Implementing unmanned aircraft system (UAS) technology in North Carolina

NCSS Nantahala Chapter

Jackson County Airport / Cullowhee, NC

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Terms

- **UAV**: Unmanned aerial vehicle
- **UA**: Unmanned aircraft
- **UAS**: Unmanned aircraft **system**, which according to the FAA includes *"the unmanned aircraft (UA) and all of the associated support equipment, control station, data links, telemetry, communications and navigation equipment, etc., necessary to operate the unmanned aircraft"*

UAS provided surveying products

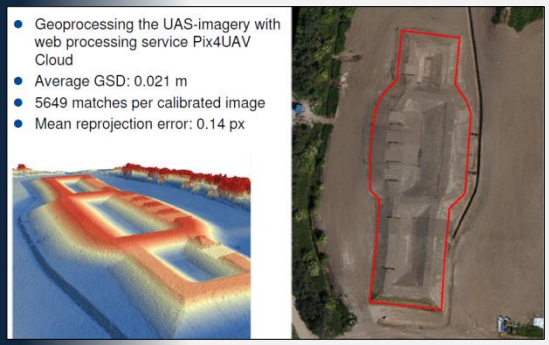
- Scaled orthophotos

http://www.uav-g.org/Presentations/UAS_derived_DSM_and_DEM/Gehrke_R-Aspects_of_DEM_Generation.pdf

- Point clouds

Presentations from the UAV-Geomatics 2013 Conference (www.uav-g.org/presentations_online.htm)

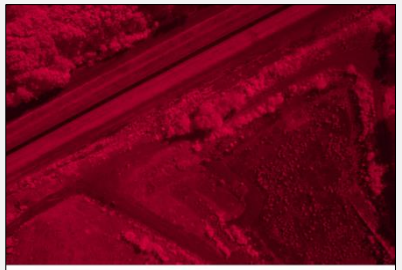
- Digital Elevation Models (DEMs) and Digital Surface Models (DSMs)



http://www.uav-g.org/Presentations/UAS_derived_DSM_and_DEM/Naumann_M-Accuracy_comparison_of_DSM.pdf

- Multispectral analyses

RGB image



IR image

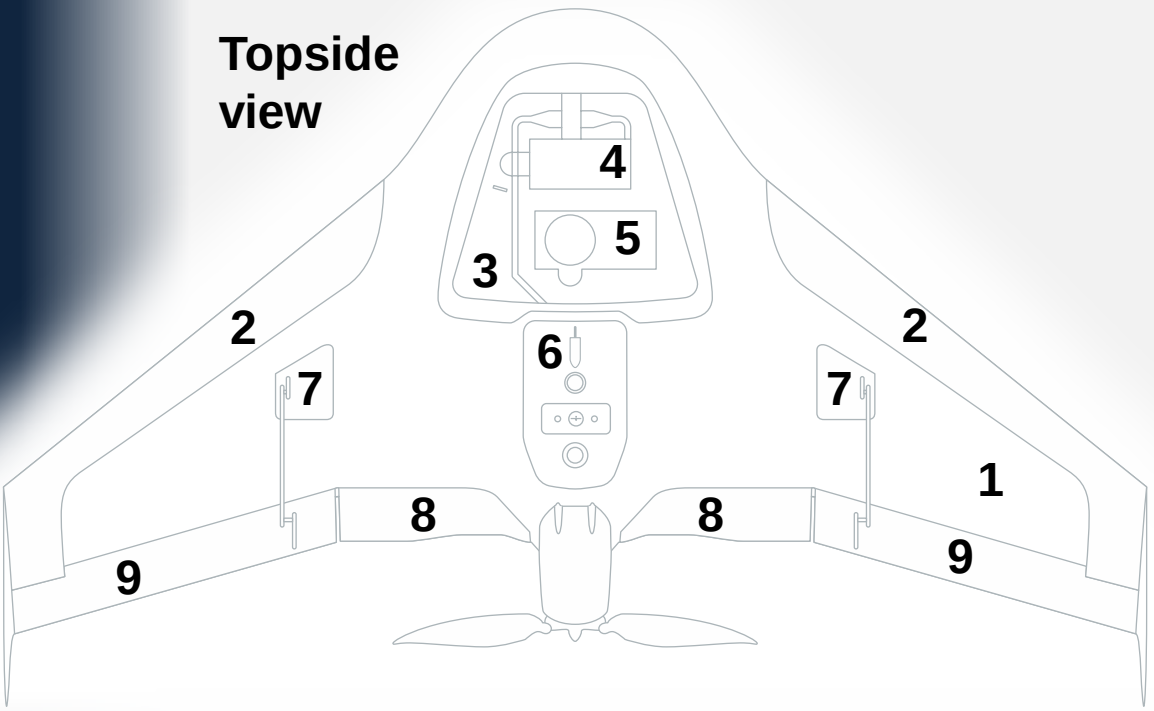
http://www.uav-g.org/Presentations/UAS_Imaging_Sensors/Gehrke_R-Multispectral_Image_Capturing.pdf

