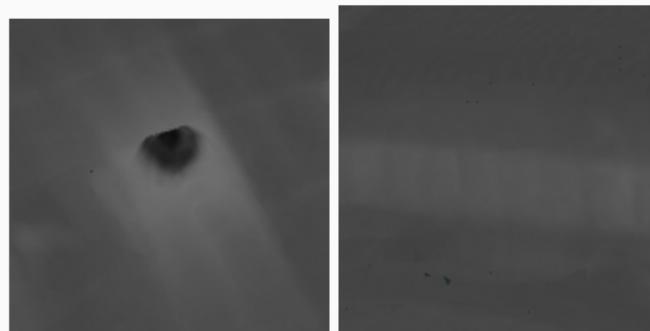


Figure 3: Exhaust vent (left) and Windows (right)

## Industrial and Grid-scale Applications

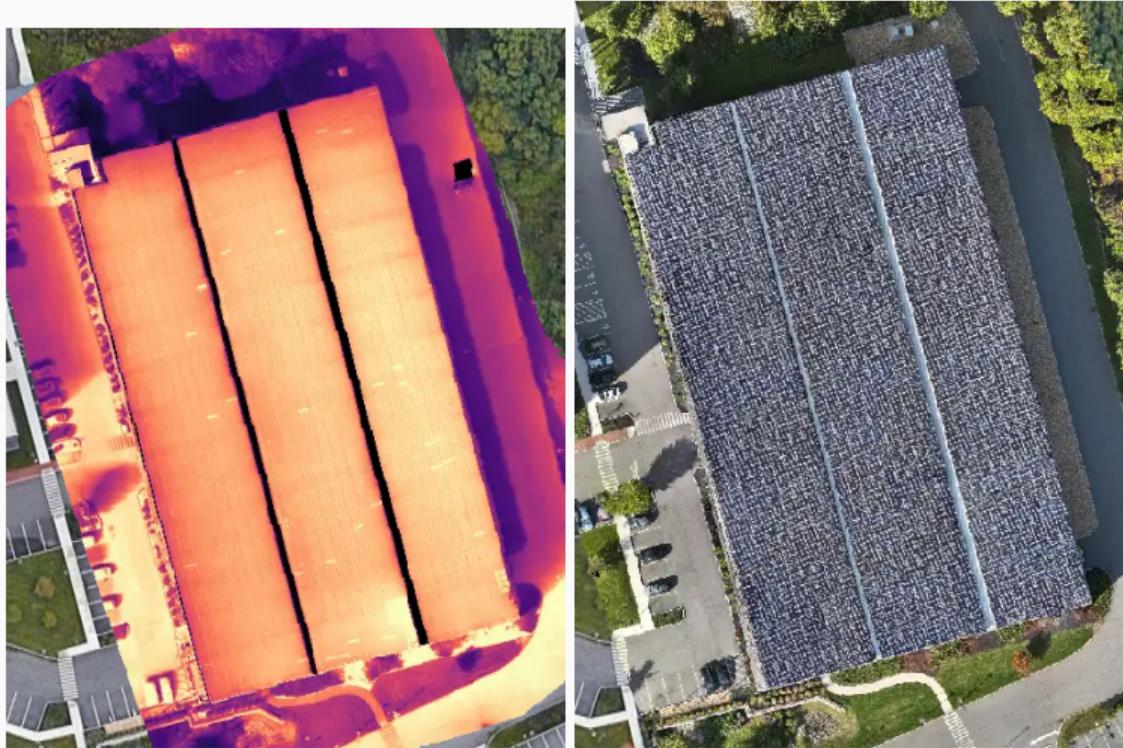
Significant uses include:

- Identifying overheating components in electrical grids
- Inspecting transmission lines and substations
- Preventing equipment failures and power outages

## Case Studies

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## Case Study: Solar PV Inspection



