Applications of Thermal Drones

Energy Assessments for Efficiency and Reliability

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Introduction

Why Thermal Drones?

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

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

Essential components include:

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

Processing Pipeline

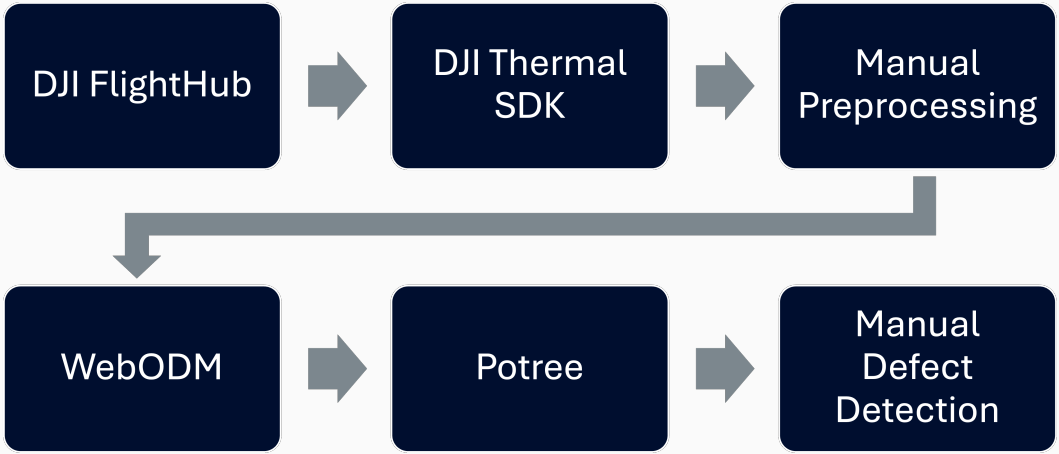

Figure 1: Drone Imagery Processing Pipeline

ML-based Defect Detection

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

Solar Panel Inspections

Common defects identified:

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

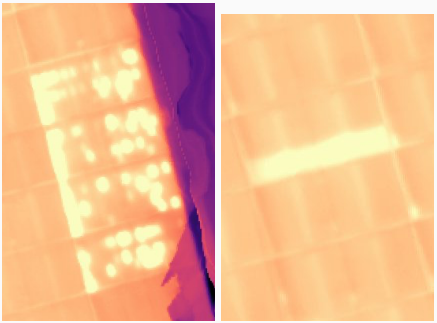

Figure 2: Thermal Image of PID (left) and Internal Short (right)

Building Energy Efficiency

Thermal drones aid in detecting:

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

Leads to targeted energy-saving interventions.

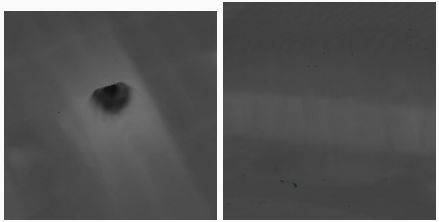

Figure 3: Exhaust vent (left) and Windows (right)

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

Case Study: Solar PV Inspection

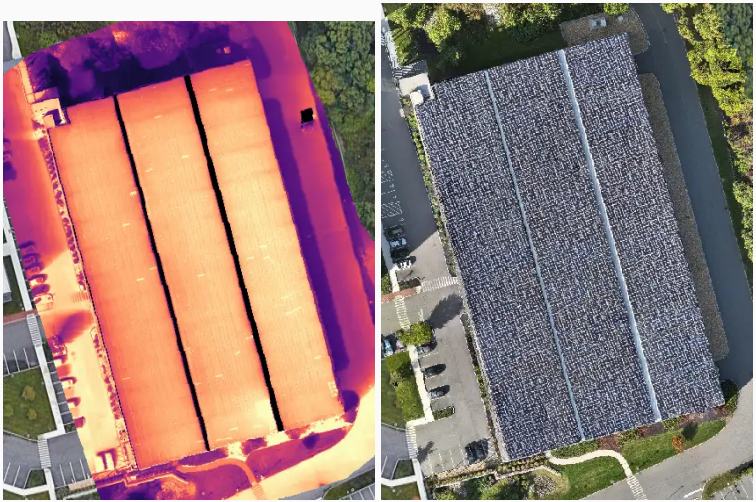

Figure 4: Thermal (left) and visual-spectrum (right) images of a rooftop photovoltaic system