UAS provided surveying products

http://www.uav-g-2015.ca/

https://www.facebook.com/uavg2015

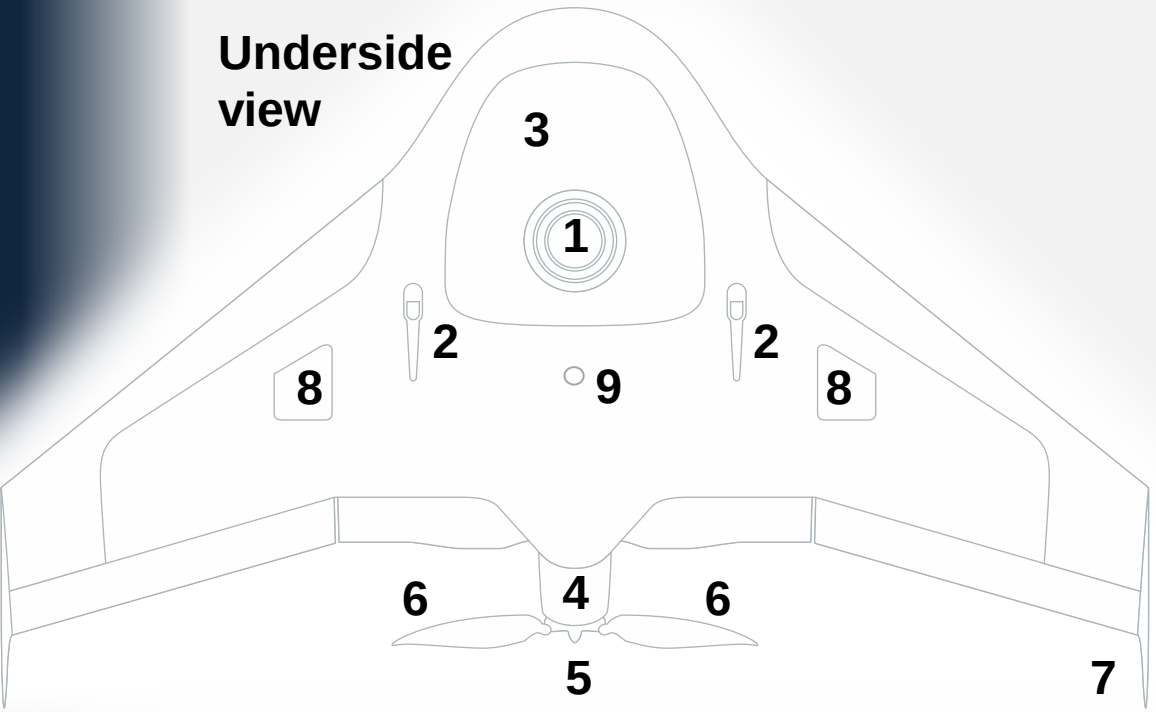
UAS components: Fixed-wing UA



Note: Although the various UAS models are built and operated differently, this presentation will use the Trimble UX5 (http://uas.trimble.com/ux5) fixed-wing UAS to illustrate the following UAS parameters: subcomponents of a UAV, ground control station, flight monitoring, and clearances (e.g. take off, cruise, descent, and landing).

