PSURT UAS RPIC Level 2 Course

Instructor Guide

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The vision of the participating departments and agencies is to create baselines for emerging technologies and standards for integrating them into existing emergency response, establish coordination between private and public, local and regional stakeholders to bridge the gaps in resource and capability sharing, and increase situational awareness and incident command decisions at emergency scenes.

This document establishes standard guidelines for training UAS RPIC for departmental as well as multi-agency missions.

Contents

Introduction

This course is for UAS RPIC's who have:

- Already obtained their FAA Part 107 Remote Pilot certificate
- Completed the PSURT UAS RPIC Level 1 Course
- Several hours of daytime flight experience

Instructors should be knowledgeable about the types of missions to which law enforcement and emergency management personnel respond. It is recommended that, at a minimum, instructors have their FAA Part 107 Remote Pilot certificate and several hours of hands-on night flight experience on multiple small unmanned aircraft.

Thoroughly read through the Instructor Guide. Throughout the guide, there are instructor notes in gray boxes that contain additional information and tips for you. The student guides have the same format as the instructor guide but without the instructor notes.

Conduct a walk-through of the exercises and be prepared to answer any questions that the students may ask while completing the exercises.

While it is recommended that you teach all of the included material, you should add any additional information that is relevant to your community / department / agency.

Certification

At the successful completion of this course, the student may be certified as a PSURT UAS Level 2 RPIC on the specified aircraft. The certification is valid for one year from the test date.

Equipment

For ground school, you will need:

- A computer with PowerPoint and sound
- An aircraft with thermal / FLIR camera for each team
- An aircraft with spotlights for each team
- NIST Aerial Standard Test Methods course
- Student guides
- Printed supplements for each student:
  - FAA Pilot's Handbook of Aeronautical Knowledge, Chapter 17: Aeromedical Factors (pages 17-22 through 17-29) https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/
  - FAA Helicopter Flying Handbook, Chapter 13: Night Operations https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/
- RPIC Level 2 Checklists
- RPIC Certification Forms
- RPIC Course Evaluation Forms

The supplements and forms are included with the PSURT Program.

See the relevant hands-on training and scenarios for equipment needed for those activities.

Suggested Course Schedule

For the scenario-based training, each team will complete one scenario each session. Rotate the teams through the various scenarios.

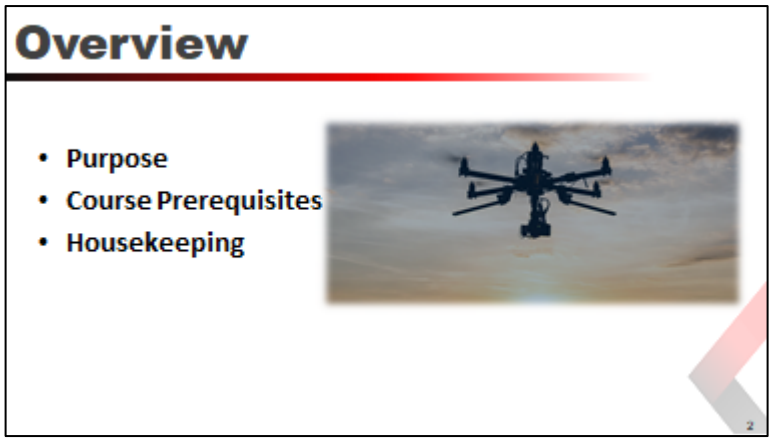
Night 1

- Ground school (2 hours)
- Hands-On Test: Basic Proficiency (1 hour)
- Scenario-based Training (1 hour)

Night 2

- Discussion / Guest Speaker (1 hour)
- Scenario-based Training (1 hour)
- Scenario-based Training (1 hour)
- Proficiency Test (1 hour)

Welcome and Overview



Purpose

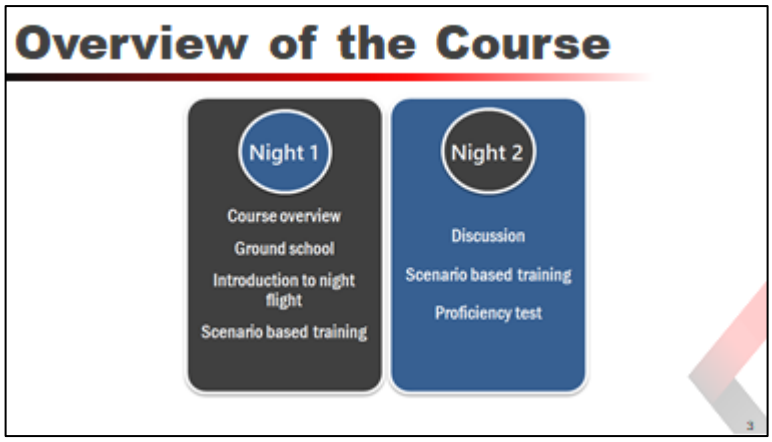
The purpose of the PSURT UAS RPIC Level 2 course is to provide emergency response personnel who have received their FAA Part 107 Remote Pilot certificate, and completed the PSURT UAS Level 1 Course, the training necessary to safely operate UAS at night.

Course Prerequisites

- The student must have their FAA Part 107 Remote Pilot certificate prior to attending the course.
- The student must have completed the PSURT UAS RPIC Level 1 Course.
- It is recommended that the student have at least five hours of logged day flights prior to attending this course.

Housekeeping

Cover any needed housekeeping topics, such as breaks and directions to the restroom.



Course Structure

This two-day program is divided into three main sections:

- Ground School
- Practical Training
- Proficiency Course

Ground School — The two-hour classroom ground school covers the following topics:

- Night Operations
- How the Eye Works
- Spatial Disorientation and Visual Illusions
- Improving Your Night Vision
- Thermographics

Practical Training — The hands on training course will provide the students with the practical experience to safely operate the UAS at night in the field. During the two days, students will learn how to operate the UAS safely in low light conditions and practice tactical scenarios.

Proficiency Course — Based on the *National Institute of Standards and Technology (NIST) Remote Pilot Proficiencies Using Standard Test Methods*, students are required to successfully pass a proficiency course. The course measures each student's ability to operate the UAS safely while demonstrating their ability to operate the UAS and the onboard camera in a variety of situations.

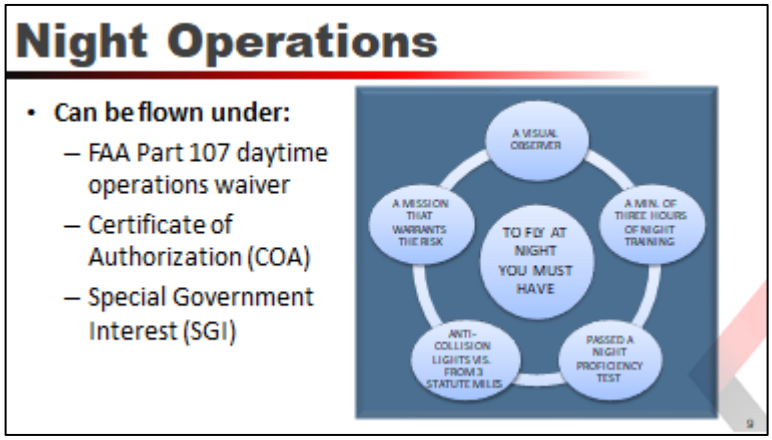
Instructor Note: Mention that the instructors for this five-day training program all have their FAA Part 107 Remote Pilot certificate. Have each instructor give a brief introduction.

Instructor Note: Before this lesson, assign students to teams.

Each certification is valid for one year from the date of the test, at which time the RPIC must recertify on each aircraft they fly. The recertification is a one-day class that includes ground school and a hands-on flight test.

