MUAS Night Flight Considerations

Micro-UAS Remote Pilot Course

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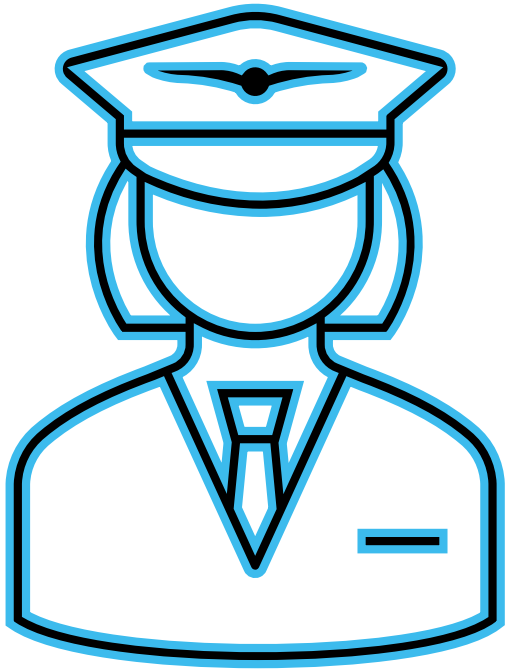
Aim

To introduce night flying concepts which will aid in your understanding of M-UAS ISR operations.

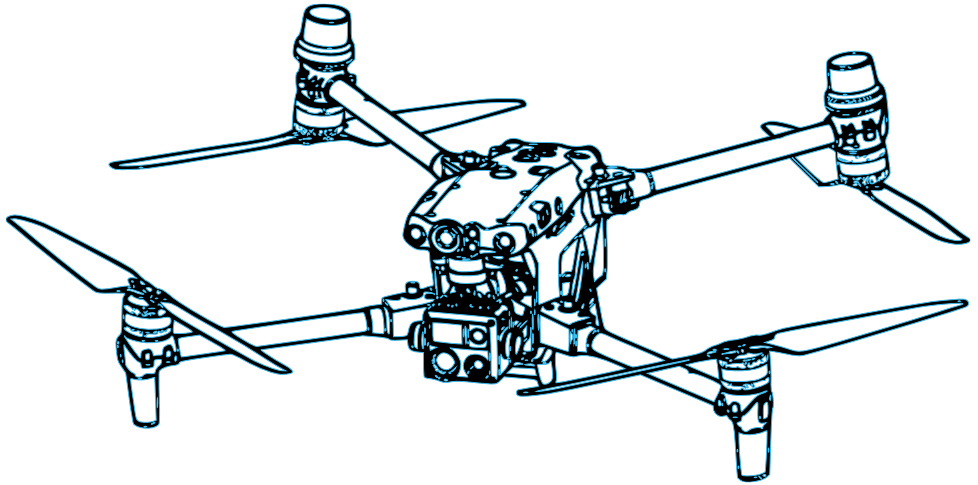


Learning Objectives

1. **Night Operations Fundamentals:** Understand the concepts of night operations with micro UAS
2. **Micro-UAS Sensors and Accessories:** To learn how to use the EO&IR systems and other accessories in micro-UAS during night operations

Why is this important for me?

- Understand how UAS EO&IR payloads and accessories work at night time
- Support the mission / team / leadership
- Ensure the capability is operated professionally



Agenda

1. Night Operations with Micro-UAS
2. UAS EO & IR Sensors and Accessories Settings for Night Flying
3. Summary

Night Operations with Micro-UAS: Use Cases

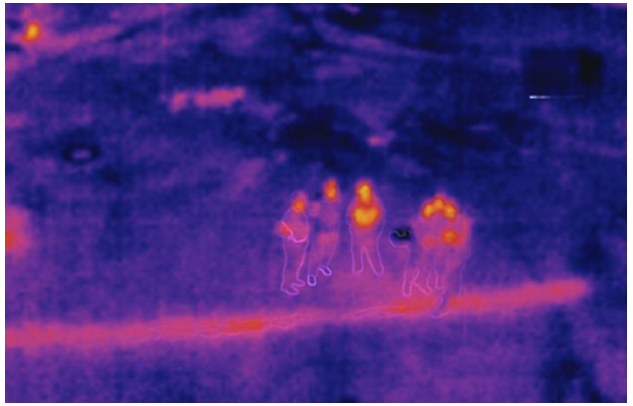
- Base protection
- Main supply route
- Vulnerable point reconnaissance
- IDP Camp Monitoring
- Force protection
- Protection of Civilians
- Convoy over watch
- Border surveillance
- Battle damage assessment

Night Operations with Micro UAS

What to look for in the scenarios?