1. Expanded polypropylene (EPP) body
2. Leading edges
3. Payload bay
4. Battery
5. Sensor
6. eBox (GPS ant, Mode, & Pitot tube)
7. Servos
8. Inboard elevons
9. Outboard elevons

UAS components: Fixed-wing UA



1. Lens filter
2. Launcher slats
3. Belly plate
4. Drive unit
5. Propeller holder
6. Propellers
7. Winglets
8. Servos
9. RF antenna (part of eBox)

http://uas.trimble.com/ux5

UAS components: GSC for a fixed-wing

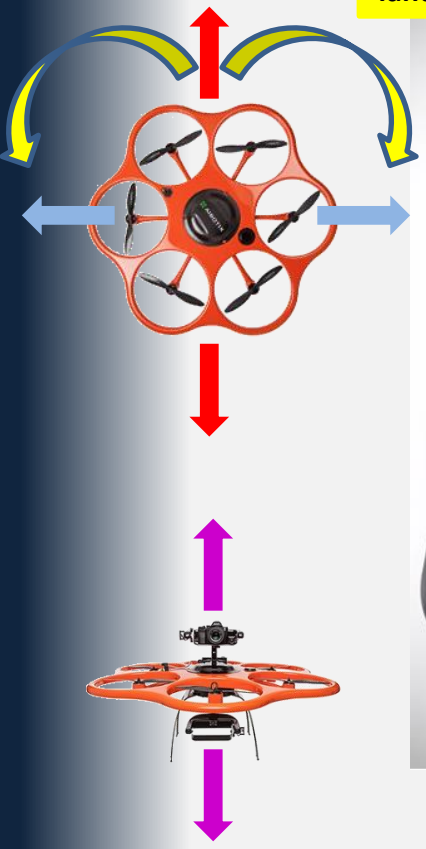
Ground control station (GSC)

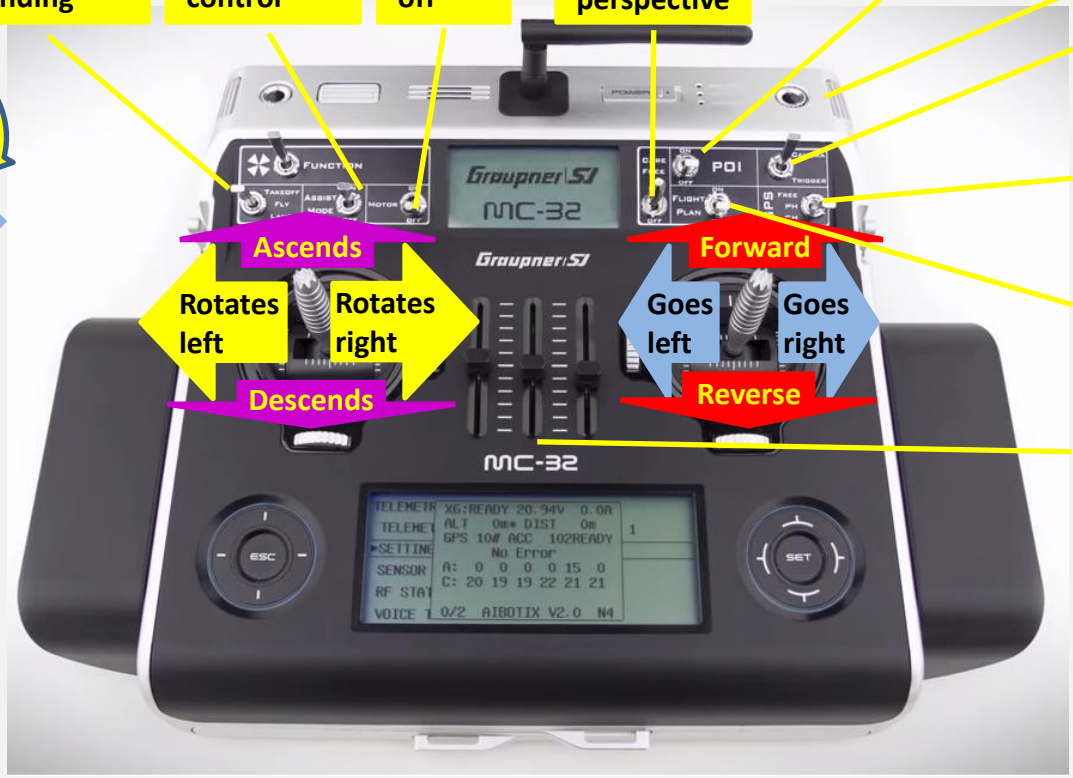
Trimble Yuma 2 tablet running the Trimble Access Aerial Imaging software