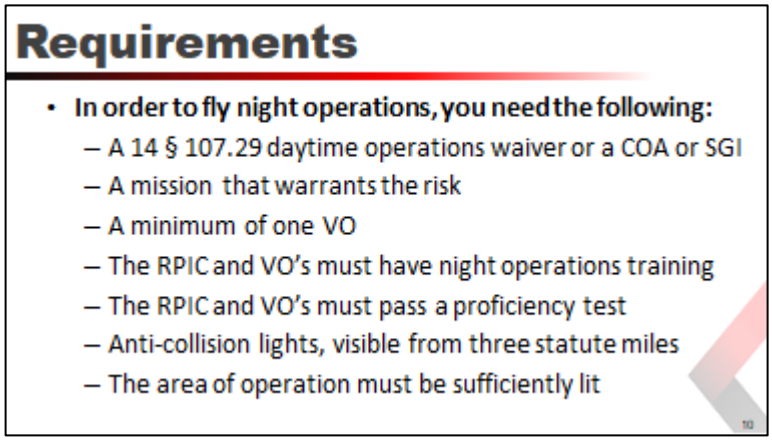
- Ground school covers rules and regulations that have changed in the past year, as well as new and revised best practices learnt in the field. In addition, the RPIC is required to pass a written test similar to the recurrent Part 107 test that includes questions about airspace, maps, weather, mission planning, FAA rules and regulations, among other topics. Both Level 1 and Level 2 RPIC's complete the test; however, there is an additional section in the test for Level 2 RPIC's to complete that covers night operations.
- The hands-on flight test is scenario-based using one or more of the scenarios in the Level 1 or Level 2 training courses.

UAS Night Operations



Night operations have unique challenges that require an understanding of how vision works at night as well as an increased understanding of the hazards and dangers involved.

The daytime operations waiver is for uncontrolled airspace (Class G). If you need to fly in controlled airspace, you must apply separately for airspace authorization if it is not included in your COA.

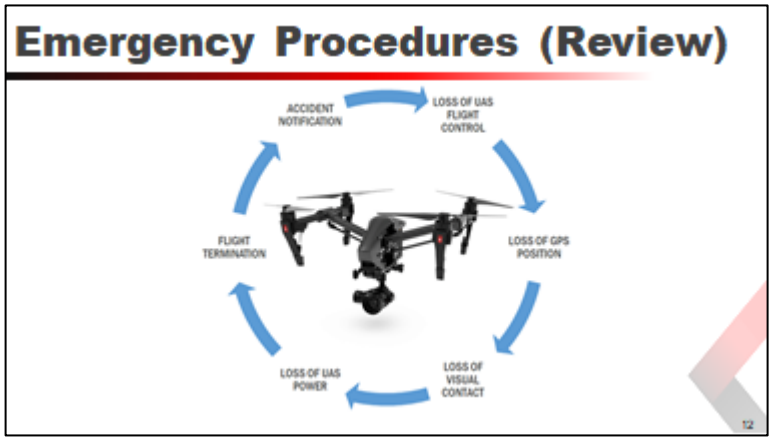


Night operations training and review should include:

- FAA Pilot's Handbook of Aeronautical Knowledge, Chapter 17: Aeromedical Factors (pages 17-22 through 17-29) https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/
- FAA Helicopter Flying Handbook, Chapter 13: Night Operations https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/
- Review FAA video, "FAA TV: Vision in Aviation" (https://www.faa.gov/tv/?mediaId=467)
- Proficiency Test just prior to the mission

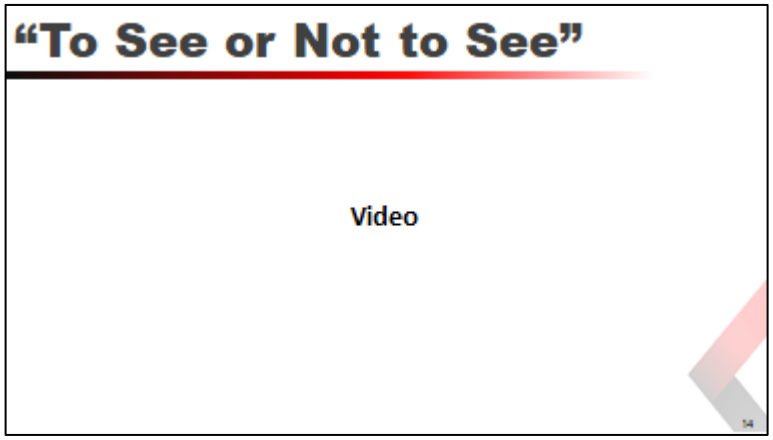
> **Note:** See Proficiency Test Example.

Instructor Note: Students should have learnt about these topics in the PSURT UAS RPIC Level 1 Course and from flying missions. Review by asking questions such as, “What do we need to take into account for <category> when planning a mission?



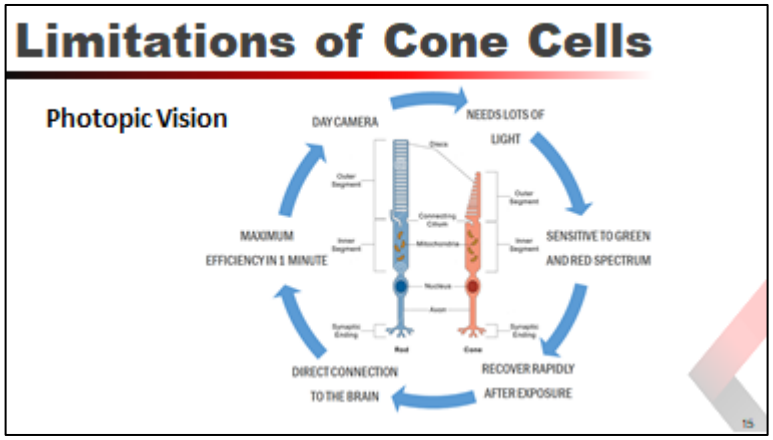
Instructor Note: Students should have learnt about this topic in the PSURT UAS RPIC Level 1 Course and from flying missions. Review by asking questions such as, “What do we need to do for <category>?

How the Eye Works



Instructor Note: This is a 15-minute video. After watching, use the next few slides to review what was covered in the video.

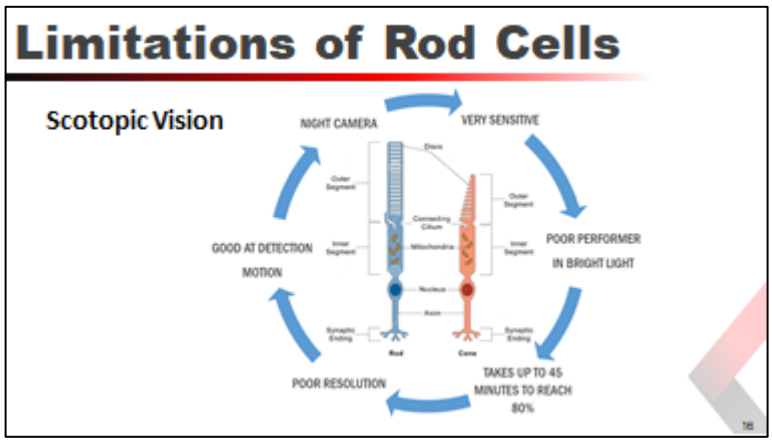
Limitations of Cone Cells (Our Day Camera)



Photopic vision or cone vision is like a camera with very slow film. It can shoot pictures very quickly in the right light but produces poor out of focus pictures in dim light.