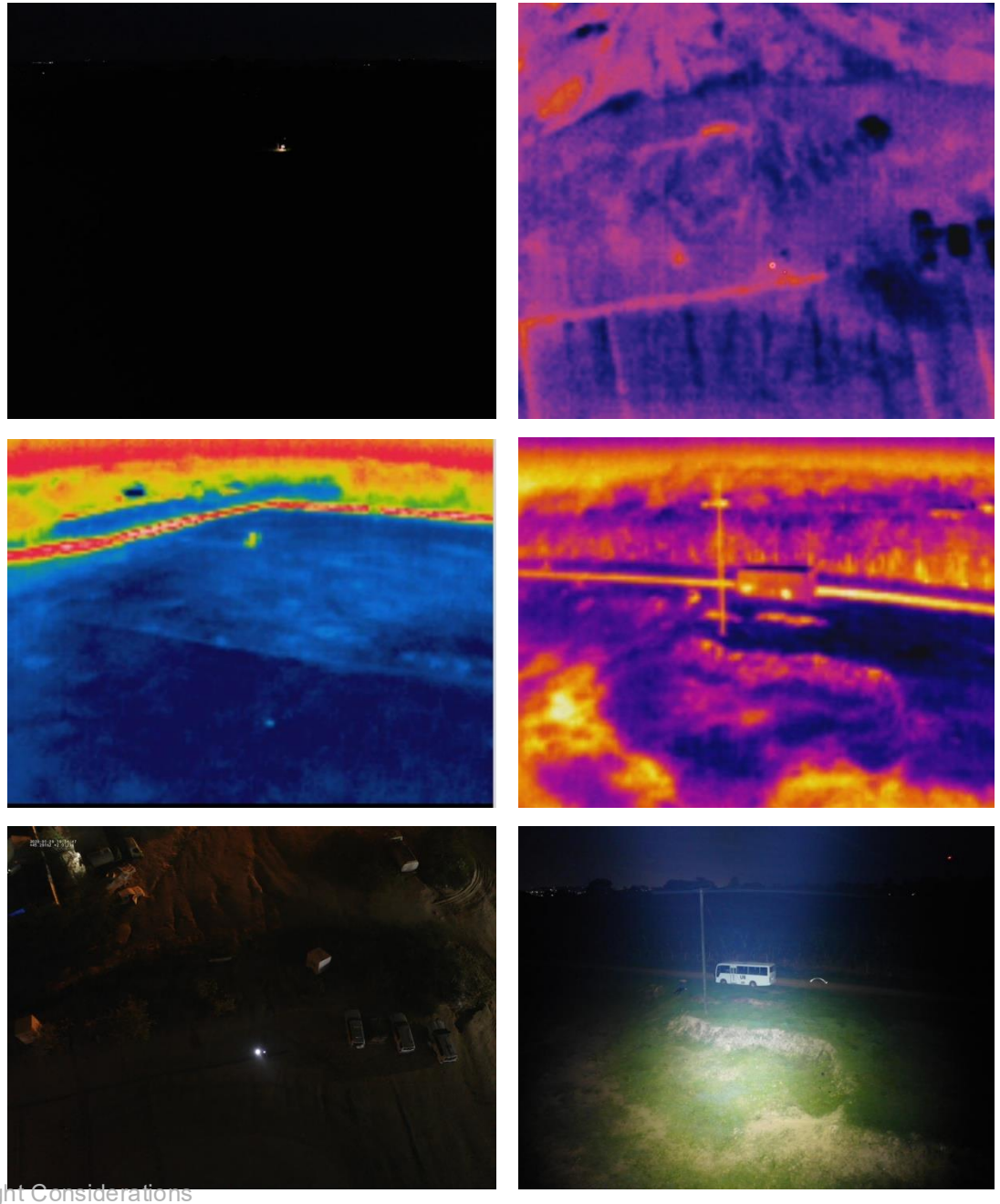
- Each scenario is different.
- Consider the objects and potential threats.
  - IED & Mines

What to look for in the scenarios?