UX5 ground modem (2.4 GHz) straps to the tablet, connects to the tablet via its USB cable, and communicates with the aircraft via its RF antenna.

http://uas.trimble.com/ux5

UAS components: GSC for a multirotor

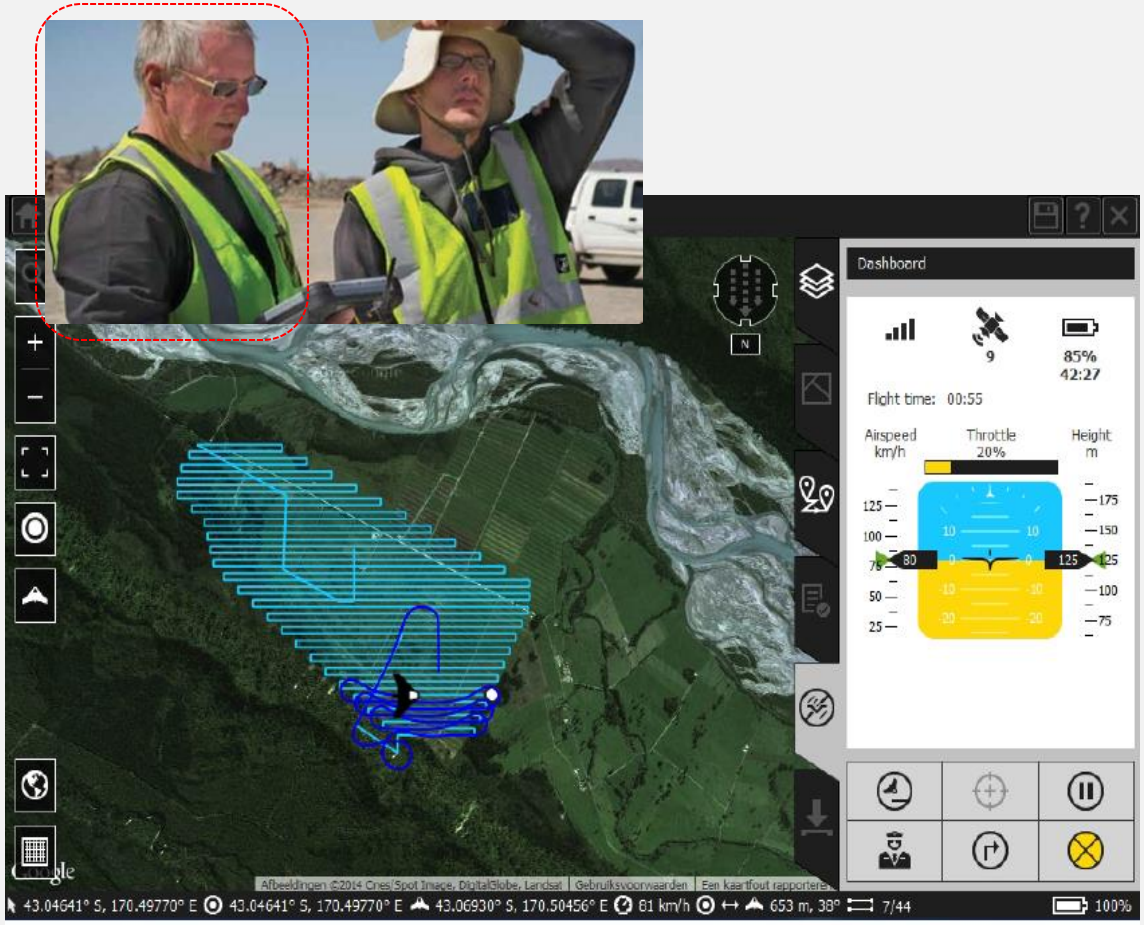




https://www.aibotix.com/en/overview-aibot-uav.html https://www.youtube.com/watch?v=P3Kbd8LEKqI