- Needs lots of light (works poorly in low light levels)
- Are most sensitive to light in the green to red spectrum
- 580 nm range (predominately adjusted to sunlight)
- Highest concentration of cells (green and red)
- Can discern some contrast below color threshold
- Recover rapidly after exposure (100 times faster than rod cells)
- Direct connection to the brain via their dedicated ganglion cells
- Can reach maximum efficiency in less than one minute

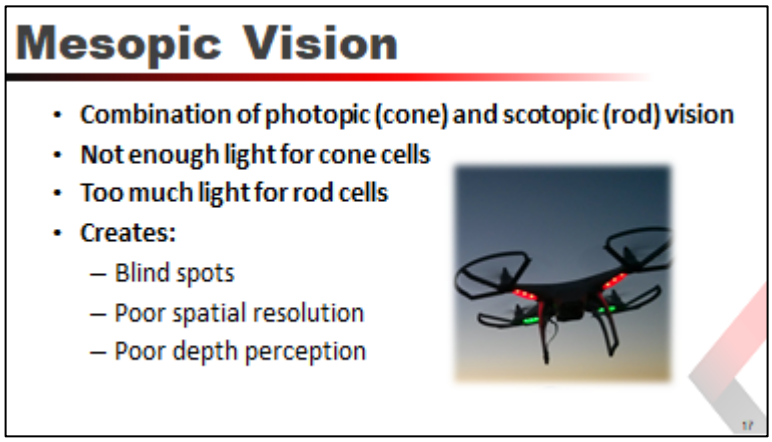
Limitations of Rod Cells (Our Night Camera)

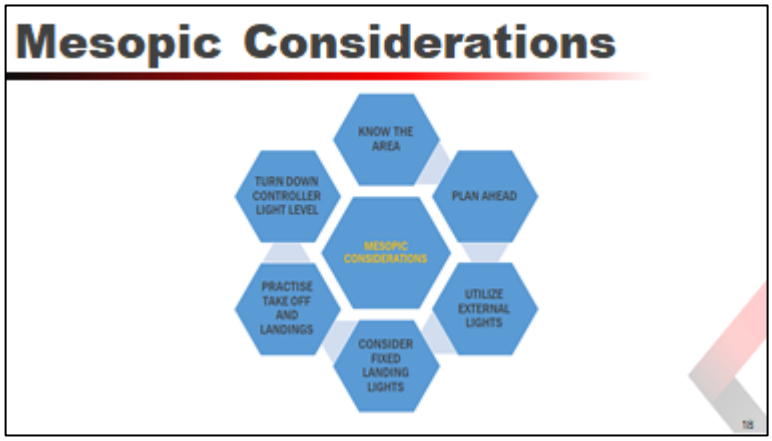


Scotopic vision or rod vision is like a camera with very fast film. Too much light will overexpose the film. It produces low resolution, poor detail images.

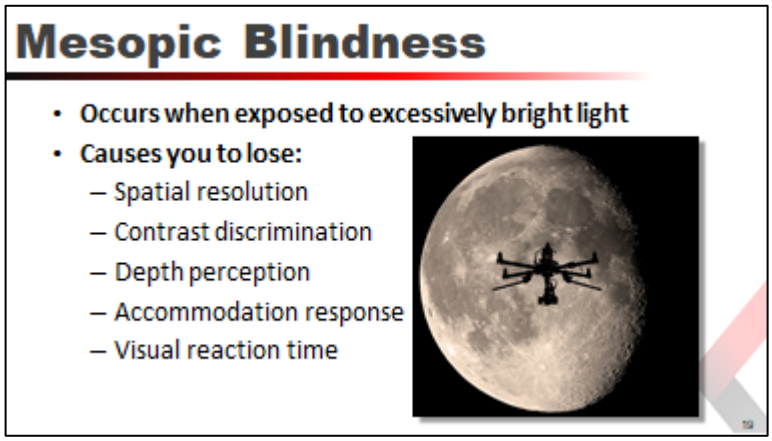
- Poor performer in bright conditions (overexposed picture)
- Most sensitive about 507 nm (moonlight has the same spectrum as sun light)
- Good at detecting motion
- Fires quickly (1/1000 of a sec) but recovers very slowly (1/5 sec)
- Has no direct Ganglion cell and many use the same pathway
- Takes as much as 45 minutes to reach 80% capability
- Multiple cells connect through a single connection (poor resolution)

Mesopic Vision





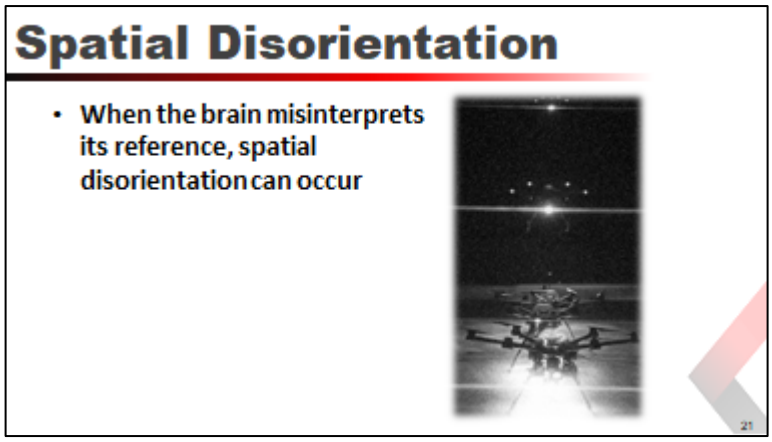
Know the area and plan ahead	Study the area you are going to operate in identifying a takeoff/landing point free of shadows. Define minimum altitudes prior to the mission to minimize risk
Utilize external lights	Have available a lighting source to illuminate your LZ. Fly from an area that is free from flashing lights, headlights or other variable light sources.
Consider fixed landing lights	Fixed landing lights can illuminate your LZ and in an emergency provide lighting directly below the aircraft.
Practice taking off and landing	Prior to the mission test your LZ to ensure you have adequate lighting to take off and land safely, if not, reposition your LZ and test again.
Turn down controller light level	Reducing the brightness level on your controller (Crystal Sky, iPad, and so on) will reduce the strain on your eyes and allow them to compensate for the low light levels more easily.



If, during low light conditions, you are exposed to excessively bright lights, your central vision will be blind and the rod cells will be bleached for several minutes.

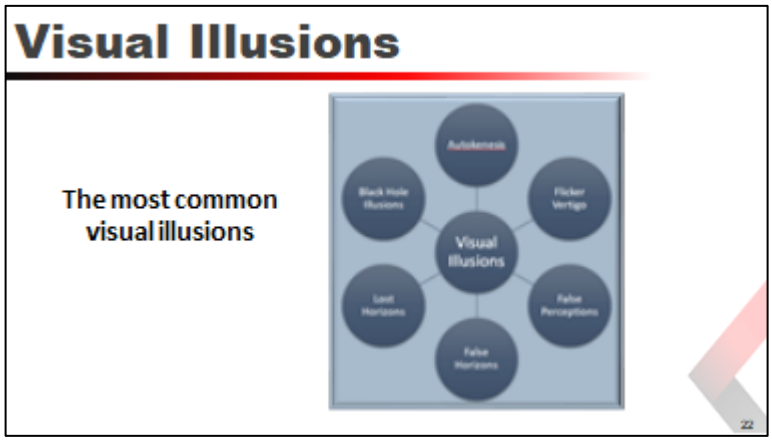
If this occurs, put the aircraft in a safe hover and allow your vision to recover.

Spatial Disorientation and Visual Illusions



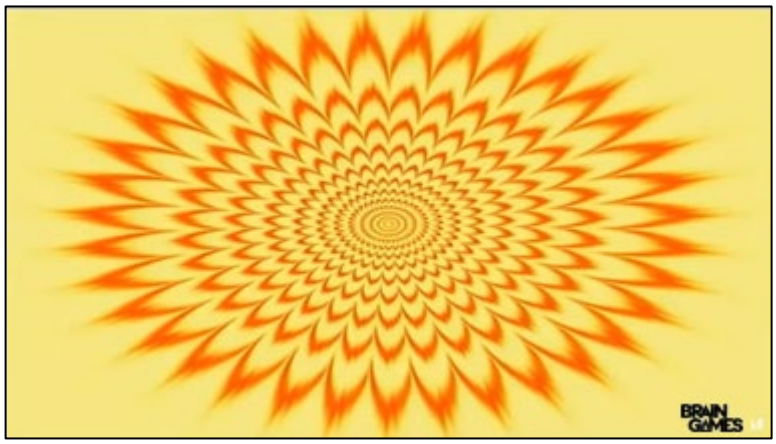
It is important to remember that the brain has to interpret the scenes based upon certain rules and criteria that have been learned over the experience of the person. When the brain misinterprets its reference, spatial disorientation can occur.