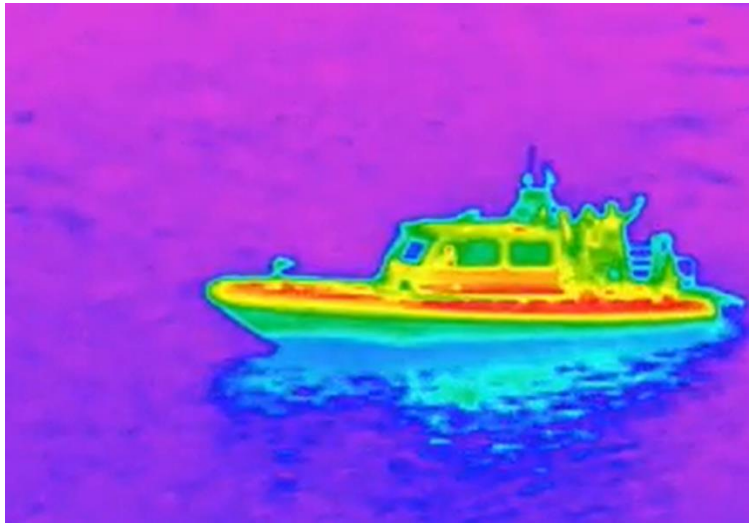


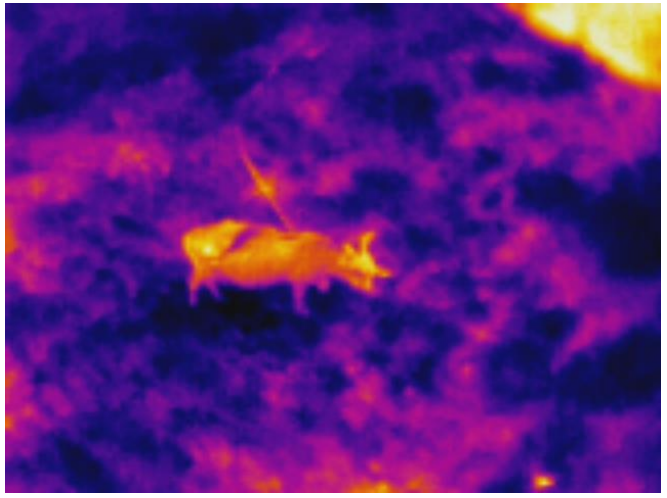


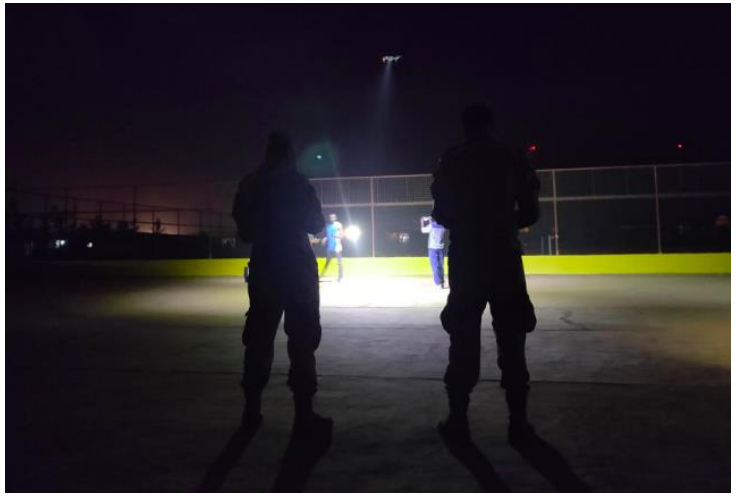
Typical Scenarios



Night Operations with Micro UAS: Typical Scenarios

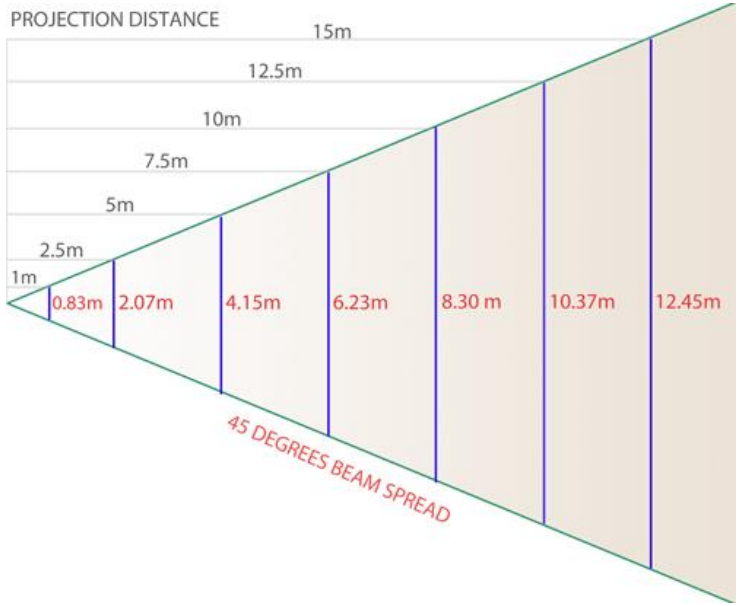


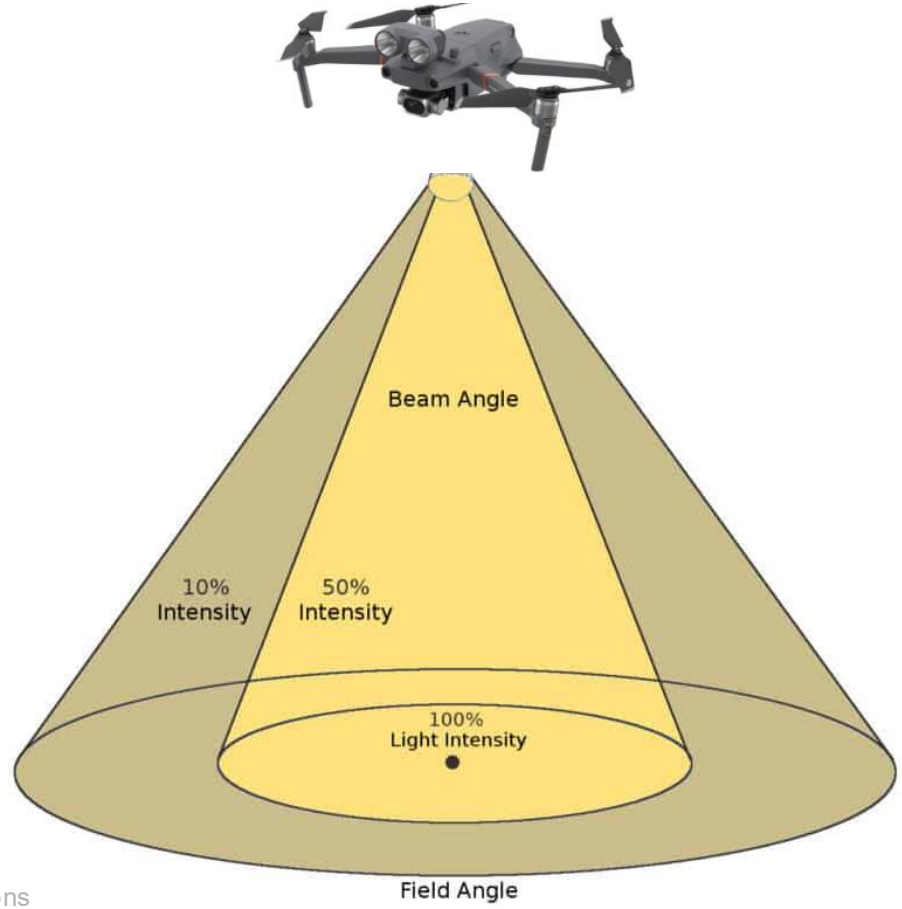




UAS EO&IR Sensors and Accessories

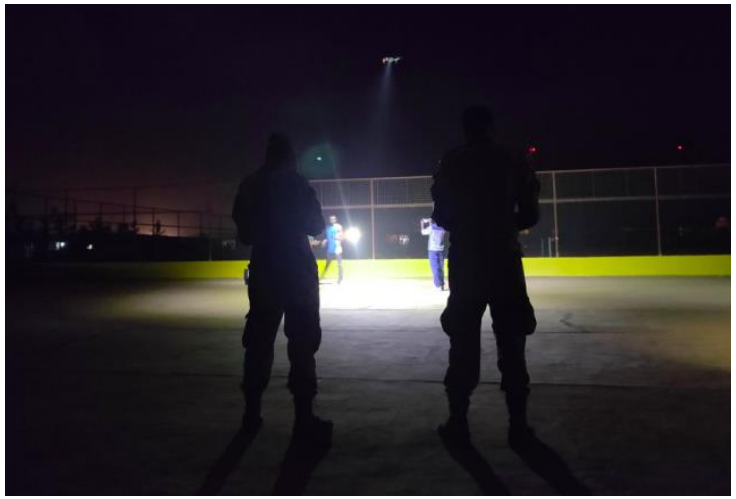
- Spotlight
- Beam angle
- Projection distance





UAS Night Operations with EO&IR Sensors and Accessories