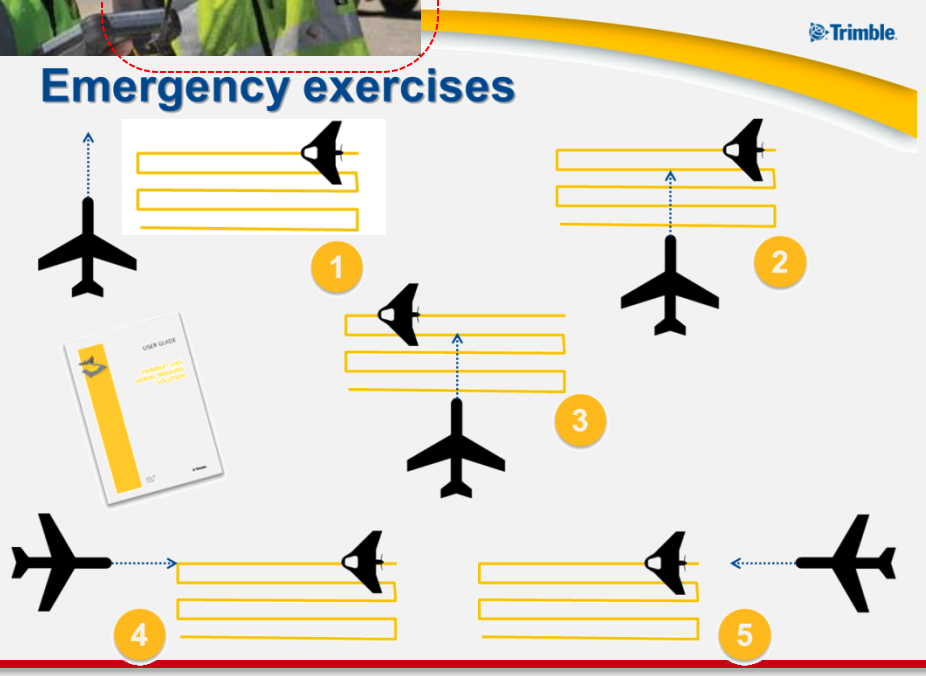
UAS flight monitoring: The pilot & the flight observer

- **The pilot:**
  - Monitors the GSC display
    - Battery (%) & estimated battery life
    - Radio status
    - GPS status
    - Trajectory (turns, level flight)
    - Airspeed (kph)
    - Throttle
    - Height (m)



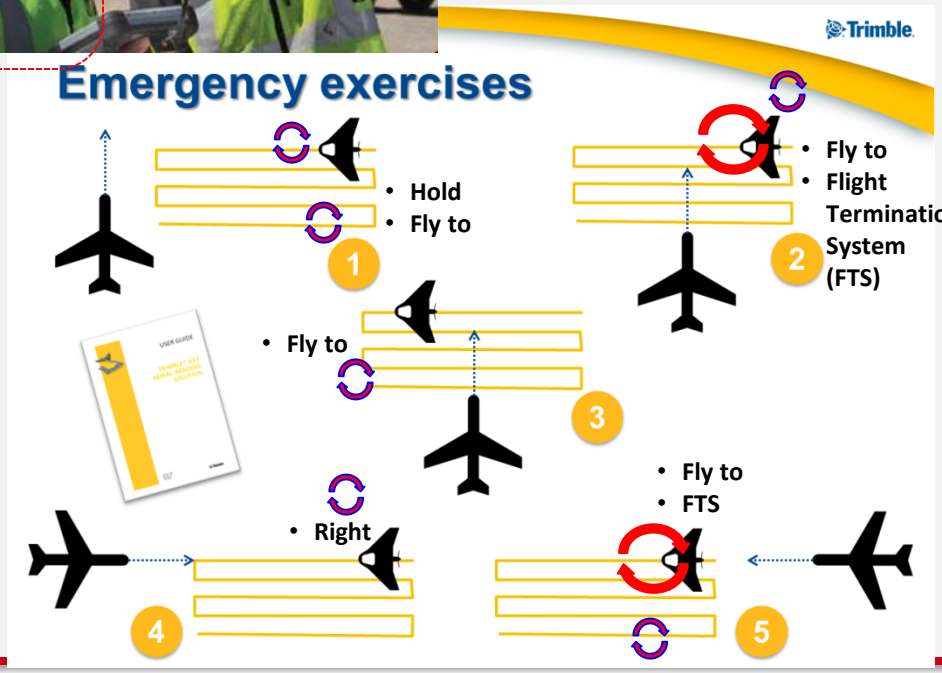
UAS flight monitoring: The pilot & the flight observer