**Figure 4:** Thermal (left) and visual-spectrum (right) images of a rooftop photovoltaic system

# Building Envelope Inspection

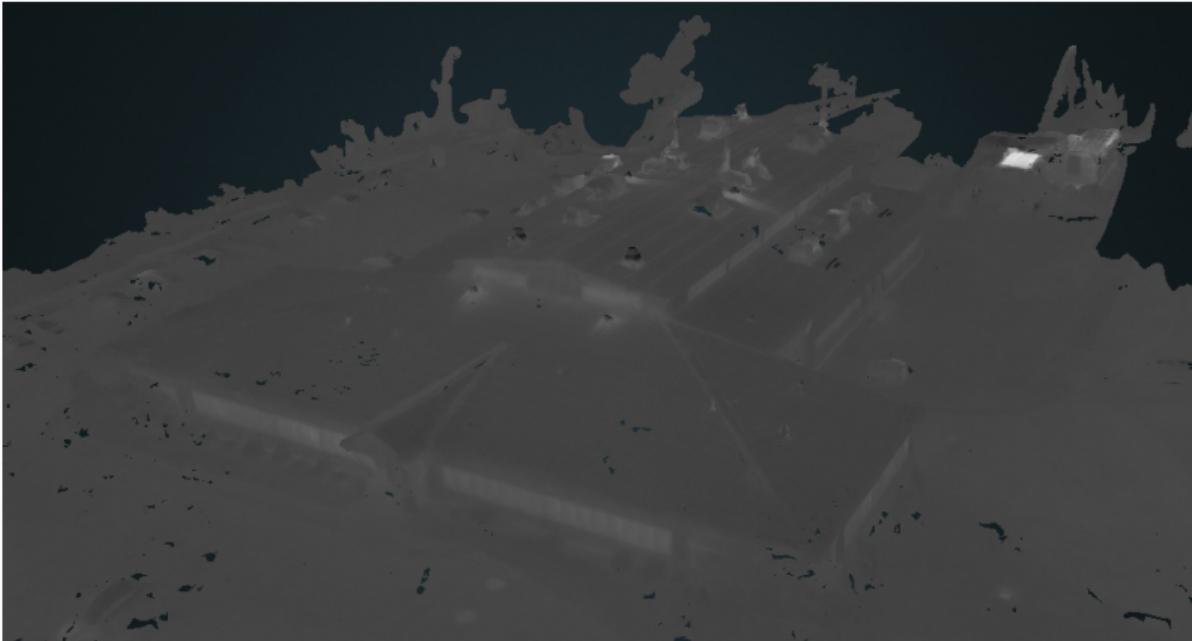


Figure 5: 3D thermal model of UConn building (white hot)

## Demo

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## Conclusion

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## Future Steps

There are may areas for improvement/increased performance

- Integration with various ML techniques for automated PC defect detection
- Integration with simulation software such as EnergyPlus
- More efficient processing/route planning

## Summary

Thermal drones are a transformative tool for energy assessments:

- Enhance efficiency and reliability
- Offer rapid ROI for various sectors
- Crucial for proactive maintenance strategies