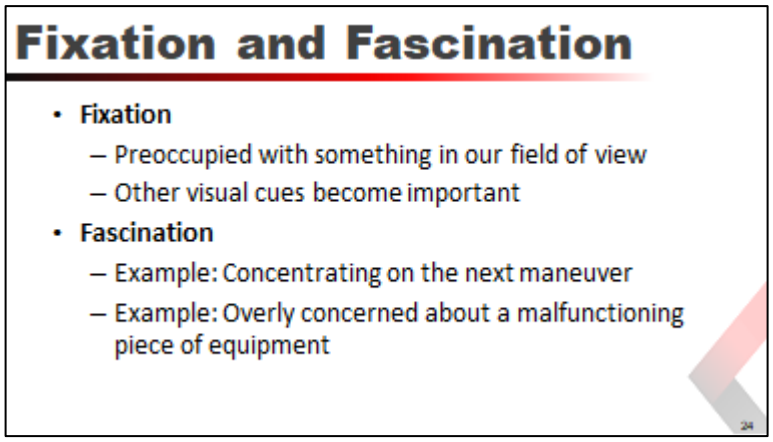
You need to recognize where these misinterpretations are most likely to occur and to be prepared for such instances.



Autokenesis	The movement of a single light when stared at for a period of time caused by the brain attempting to isolate the light within the visual field. The eye and brain are turning on and off bipolars and ganglion cells in an attempt to establish reference and edges. Mitigate by focusing your eyes at varying distances, and increasing the speed of visual scanning.
Flicker Vertigo	This is more a condition than an illusion. It is caused by flicker lights at a steady rhythm and can induce nausea or dizziness. Mitigate with continual scanning.
False Perceptions	Lack of distant horizon. The brain references the horizon to determine it's "up" condition. Without a visible or detectable horizon, the brain can lose it reference.
False Horizons	Believing a line of sight (lights along a road, lights along a coastline, or clouds) is the actual horizon when it is not. This leads to spatial disorientation.
Lost Horizons	Turning from a brightly lit area to a dark area causes the loss of a dark horizon. If the RPIC is in a takeoff rotation, or making a turn when the lights are extinguished, spatial disorientation could ensue.
Black Hole Syndrome / Black Hole Approach	Can occur at airports where there is darkness between you and the lit runway environment, with an obscured horizon (such as when the airport lighting drives the central vision and the dark horizon is lost to the peripheral retina).

Example of Autokenesis





We become visually fixated in flight when our central vision becomes preoccupied with something in our field of view or when other cues which our visual system has chosen to ignore are of more importance.

We become so mentally fascinated with something in flight, such as concentrating hard on the next maneuver, that we forget to fly. This also happens when we become overly concerned about some light activation or malfunctioning piece of equipment.

Improving Your Night Vision

Rest and Sleep Cycles

- Changes to the natural day night cycle can cause sleep disruptions, fatigue, irritability, loss of appetite, and judgement alterations
- Improving your rest and sleep cycles indirectly improves your night vision capabilities.

Circadian cycles in humans are triggered by special ganglion cells connected to the brain that are regulated by exposure to sunlight.

These ganglion cells regulate the supra chiasmatic nucleus which is the time keeper in the brain.

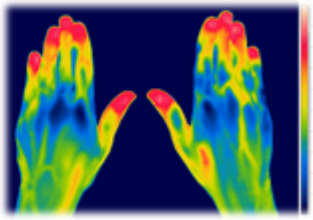
Nutrition

- Improve night vision through nutrition

Thermographics

Thermography

- A technique for detecting and measuring variations in the heat emitted by various objects and people and transforming them into visible signals that can be recorded photographically



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Thermal vs. FLIR

- **Thermal**
  - Passive and only senses differences in heat
  - Mid to long wavelength infrared energy
- **FLIR (Forward-Looking Infrared Radar)**
  - Illuminates the area
  - Identifies objects by heat differences
  - Short wavelength infrared light

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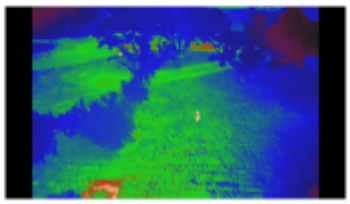
FLIR is slightly different from thermal imaging in that thermal imaging cameras are passive and only sense differences in heat. FLIR systems use the infrared light to illuminate an area as well as identify objects by heat differences. This type of system is useful in search and rescue missions, large fires (especially in defensive modes), wildland fires, hazardous materials and just about any other scene where an elevated thermal image would be helpful.

- Spot metering and area measurement
- Isotherm mode
- Temperature alert
- Photo / video mode
- Region of Interest (ROI)
- Palette

FLIR Camera Footage

This footage was taken at 400 feet with a DJI Zenmuse XT 30Hz 640x512 13mm camera to demonstrate some of the camera settings



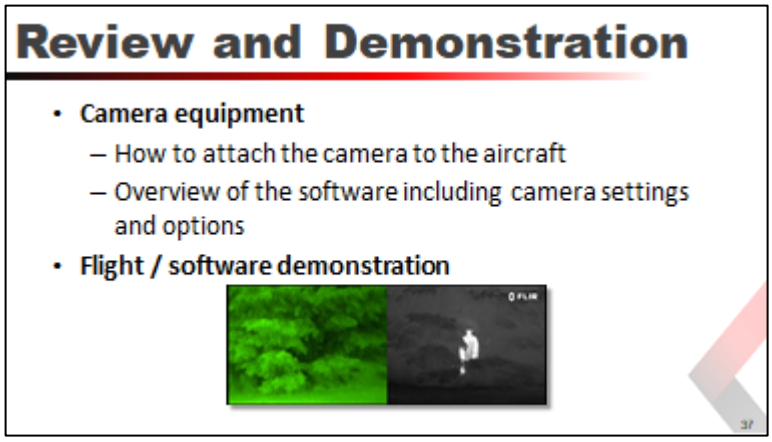
Camera Settings

- Spot Metering
- Isotherm / Color Alarm
- Area Measurement
- Temperature Alert
- Region of Interest (ROI)
- Thermal Palette
- MSX (Multi-Spectral Dynamic Imaging)

Different cameras include different features. These are some common settings:

Spot Metering	Measure temperature, within a few degrees, of a small area
Isotherm / Color Alarm	Designate temperature ranges represented by different colors. Highlight a specific temperature level; grays out all other temperatures
Area Measurement	Display average, low, and high temperatures
Temperature Alert	Display on-screen notification when highest temperature exceeds your specified value
Region of Interest (ROI)	Maximize contrast for regions of highest interest. Example, exclude sky
Thermal Palette	Different color choices to improve contrast, depending on the type of image you are viewing
MSX (Multi-Spectral Dynamic Imaging)	Adds visible light details for greater clarity

Camera and Software Demonstration



Instructor Note: Customize this topic to include the settings on the camera you are using for training.

Instruction and demonstration on the camera controls and settings, including:

- Spot metering and area measurement
- Isotherm mode
- Temperature alert
- Photo / video mode
- Region of Interest (ROI)
- Palette

Pre-Flight Quiz

Pre-Flight Quiz

- Prior to a night mission, the RPIC and VO's should complete a pre-flight quiz.
- Before the hands-on portion of the class begins, you have 10 minutes to complete the quiz and then we will review it together.

Hands-On Test: Basic Proficiency

Prior to beginning scenario-based training, students will demonstrate their ability to safely and proficiently operate the UAS at night by completing the following without assistance:

- Set up the mission area and landing zone to ensure:
  - A designated cordoned space for sage takeoffs and landings
  - Proper and adequate lighting for takeoffs and landings
- Perform a preflight inspection
- Power on the controller
- Power on the aircraft
- Connect the flight display and start the flight software
- Set up and turn on the strobe lights required for night operations

Students will conduct a series of flights at a variety of altitudes per the instructor's directions.

Students will demonstrate the ability to adjust the thermal / FLIR camera controls and settings, including taking stills and video, and SD card management.

Hands-On Training: Scenario-Based

Instructor Note: Prior to each scenario being performed, student RPIC's shall demonstrate the ability to perform a proper and thorough preflight inspection of the UAS. Student RPIC's will demonstrate the ability to assess the situation, identify hazards and communicate effectively with the entire UAS team. Scenarios are not timed and students are encouraged to take their time to accomplish the mission objectives. If battery changes are required during the mission, the UAS team will communicate a plan to accomplish the landing and battery change as safely as possible.