- **The flight observer:**
  - Monitors the UAV
  - Monitors the sky for approaching aircraft
  - Communicates the situation to the pilot



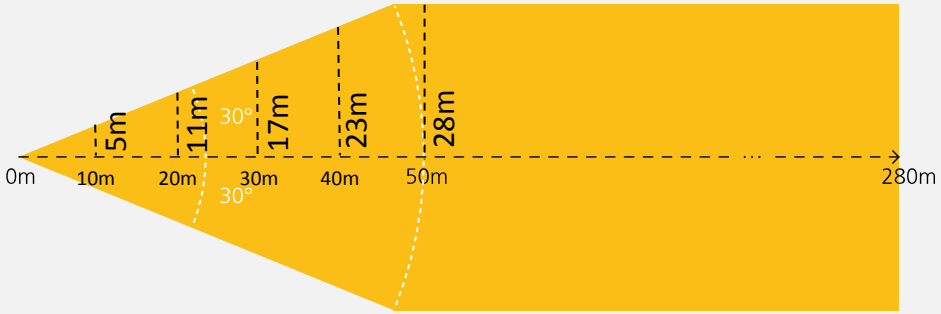
UAS flight monitoring: The pilot & the flight observer

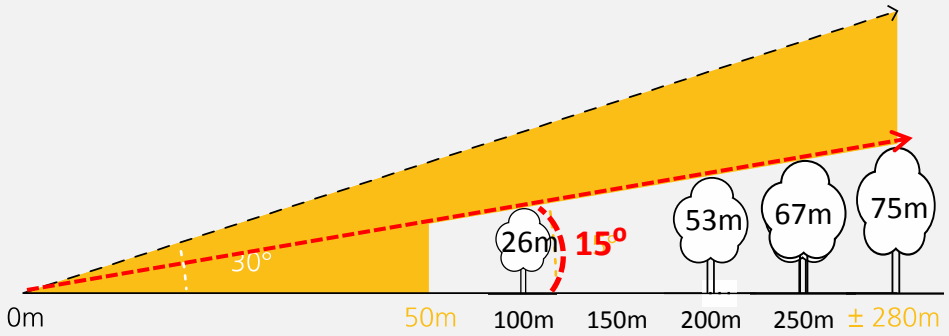
- **The pilot:**
  - Executes evasive actions:
    - Hold (100 m radius)
    - Right (300 m to the right & then 100 m radius)
    - Fly to (flies to the selected position & then 100 m radius)
    - Here (flies to the GSC location & then 100 m radius)
    - Flight Termination System (FTS) (forced landing at 200 m radius)



UAS clearances: Fixed-wing take-off

- **Obstacle clearances for takeoff**
  - **HORIZONTAL CLEARANCE:** Within the first 50 m (164 ft), there must be a clear area free of obstacles within 30º to the left and to the right of the launch direction
  - **VERTICAL CLEARANCE:** Within 280 m (919 ft) of the launch direction, no obstacles can be above a 15º safety angle