Building Envelope Inspection

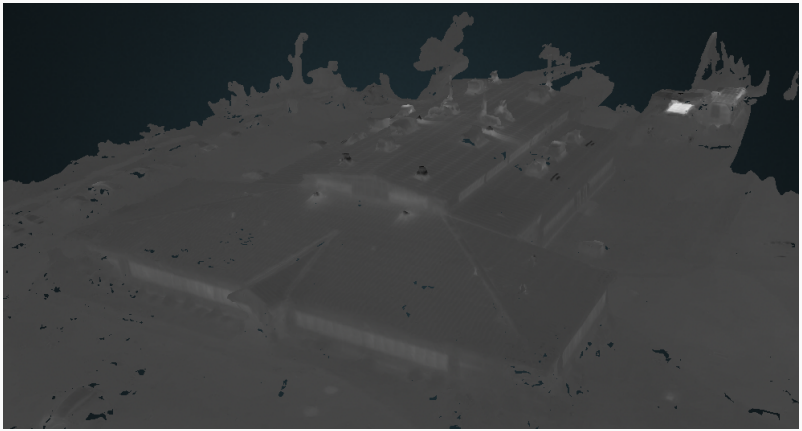

Figure 5: 3D thermal model of UConn building (white hot)

Demo

Conclusion

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

DJI Flighthub

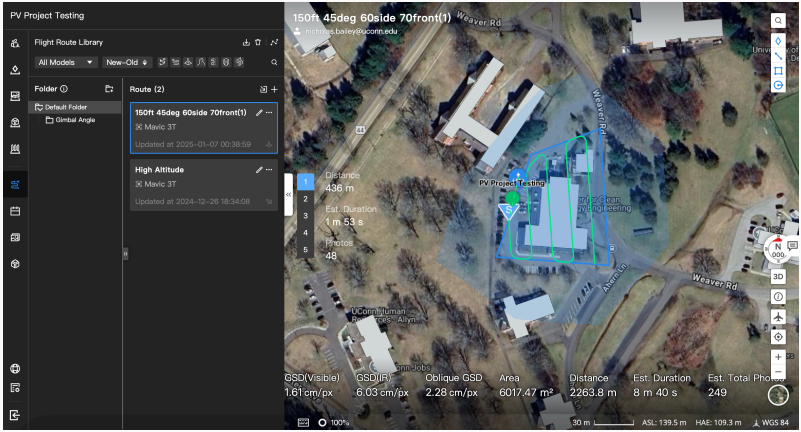

Figure 6: DJI Flighthub Software

Flight Paths

Figure 7: Five flight paths necessary for 3D model

DJI Thernal SDK

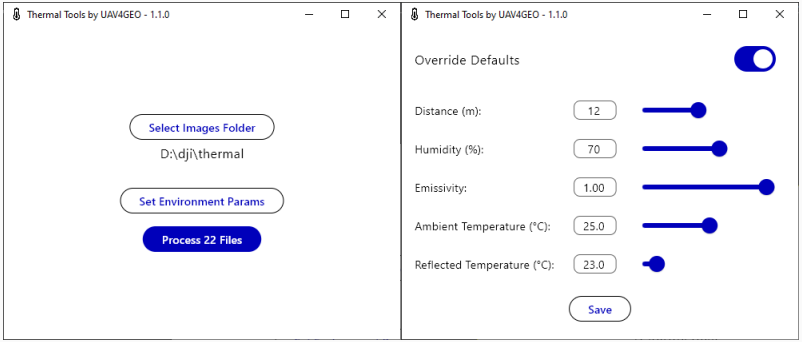

Figure 8: Thermal Tools (Wrapper for DJI SDK)

WebODM

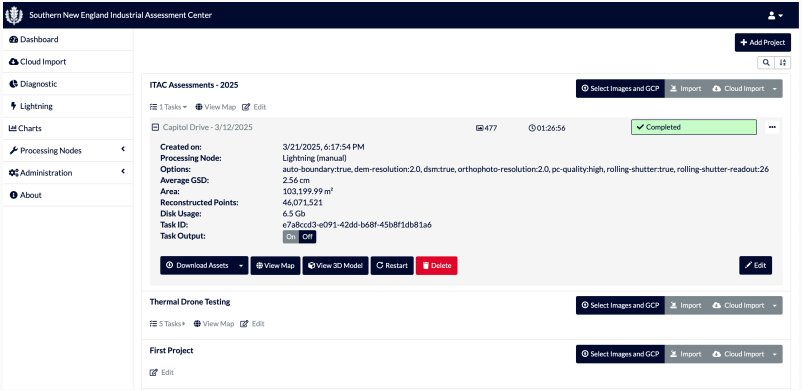

Figure 9: SNE-ITAC Implementation of WebODM

- Custom implementation
- Processing done via WebODM Lightning

Potree

Figure 10: 3D and 2D views on Potree