During the course of scenario-based training, students will be randomly tested on their ability to safely and effectively handle emergency situations including:

- Flight display failure
- Flight display cable failure
- Loss of VLOS
- Lost link video
- Lost link telemetry
- Loss of aircraft position

This section includes three scenarios:

- Scenario 1: Search and Identify
  - Scenario 1a: Suspect (Law Enforcement)
  - Scenario 1b: HAZMAT Event (Emergency Response)
- Scenario 2a: Track Suspect (Law Enforcement)
- Scenario 2b: Locate Alzheimer's Patient (Emergency Response)
- Scenario 3: Search and Rescue

Scenario 1a: Search and Identify (Law Enforcement)

Suspect	
Props:	Vehicle, License Plates, Gun, Hat, Evidence
Flight Time:	Each RPIC should get one hour of flight time during the scenario.
Scenario:	It is believed that a homicide suspect is hiding in his truck surrounded by brush. A helicopter crew was dispatched to locate the vehicle. The crew located the vehicle but due to limitations of thermal cameras was unable to see inside the windows. Shortly after they located the vehicle, the weather conditions required that the helicopter return to base. UAS team is called to attempt to determine if the suspect is still in the vehicle and assist ground units in approaching the vehicle.
Student Actions:	RPIC #1 operates an aircraft with a thermal camera. RPIC #2 operates an aircraft with a spot light in order to ascertain the location of the suspect. 1. Two RPIC's launch from the designated coordinates and locate the vehicle based on the GPS coordinates relayed by the helicopter crew. 2. After RPIC #1 has located the vehicle with the thermal camera, RPIC #2 utilizes RPIC #1's display to safely lower the aircraft into position, providing a view inside the driver's side window. 3. After confirmation of the suspect location is achieved, RPIC #2 flies around the vehicle and provides a description of the vehicle and any additional occupants. 4. RPIC #1 continues to provide overwatch of the scene. 5. After it is determined that there is no threat from the suspect, RPIC #1 guides ground units in to arrest the suspect. Non-flying students fill the role of visual observers. VO's simulate utilizing the UAS radio channel to relay pertinent information back to command. If the flight crew is enabled using DroneSense, VO's shall demonstrate the ability to access the Ops Center for viewing of video streaming and to assist with airspace deconfliction.
Expectations:	Students are expected to demonstrate the ability to effectively communicate and coordinate activities. Students must identify the primary (#1) RPIC and the secondary (#2) RPIC. Students must demonstrate the ability to properly maintain a safe altitude from each other. Utilizing the onboard thermal camera, students must demonstrate the ability to perform a search for a vehicle. Utilizing the camera and spotlight, students must demonstrate the ability to lower the aircraft into position around the vehicle to gain situational awareness.
After Action:	After all criteria have been met, both RPIC's safely land their aircraft and discuss the scenario with the instructor. Each student is required to be the primary and secondary RPIC in this scenario.

Scenario 1b: Search and Identify (Emergency Response)

HAZMAT Event

Props: Pickup truck, 55 gallon drums or hazardous material tote(s), HAZMAT placards, liquid to simulate spill.

Flight Time: Each RPIC should get one hour of flight time during the scenario.

Scenario: It is believed that a vehicle transporting hazardous material has been abandoned in an area surrounded by brush. A helicopter crew was initially dispatched to locate the vehicle. The crew located the vehicle; however, due to limitations of thermal cameras, they were unable to visualize the contents of the material being carried in the bed of the vehicle. Shortly after they located the vehicle, the weather conditions required that the helicopter return to base. A UAS team is called to attempt to determine if the driver is still in the vehicle and assist ground units in approaching the vehicle and determining the contents of the pickup bed.

Student Actions: RPIC #1 operates an aircraft with a thermal camera. RPIC #2 operates an aircraft with a spotlight in order to ascertain the location of the suspect.

1. Two RPIC's launch from the designated coordinates and locate the vehicle based on the GPS coordinates relayed by the helicopter crew.
2. After RPIC #1 has located the vehicle with the thermal camera, RPIC #2 utilizes RPIC #1's display to safely lower the aircraft into position, providing a view inside the driver's side window.
3. After confirmation of the driver is achieved, RPIC #2 orbits around the vehicle and provides a description of the vehicle and the contents of the pickup bed.
4. RPIC #1 continues to provide overwatch of the scene.
5. After it is determined that there is no clear threat from the contents of the storage vessels, RPIC #1 guides ground units into the area for further response.

Non-flying students fill the role of visual observers. VO's simulate utilizing the UAS radio channel to relay pertinent information back to command. If the flight crew is enabled with DroneSense, VO's shall demonstrate the ability to access the Ops Center for viewing of video streaming and to assist with airspace deconfliction.

Expectations: Students are expected to demonstrate the ability to effectively communicate and coordinate activities.

Students must identify the primary (#1) RPIC and the secondary (#2) RPIC.

Students must demonstrate the ability to properly maintain a safe altitude from each other.

Utilizing the onboard thermal camera, students must demonstrate the ability to perform a search for a vehicle.

Utilizing the camera and spot light, students must demonstrate the ability to lower the aircraft into position around the vehicle to gain situational awareness.

After Action: After all criteria have been met, both RPIC's safely land their aircraft and discuss the scenario with the instructor. Each student is required to be the primary and secondary RPIC in this scenario.

Scenario 2a: Track Suspect (Law Enforcement)

Props: Instructor to act as suspect.

Flight Time: Each RPIC should get one hour of flight time during the scenario.

Scenario: Armed suspects are loose in a suburban neighborhood. The perimeter is set by ground units. Due to weather minimums and length of flight, the helicopter crew is unable to assist. A UAS team is deployed to conduct an aerial search utilizing the thermal camera.

Student Actions: Two RPIC's launch from the designated location and conduct a coordinated search of the area based on information received from ground units.

Non-flying students fill the role of visual observers. VO's simulate utilizing the UAS radio channel to relay pertinent information back to command. If the flight crew is enabled using DroneSense, VO's shall demonstrate the ability to access the Ops Center for viewing of video streaming and to assist with airspace deconfliction.

Expectations: Students are expected to demonstrate the ability to effectively communicate and coordinate activities.

Students must identify the primary (#1) RPIC and the secondary (#2) RPIC.

Students must demonstrate the ability to properly maintain a safe altitude from each other.

Utilizing the onboard thermal cameras, students must demonstrate the ability to perform an aerial search of the neighborhood and locate the suspect. Once located the students must demonstrate the ability to "walk in" ground units safely.

After Action: After all criteria have been met, both RPIC's will safely land their aircraft and discuss the scenario with the instructor. Each student will be required to be the primary and secondary RPIC in this scenario.

Scenario 2b: Locate Alzheimer's Patient (Emergency Response)

Props: Instructor to act as patient.

Flight Time: Each RPIC should get one hour of flight time during the scenario.

Scenario: An Alzheimer's patient has left a care facility in a suburban neighborhood. The perimeter is being searched by ground units. Due to weather minimums and length of flight, the helicopter crew is unable to assist. A UAS team is deployed to conduct an aerial search utilizing the thermal camera.

Student Actions: Two RPIC's launch from the designated location and conduct a coordinated search of the area based on information received from ground units.

Non-flying students fill the role of visual observers. VO's simulate utilizing the UAS radio channel to relay pertinent information back to command. If the flight crew is enabled using DroneSense, VO's shall demonstrate the ability to access the Ops Center for viewing of video streaming and to assist with airspace deconfliction.

Expectations: Students are expected to demonstrate the ability to effectively communicate and coordinate activities.

Students must identify the primary (#1) RPIC and the secondary (#2) RPIC.

Students must demonstrate the ability to properly maintain a safe altitude from each other.

Utilizing the onboard thermal cameras, students must demonstrate the ability to perform an aerial search of the neighborhood and locate the Alzheimer's patient. After the patient has been located, the students must demonstrate the ability to "walk in" ground units safely.

After Action: After all criteria have been met, both RPIC's will safely land their aircraft and discuss the scenario with the instructor. Each student will be required to be the primary and secondary RPIC in this scenario.

Scenario 3: Search and Rescue

Props: Child Size Analog, hand warmers / heat packs

Flight Time: Each RPIC should get one hour of flight time during the scenario.

Scenario: Provide the last know location of a child lost in the woods, two teams plan a search pattern, find, and identify location.

Student Actions: Prior to the start of the mission the students conduct a mission brief to decide the best course of action to accomplish the objective. Utilizing the map on the screen the RPIC's will coordinate a search area.