# Questions?

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# Backup

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# DJI Flighthub

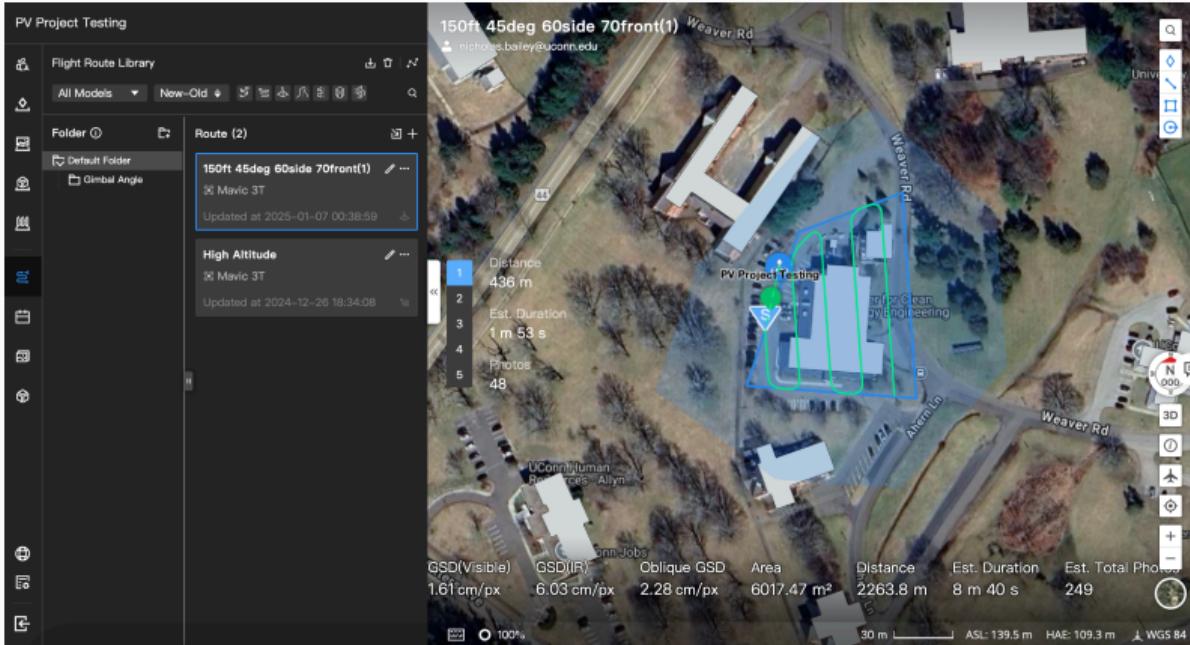


Figure 6: DJI Flighthub Software

# Flight Paths

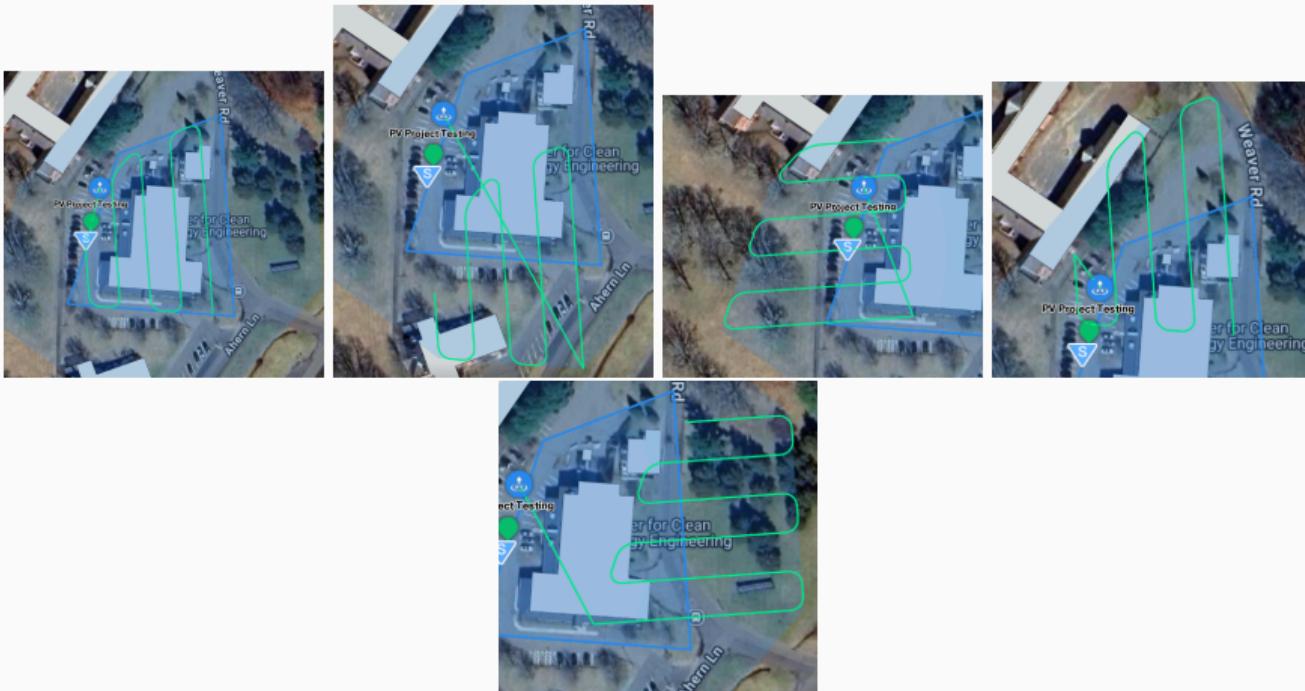


Figure 7: Five flight paths necessary for 3D model

# DJI Thermal SDK

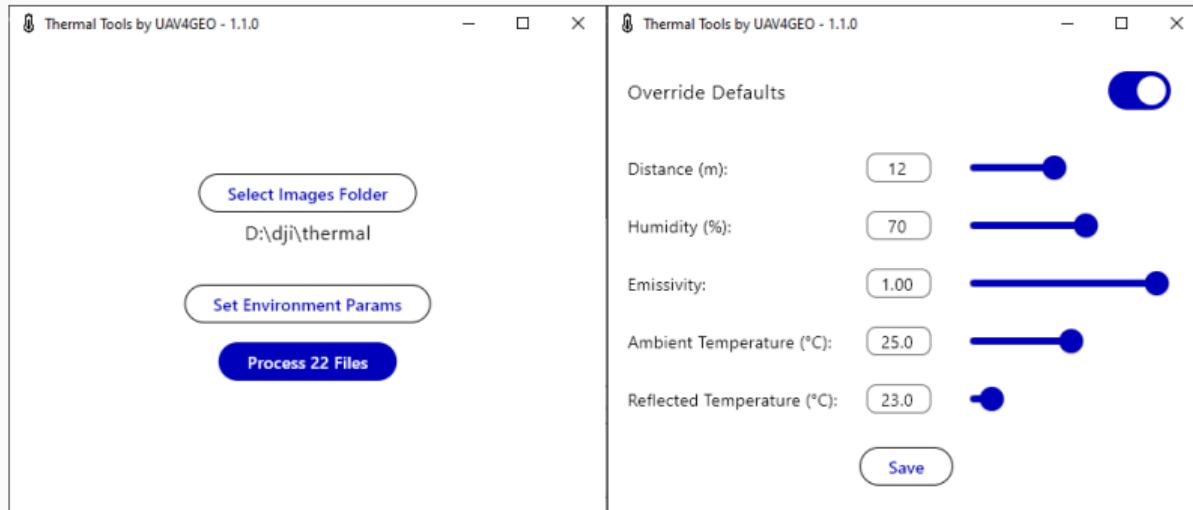


Figure 8: Thermal Tools (Wrapper for DJI SDK)

# WebODM

The screenshot shows the SNE-ITAC implementation of the WebODM interface. The left sidebar contains navigation links: Dashboard, Cloud Import, Diagnostic, Lightning, Charts, Processing Nodes, Administration, and About. The main area displays three projects:

- ITAC Assessments - 2025**:
  - Created on: 3/21/2025, 6:17:54 PM
  - Processing Node: Lightning (manual)