Max Hovering Time	29 min (no wind) 27 min (with beacon turned on) 28 min (with beacon turned off) 22 min (with spotlight turned on) 26 min (with spotlight turned off) 25 min (with speaker turned on) 26 min (with speaker turned off)



Night operations with micro UAS

UAS Night operations with EO&IR sensors and accessories

Covert mode:

Navigation lights off.

No loudspeaker.

No spotlight.

EO&IR cameras on.

High altitude profile

Deterrent mode:

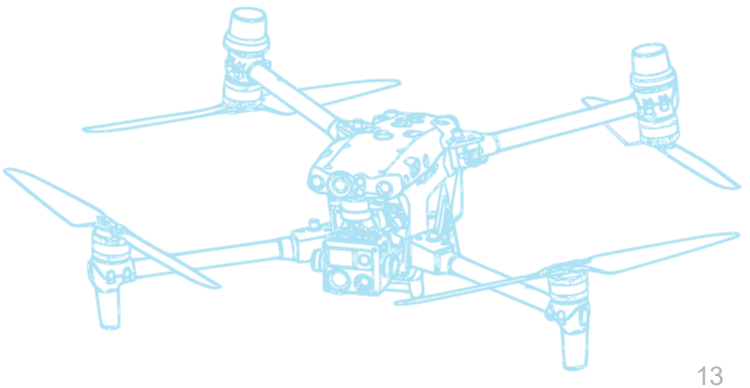
Navigation lights on.

Loudspeaker on.

Spotlight on.

EO&IR cameras on.

Variable altitude profile.



Night operations with micro UAS

UAS Night operations with EO&IR sensors and accessories

Human Temperature Detection:

IR camera

Background and foreground temperature

Nighttime @ different seasons

use different Pallets

Set up isotherm

Camp Intruder Overwatch:

EO&IR cameras switching

Navigation lights on

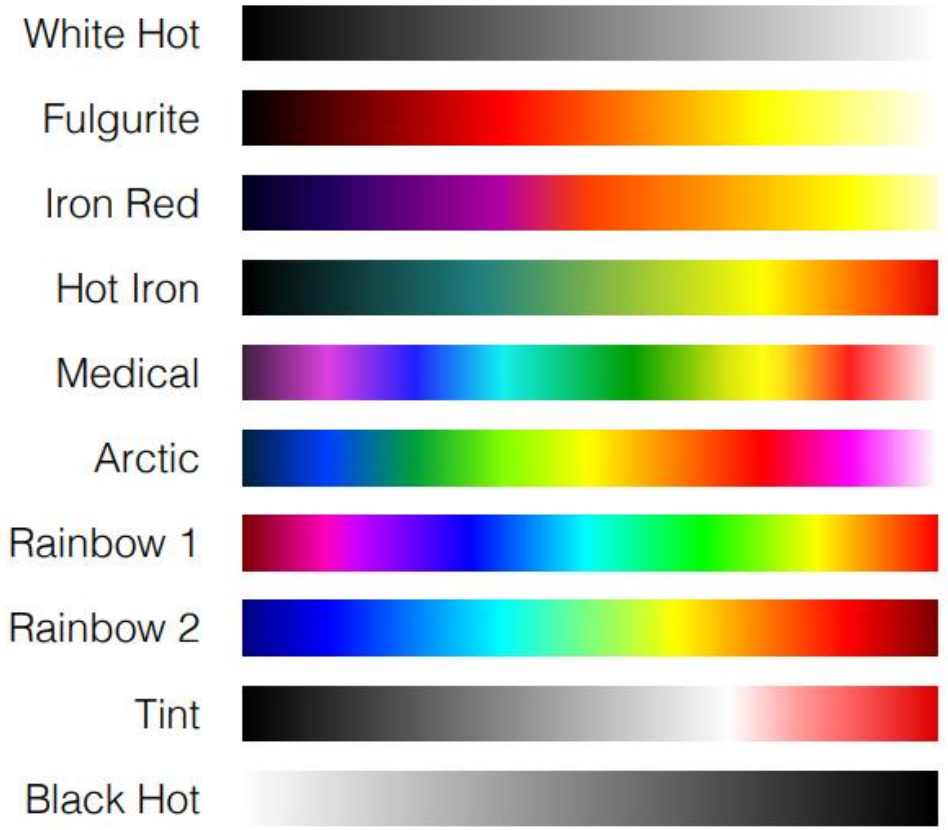
Loudspeaker on

Spotlight on

Variable altitude profile (light spread effect)

Palettes

- Use distinct color to show temperature difference
- 256 colors
- Displayed in 8-bit JPEG

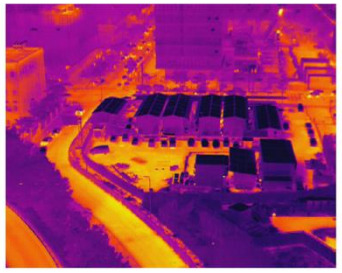


Palettes

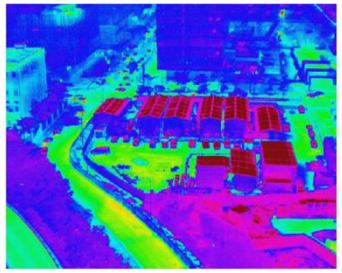
White Hot

Black Hot

Iron Red



Rainbow 1



Palette	Description
White Hot	The most commonly used pseudo color, using white for high temperatures and black for low temperatures, which is a natural association for people.
Fulgurite	Dark red represents low temperatures and white represents high temperatures. The warm tone of this palette aligns with people's association with hot temperatures.
Iron Red	This palette displays nuanced differences in heat signatures, quickly displaying anomalies and human bodies. Hotter objects appear as light warm colors and colder objects appear as dark cool colors.
Hot Iron	Red represents high temperatures, and cool colors represent low temperatures. It is able to identify hot targets quickly, while showing the details of cool targets.
Medical	This palette shows nuanced differences in temperatures, and is therefore ideal for scenarios with small temperature changes. In environments with low contrast, it is still able to detect objects and slight temperature changes. It is mainly used in the medical field for human body temperatures.
Arctic	Uses the same palette as Medical, except switching the purple for a cool blue to better reflect temperature changes.

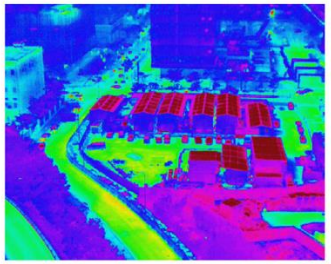
Palettes

White Hot

Black Hot

Iron Red

Rainbow 1



Rainbow 1	Similar to Medical, it reduces the warm color ratio and increases the cold color ratio for high temperature targets to better show the details of cool targets.
Rainbow 2	The color transition is reduced, the warm and cold colors are moderately proportioned, which can show the details of high and low temperature targets at the same time.
Tint	Uses black and white for low temperatures and bright red for high temperatures, it is able to detect high temperature targets quickly. Mainly used for high-contrast environments, ideal for quickly and accurately identifying high temperature targets at night.
Black Hot	The opposite to White Hot, using black for warmer objects and white for cooler objects. The heat distribution of high temperature targets can be better observed when outdoors.