After a plan is in place, two RPIC's launch and begin searching the area. If the lost child is located, the GPS coordinates of the child are relayed to the instructor.

Non-flying students fill the role of visual observers. VO's simulate utilizing the UAS radio channel to relay pertinent information back to command. If the flight crew is enabled using DroneSense, VO's shall demonstrate the ability to access the Ops Center for viewing of video streaming and to assist with airspace deconfliction.

Expectations: Students are expected to demonstrate the ability to effectively communicate and coordinate activities.

Students must demonstrate the ability to use the map and plan a search pattern.

Utilizing the onboard thermal camera and map functions, students must demonstrate the ability to perform an aerial search in a wooded area.

Students must demonstrate the ability to fly at tree top altitudes and locate a missing child.

Students must demonstrate the ability to relay GPS coordinates of the UAS.

After Action: After all criteria have been met, both RPIC's will safely land their aircraft and discuss the scenario with the instructor. Each student will be required to be the primary and secondary RPIC in this scenario.

RPIC Qualification Check

This UAS proficiency course ensures that all department Remote Pilots in Command (RPIC) have the skills necessary to safely operate a UAS at night.

This proficiency course is based on the *National Institute of Standards and Technology (NIST) Guide to Measuring and Comparing UAS Capabilities and Remote Pilot Proficiencies Using Standard Test Methods*.

The course is untimed and RPIC's can retest on any areas they do not successfully complete the first time.

Inside each bucket is an inscribed ring to evaluate alignment. Center targets can be letters, visual/color/thermal, acuity charts, hazmat labels, or other items.

For proficiency testing objectives based on the NFPA standards for public safety UAS, see Curriculum Objectives

Documentation

Use the *PSURT UAS RPIC Level 2 Checklist* to qualify the student. After a successful test, complete the *PSURT RPIC Certification Form* which both you and the student must sign. Send a copy of both forms to the student's department.

For examples of forms, see Appendix A: Form Examples. The forms are included with the PSURT program.

Skills Evaluated

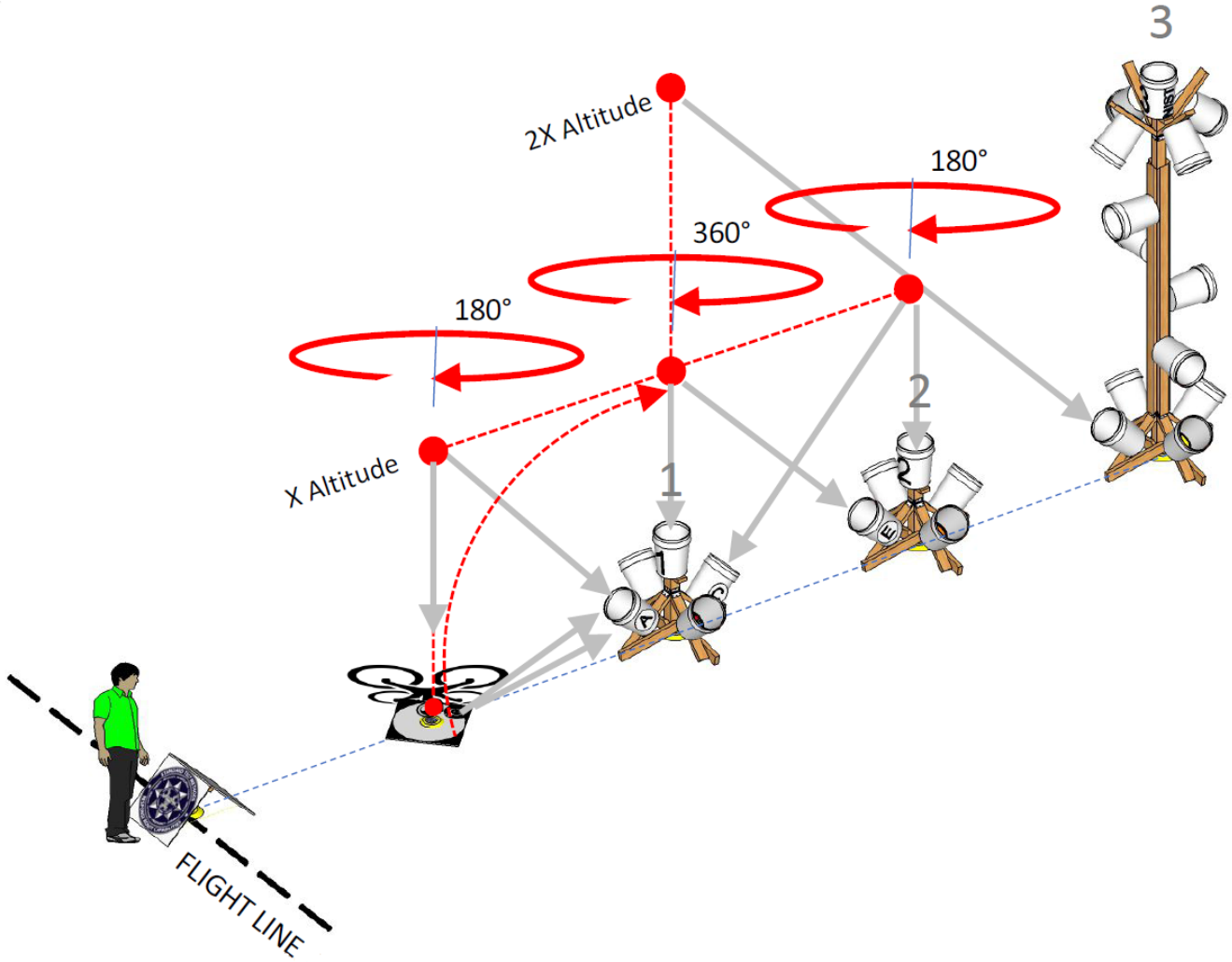
Hold Position and Altitude	Establish and hold a hover position and orientation
Orbit a Point	Move position and rotate around a point
Fly Straight and Level	Fly straight and level for short distances
Identify and Inspect Objects	Move and rotate around an object of interest to identify key features and inspect key details from close proximity
Land Accuracy	Land accurately from vertical and downward 90-degree descending approaches

In order to count an observation successful, a RPIC must view the entire ring inside each bucket. If any portion of the ring is obscured, they should maneuver their aircraft until the entire ring is in view before moving on to the next bucket.