  - Options: auto-boundary:true, dem-resolution:2.0, dsm:true, orthophoto-resolution:2.0, pc-quality:high, rolling-shutter:true, rolling-shutter-readout:26
  - Average GSD: 2.56 cm
  - Area: 103,199.99 m<sup>2</sup>
  - Reconstructed Points: 46,071,521
  - Disk Usage: 6.5 Gb
  - Task ID: e7a8cccd3-e091-42dd-b68f-45b8f1db81a6
  - Task Output: On

Buttons: Download Assets, View Map, View 3D Model, Restart, Delete, Edit.
- Thermal Drone Testing**:
  - 5 Tasks
  - View Map, Edit

Buttons: Select Images and GCP, Import, Cloud Import.
- First Project**:
  - Edit

Buttons: Select Images and GCP, Import, Cloud Import.

Figure 9: SNE-ITAC Implementation of WebODM

- Custom implementation
- Processing done via WebODM Lightning

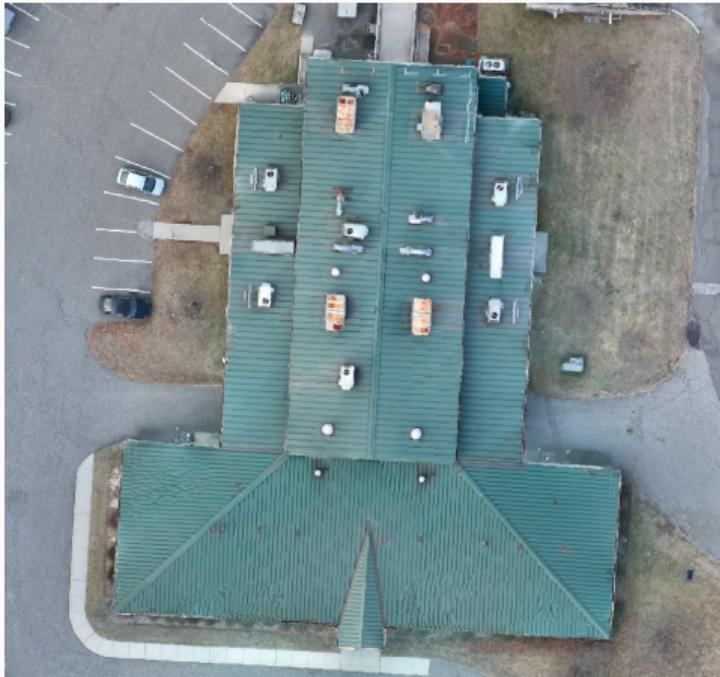


Figure 10: 3D and 2D views on Potree