

# Thermal Remote Sensing

## Drone - DJI Mavic Enterprise 3 Thermal

- <https://enterprise.dji.com/de/mavic-3-enterprise>
- <https://copterpro.de/shop/drohnen-komplettsets/djimavic3enterprise/>

## Calibration Field Targets

- Prior to + after flight measure targets with handheld thermometer. Or place thermocouples + logger under panels!?
- 30×30 cm ?
- Unknown emissivity measurement:
  - <https://www.calex.co.uk/find-correct-emissivity-setting-infrared-temperature-sensor/>
- **High-emissivity**
  - Matte black-painted aluminum
  - $\epsilon \approx 0.97$
  - Purpose: Temperature reference
  - **Coatings / Foils:**
    - <https://www.nextel-coating.com/de/shop/artikel/nextel-velvet-coating-811-21-9218-schwarz>
    - <https://de.acktar.com/tiefschwarz-beschichtete-folien-filme-2/>
- **Low-emissivity**
  - Polished aluminum sheet
  - $\epsilon \approx 0.04-0.06$
  - Purpose: Reflected apparent temperature


## IR Thermometers

- <https://www.conrad.com/en/p/fluke-566-ir-thermometer-display-thermometer-30-1-40-650-c-contact-measurement-122370.html>
- <https://www.voelkner.de/products/542871/Fluke-568EX-Infrarot-Thermometer-Optik-501-40-800-C-Kontaktmessung.html>
- [https://www.reichelt.de/de/de/shop/produkt/infrarot-thermometer\\_568\\_ir\\_und\\_kontakt\\_-40\\_bis\\_800\\_c-110173](https://www.reichelt.de/de/de/shop/produkt/infrarot-thermometer_568_ir_und_kontakt_-40_bis_800_c-110173)
- **Calibration:**
  - <https://www.fluke.com/de-de/mehr-erfahren/blog/kalibrierung/infrared-thermometer-calibration>

## Lab Temperature Calibration (potential field use?)

- <https://www.conrad.de/de/p/voltcraft-irs-350-kalibrator-kalibriert-iso-2236161.html>
- <https://www.messbar.de/kalibrierstrahler-optris-br400-fuer-waermebildkamas>
- <https://www.messbar.de/Optris-BR20AR-Referenzstrahler>

## Research Papers

- WUR  Calibration + Processing
  - <https://www.sciencedirect.com/science/article/pii/S1569843224005405>
- <https://www.sciencedirect.com/science/article/pii/S1569843224005405>
- <https://www.mdpi.com/2072-4292/17/15/2746>
- DJI Thermal Format Conversion
  - <https://www.mdpi.com/1424-8220/24/19/6267>
- <https://www.sciencedirect.com/science/article/abs/pii/S1350449523001998>

## Software / Code

- [https://github.com/DanGeospatial/dji\\_m3t\\_rpeg\\_to\\_tif/](https://github.com/DanGeospatial/dji_m3t_rpeg_to_tif/)
- <https://www.dji.com/de/downloads/softwares/dji-dtat3>
- <https://www.dji.com/de/downloads/softwares/dji-thermal-sdk>
- [https://github.com/SanNianYiSi/thermal\\_parser](https://github.com/SanNianYiSi/thermal_parser)
- <https://docs.webodm.net/how-to/process-thermal-images/>
- <https://webodm.net/thermaltools>

## ☐ IDEAS

- Use a Sous Vide (keeps temp stable) in a pot for experiment flights
  - Maybe two? one for low temp one high

## Must do's for data acquisition

- [https://dl.djicdn.com/downloads/zenmuse\\_xt/en/sUAS\\_Radiometry\\_Technical\\_Note.pdf](https://dl.djicdn.com/downloads/zenmuse_xt/en/sUAS_Radiometry_Technical_Note.pdf)

## Leaf Temperature Measurement for Validation

- Example: <https://www.implexx.io/temperature/leaf-temperature-sensor/>
- Thermocouple on a clamp
- Use thermocouple of IR-Thermometer
- 3D-Printed clamp: <https://www.printables.com/model/974751-clamp-print-in-place>



## Field Mission Sheet

### • Pre-Flight

- Record air temperature, relative humidity, wind speed.
- Measure true temperature of high-emissivity target (IR thermometer or thermocouple).
- Measure apparent temperature of low-emissivity target (reflected sky).
- **Set camera:**
  - Emissivity = 0.98
  - Reflected temperature = from low- $\epsilon$  target
  - Atmospheric temp = air temp
  - RH = measured RH
  - Image type = radiometric JPEG/TIFF

### • In-Flight

- Hover ~10 m for 30 s (thermal stabilization).
- Capture targets at start of mission (low altitude, nadir view).
- Fly survey (consistent height/speed).
- Re-capture targets at end of mission.
- Log times, environmental data.

### • Post-Flight Processing

- Extract target pixel temperatures.
- Apply correction to thermal mosaic.
- Validate canopy temps vs spot measurements.

From:

<https://wiki.eolab.de/> - **HSRW EOLab Wiki**

Permanent link:

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