Course Setup

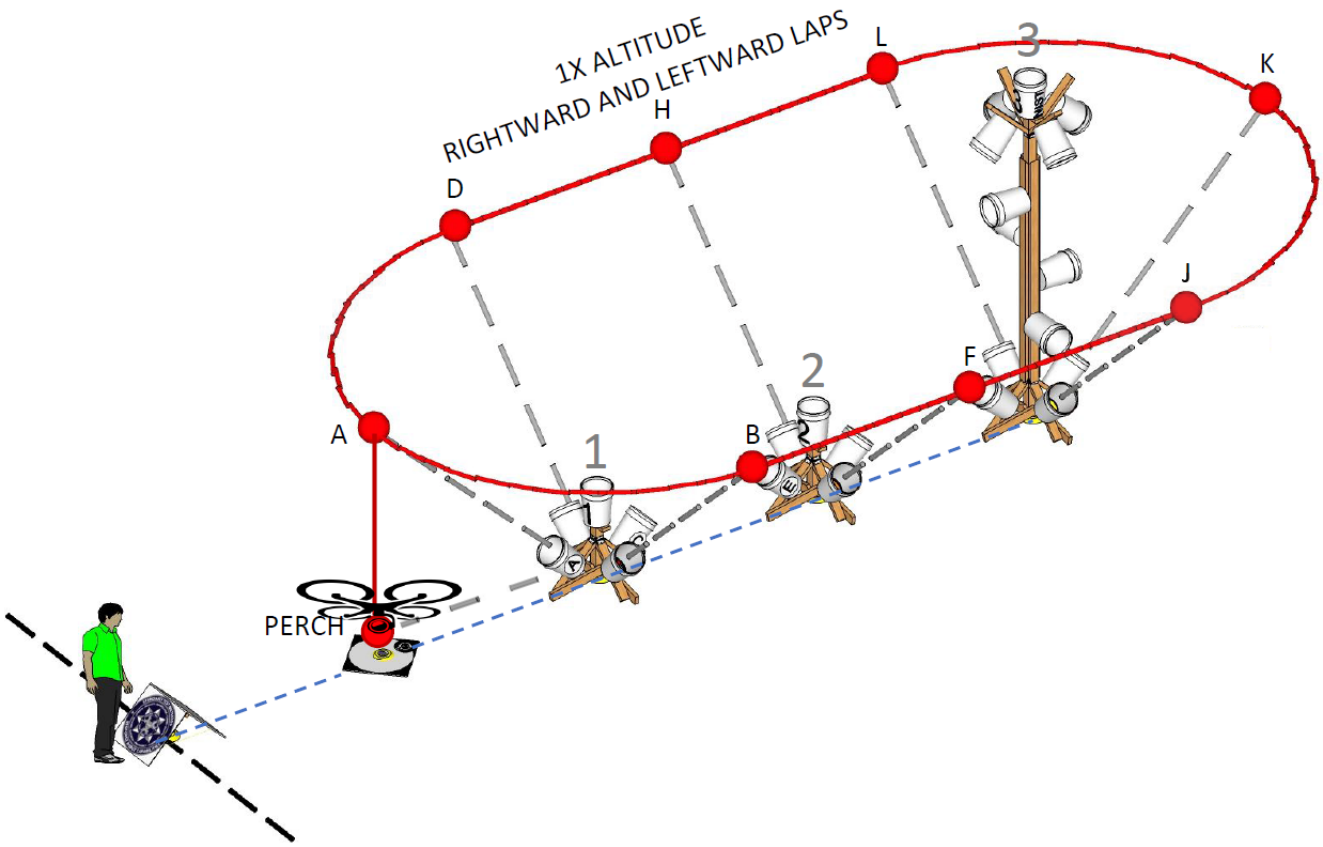
For information, see Appendix B: Building the UAS Proficiency Course.

Position (Maneuvering 1)



Task #	Maneuver	Locate
1	Launch to 10ft and hover over Stand #1	1 & 2E
2	Rotate right 360° over Stand #1	1 & 2E
3	Rotate left 360° over Stand #1	1 & 2E
4	Climb to 20ft over Stand #1	1 & 2E
5	Descend to 10ft over Stand #1	1 & 2E
6	Forward over Stand #2	2 & 3I
7	Backward over Stand #1	1 & 2E
8	Forward over Stand #2 and rotate right 180°	2 & 1C
9	Forward over Landing Platform and rotate left 180°	L & 1A
10	Land centered facing stands	

Position (Maneuvering 2)



Task #	Maneuver	Locate
11	Launch to 10ft and hover over Landing Platform	1A
12	Traverse right around the training apparatus, pausing directly over each location	1B
13	Continue	2F
14	Continue	3J
15	Continue	3K
16	Continue	3L
17	Continue	2H
18	Continue	1D
19	Continue	1A
20	Land centered facing stands	
21	Launch to 10ft and hover over Landing Platform	1A
22	Traverse left around the training apparatus, pausing directly over each location	1D
23	Continue	2H
24	Continue	3L
25	Continue	3K
26	Continue	3J
27	Continue	2F
28	Continue	1B
29	Continue	1A
30	Land centered facing stands	

Curriculum Objectives

The National Fire Protection Association has developed standards for public safety UAS that include aerial test methods developed by NIST that measure the capabilities of the drone as well as the proficiency of the RPIC. These curriculum objectives are based on the NFPA standards.

NIGHT SCHOOL OBJECTIVES	
1.	The RPIC shall be able to describe different visual illusions associated with night operations.
2.	The RPIC shall be able to describe the requirements to fly a night mission.
3.	The RPIC shall demonstrate the setting up of a proper mission area for night operations.
4.	The RPIC shall demonstrate the operation of a thermal camera.
5.	The RPIC shall be able to describe the theories associated with thermographics.
6.	The RPIC shall demonstrate an understanding of thermal palettes.
7.	The RPIC shall demonstrate an understanding of spot metering and area metering.
8.	The RPIC shall demonstrate an understanding of MSX and ISO's.
9.	The RPIC shall demonstrate a working knowledge of associated thermal camera apps and their settings and options.
10.	The RPIC shall demonstrate the ability to use mounted lighting equipment on the aircraft for navigation and assistance in identification of mission targets.

Appendix A: Form Examples

PSURT UAS RPIC Level 2 Checklist

PSURT UAS RPIC LEVEL 2 CHECKLIST

- For detailed information about the levels, see the *PSURT UAS Program Guide*.
- For detailed information about the course and testing procedures, see the relevant *PSURT Training Documents*.

INITIAL / RECURRENT
☐ INITIAL ☐ RECURRENT

TESTING INFORMATION			
TEST DATE		TEST LOCATION	

RPIC INFORMATION			
RPIC NAME		DEPARTMENT / AGENCY	
107 CERTIFICATE #		EMAIL	

AIRCRAFT INFORMATION			
UAS TYPE		REGISTRATION #	
CONTROLLER TYPE		DISPLAY TYPE	
SOFTWARE PLATFORM			

GROUND SCHOOL	PASS
UAS NIGHT OPERATIONS	
HOW THE EYE WORKS	
SPATIAL DISORIENTATION / VISUAL ILLUSIONS	
IMPROVING YOUR NIGHT VISION	
THERMOGRAPHICS	

HANDS-ON BASIC PROFICIENCY	PASS
SETUP	
BASIC FLIGHT MANEUVERS	
USING THE CAMERA	
SETTING FLIGHT MODES	

SCENARIO-BASED FLIGHTS	PASS
SCENARIO 1: SEARCH AND IDENTIFY	
SCENARIO 2: SEARCH AND RESCUE	
SCENARIO 3: TRACK SUSPECT	

PROFICIENCY TESTING	PASS
POSITION MANEUVERING 1	
POSITION MANEUVERING 2	

INSTRUCTOR INFORMATION			
INSTRUCTOR NAME		DEPARTMENT / AGENCY	
INSTRUCTOR TITLE		INSTRUCTOR EMAIL	

INSTRUCTOR SIGNATURE	RPIC SIGNATURE	DATE

PSURT UAS RPIC Certification Form

PSURT UAS RPIC CERTIFICATION FORM

- For detailed information about the RPIC levels, see the *PSURT UAS Program Guide*.
- For detailed information about the course and testing procedures, see the relevant *PSURT Training Documents*.

QUALIFICATION LEVEL		INITIAL / RECURRENT	
☐ LEVEL 1 RPIC	☐ LEVEL 2 RPIC	☐ INITIAL	☐ RECURRENT

TESTING INFORMATION			
TEST DATE		TEST LOCATION	

RPIC INFORMATION			
RPIC NAME		DEPARTMENT / AGENCY	
107 CERTIFICATE #		EMAIL	

AIRCRAFT INFORMATION			
UAS TYPE		REGISTRATION #	
CONTROLLER TYPE		DISPLAY TYPE	
SOFTWARE PLATFORM			

INSTRUCTOR INFORMATION			
INSTRUCTOR NAME		DEPARTMENT / AGENCY	
INSTRUCTOR TITLE		INSTRUCTOR EMAIL	

_____	_____	_____
INSTRUCTOR SIGNATURE	**RPIC SIGNATURE**	**DATE**

DEPARTMENT/AGENCY ENDORSEMENT

I certify that the above RPIC has successfully met all requirements for the safe operation of the listed aircraft, and may operate as a department/agency PSURT RPIC at the indicated qualification level for one year from test date.

_____	_____	_____
ENDORSING OFFICER NAME	**ENDORSING OFFICER SIGNATURE**	**DATE**

*** THIS CERTIFICATION IS VALID FOR ONE YEAR FROM TEST DATE ***

PSURT UAS RPIC/VO Night Mission Pre-Flight Quiz

PSURT UAS RPIC/VO Night Mission Pre-Flight Quiz

RPIC NAME _____

DATE _____

LOCATION _____

1. ☐ True / False: Autokinesis is caused by staring at single points of light for more than a few seconds. The lights then appear to move even if the aircraft is not moving.