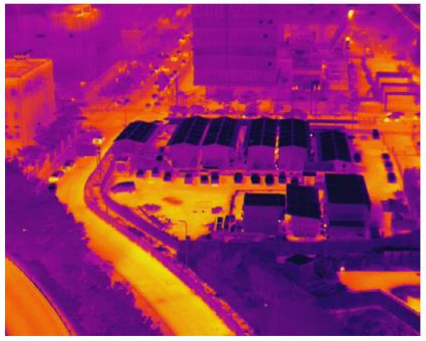
Demo

- Taking and IR Picture
- DJI Thermal analysis tool

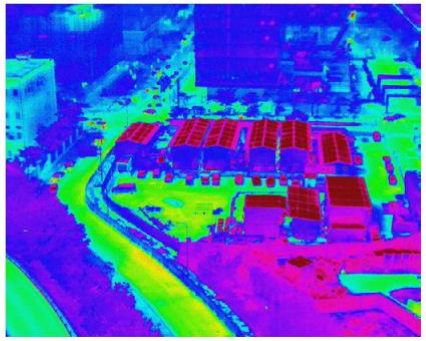
White Hot

Black Hot

Iron Red

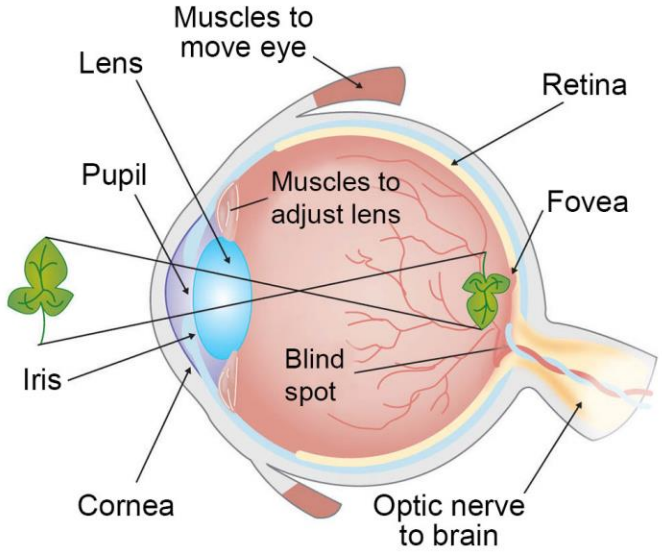


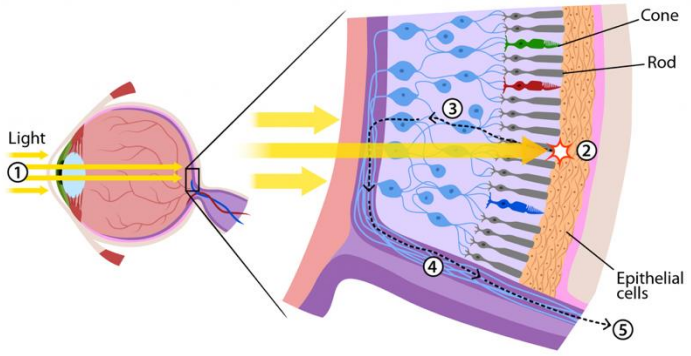
Rainbow 1



Night Operation

- Regulatory requirement
- Vision in flight
  - Primary source of info
  - Like camera
  - Optic Nerves
  - Visual Illusions / Blind Spots
  - Cornea → lens
  - Cones / Rodes
- Day – in front
- Night – tilt your head