2. ☐ Correction of Autokinesis can be done by which of the following?
   A. Focusing eyes at varying distances
   B. Increasing speed of visual scanning
   C. Increasing your eye rate of blinking
   D. A and B only

3. ☐ True / False: Reversible Perspective Illusion occurs when an aircraft may look like it's moving away from you, but it's actually moving towards you.

4. ☐ Reversible Perspective Illusion can be eliminated by which of the following?
   A. Comparing the possible moving light to a fixed light on the surface.
   B. Reversible Perspective Illusion cannot be corrected so the mission must be terminated
   C. Looking away from the aircraft lights to regain night vision
   D. None of the above

5. ☐ True / False: Size and Distance Illusion occurs when a light is slowly pulsing, creating a false impression of approaching or receding aircraft.

6. ☐ True / False: Fascination is becoming fixated on one particular subject and not paying attention to surroundings.

7. ☐ What do you lose when you are exposed to excessively bright light?
   A. Contrast discrimination
   B. Depth perception
   C. Visual reaction time
   D. All of the above

8. ☐ True / False: Flicker Vertigo is when the lighting cycle causes nausea or dizziness.

9. ☐ Which of the following may be other issues that can affect the flight team during night operations?
   A. Loss of night vision
   B. Inability to focus on a subject
   C. Dehydration
   D. All of the above are concerns for night operations

10. ☐ True / False: Rest and Nutrition can improve your night vision.

Answers: 1 (True); 2 (D), 3 (True), 4 (A), 5 (True), 6 (True), 7 (D), 8 (True), 9 (D), 10 (True)

PSURT UAS Course Evaluation Form

PSURT UAS Course Evaluation Form

COURSE TITLE _____

COURSE DATE _____

COURSE LOCATION _____

LEAD INSTRUCTOR _____

		Not At All	Somewhat	Very Much
1.	The training was well organized	☐	☐	☐
2.	The training sessions were relevant to my needs	☐	☐	☐
3.	The presenters were well prepared	☐	☐	☐
4.	The presenters were receptive to participant comments and questions	☐	☐	☐
5.	The scenarios helped me to learn the material	☐	☐	☐
6.	There was enough time to cover all materials	☐	☐	☐
7.	The training enhanced my knowledge and skills	☐	☐	☐
8.	I expect to use the knowledge from this training	☐	☐	☐

Please reflect on the training that you just completed and respond to the following:

1. What part of the training was the most useful to you?

2. What information/topics should be added to this training?

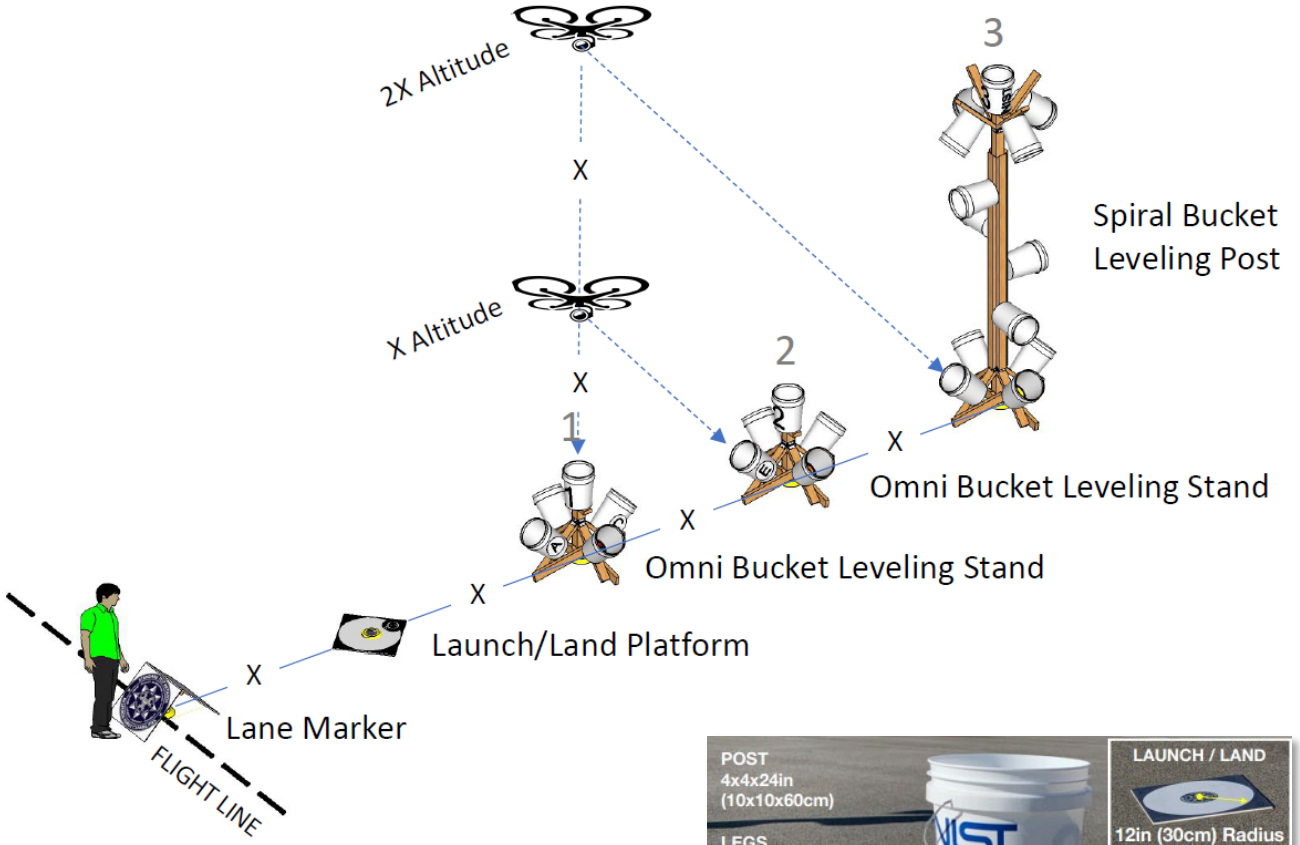
3. How could the course be improved?

4. Other comments

Appendix B: Building the UAS Proficiency Course

The proficiency course is based on the *National Institute of Standards and Technology (NIST) Guide to Measuring and Comparing UAS Capabilities and Remote Pilot Proficiencies Using Standard Test Methods*.

For information about the NIST course, and for detailed setup steps, including printable stickers, see the *NIST Standard Test Methods for sUAS_v20190905.pdf* that is included with this program.



Setup Options

Depending on the tests that you want to use, there are two options for building your test lane:

- Two Omni bucket levelling stands + one Spiral bucket leveling post, or
- Three Omni bucket levelling stands

Lane Features

- Pilot flight line for safety (A-frame as lane marker).
- Centerline using 100ft (30m) measuring tape.
- Launch/Land platform to measure accuracy.

- Bucket stands with vertical and angled white buckets that can be stowed and transported
- Optional outriggers that enable bucket stands to be leveled on uneven terrain
- Apparatus spacing is 10ft (3m)
- Flight altitudes are 10ft (3m) and 20ft (6m)
- Overall length is 50ft (15m)

Supplies

3 bucket stands and 1 launch/land platform panel.

Note: The supplies listed below are for three of the short stands. They do not include the spiral bucket leveling post (tall stand).

Quantity	Item
3	4x4x24in posts
12	2x4x20in legs, 45deg cuts both ends opposing
3	2x4x12in T-tops
12	2x2x24in or 2x4x24in outriggers (uneven terrain)
100	3-1/in washer head screws to secure lumber joints
15	Bolts with wing nuts to secure buckets, allowing buckets to be easily removed
15	2 or 5 gallon white buckets
1	Launch/Land platform panel with 12in radius circle
1	100ft measuring tape as center line
1	Post level to measure vertical
1	Thick black marker to inscribe 1in (25mm) rings inside buckets and write letters inside and out. Or 8in (200mm) round white polyester weatherproof labels can be printed from the QUICK START GUIDE downloadable from www.RobotTestMethods.nist.gov Aerial Systems web page.

Note: For night missions, in addition to the standard course setup, you will need to either strap inward-facing lights to each bucket or put a hand-warmer inside each bucket for thermal flights.

PUBLIC SAFETY

UNMANNED RESPONSE TEAM