https://askabiologist.asu.edu/rods-and-cones

Night Operation

Do not stare at a bright light

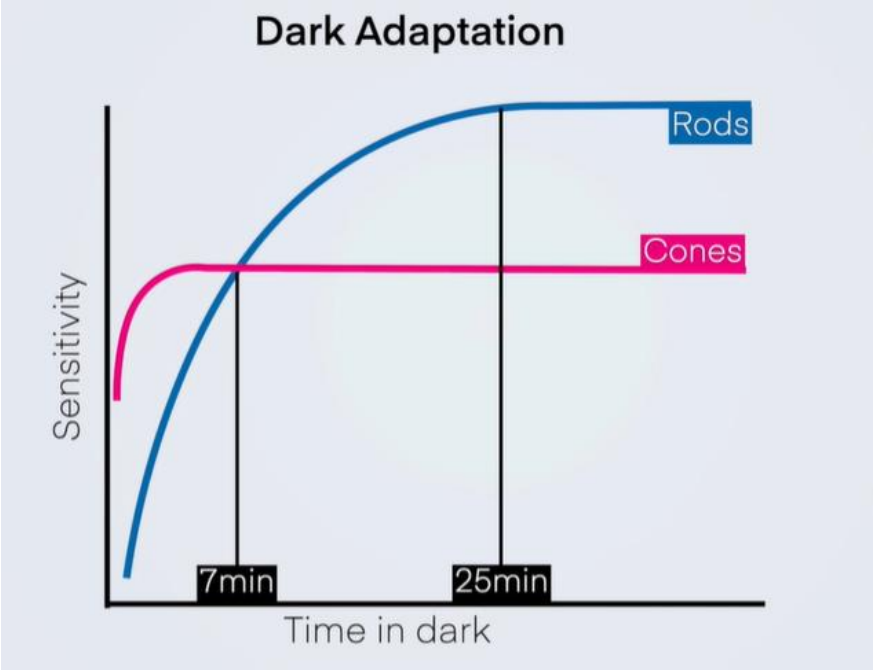
Do

Wear a sunglass in bright places

Turn the brightness down of controller / phones etc. …

Use red / green light

Keep your flashlight low



Stress

Night Ops are Fatiguing and Stressing

Additional

drug and alcohol

exhaustions

tobacco use

Night Operation

It is Difficult

- Distance Estimation
- Depth Perception

Night Illusions

- Autokinesis
- False Horizon
- Reversible perspective illusion
- Flicker Vertigo

Night Operation Tips

Planning

- Emergencies
- Strobe lights
- Potential obstacle
- Day visit
- RTH function
- vlos
- Spotlight
- Visual observer

Night Operation Losing Visual Line of Sight

Reason

- Obstacle
- Fog / cloud
- Navigation / strobe light off / broken
- Crash

What to do

- Stop
- Verify connectivity
- Check sensors information (camera / thermal)
- If safe climb
- Esc beeps

Summary

To obtain good results:

- **Training.**
- **Experience.**
- **Planning.**
- **Parameters Settings.**

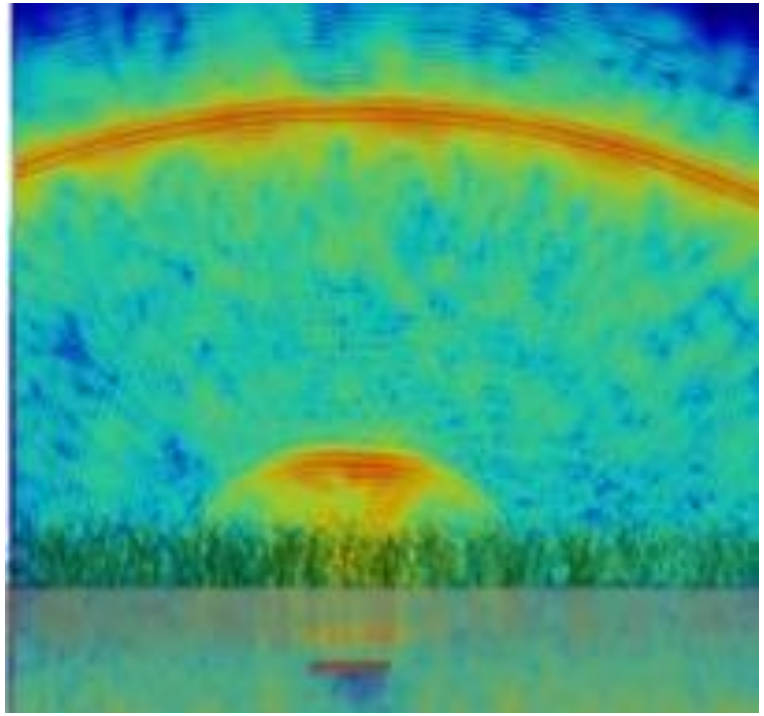
Some important factors:

- **Geography / Climate.**
- **Target signature**
- **Solar effects**

Questions?

FindMine

UAV-based Remote Sensing for Mine Detection



Thank You