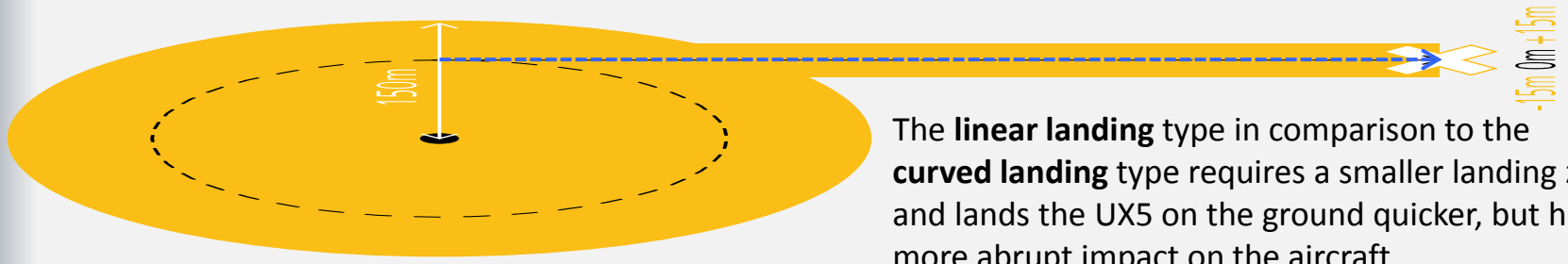




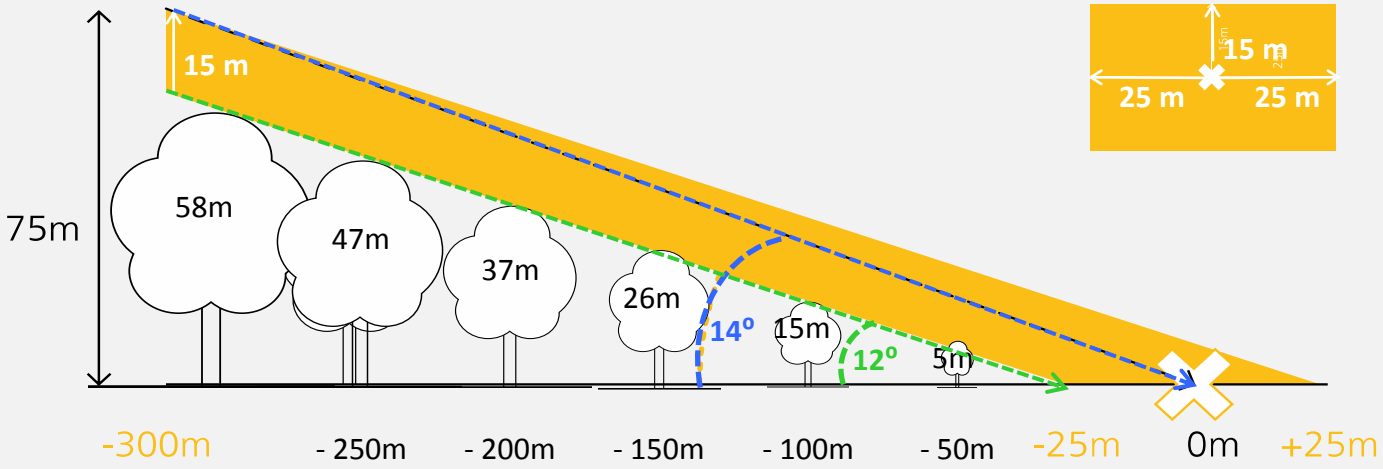
http://uas.trimble.com/ux5

UAS clearances: Fixed-wing landing

- **Obstacle clearances for landing**
  - **Linear landing**:

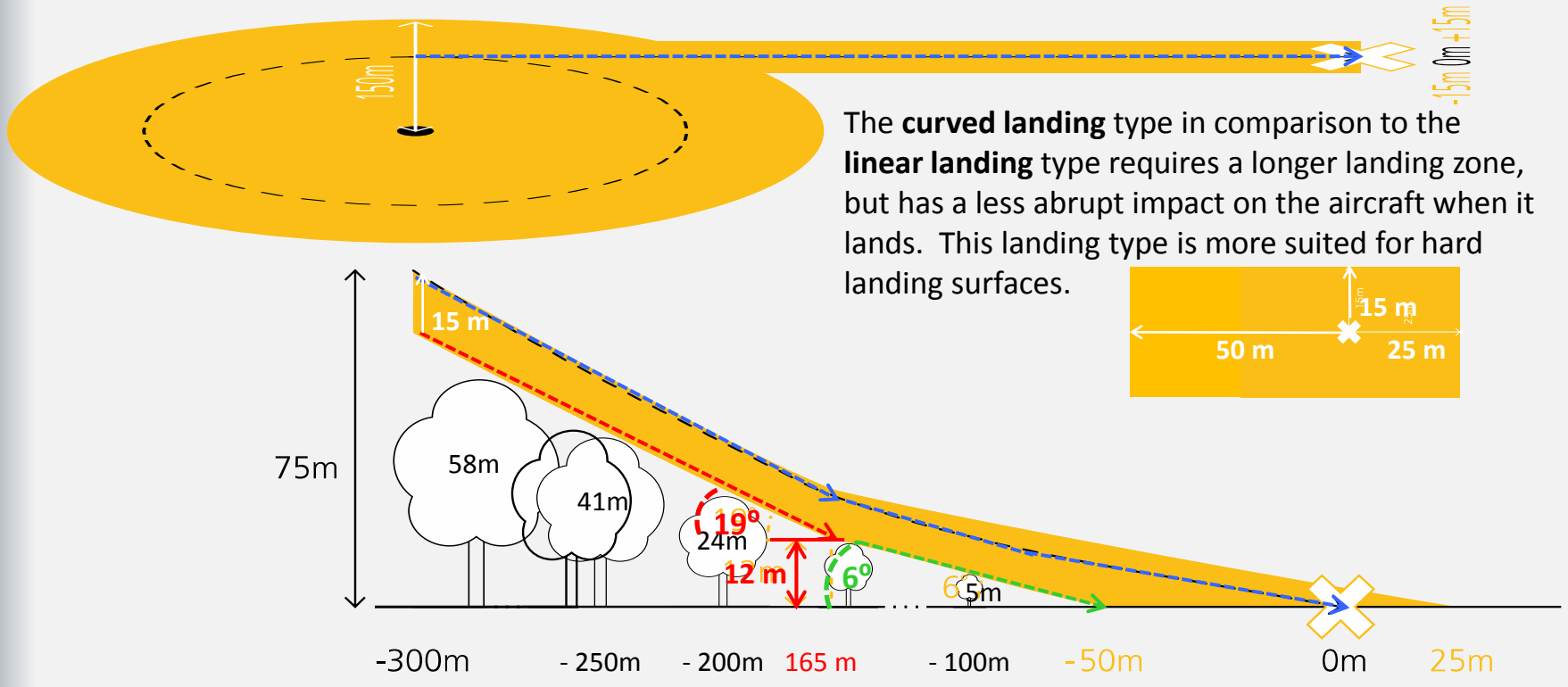


The **linear landing** type in comparison to the **curved landing** type requires a smaller landing zone and lands the UX5 on the ground quicker, but has a more abrupt impact on the aircraft.



UAS clearances: Fixed-wing landing

- **Obstacle clearances for landing**
  - **Curved landing:**



The **curved landing** type in comparison to the **linear landing** type requires a longer landing zone, but has a less abrupt impact on the aircraft when it lands. This landing type is more suited for hard landing surfaces.

NCEM is partnering with NGAT

- **NextGen Air Transportation (NGAT)**
  - Focuses on **developing and evaluating improvements** to existing and anticipated air traffic control, airspace management, airport and airspace system capacity, surface traffic management, and flight safety, specifically as it relates to the integration of **Unmanned Aircraft Systems (UAS)** into **domestic airspace**.
  - NGAT has led the State of North Carolina's UAS efforts for the last three years.

http://www.itre.ncsu.edu/ngat/

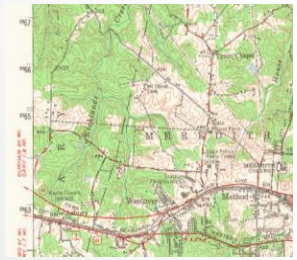
NCEM is partnering with NGAT

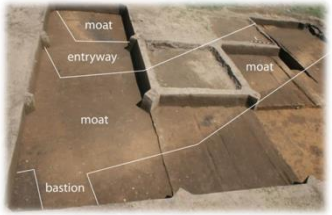
- **NextGen Air Transportation (NGAT)**
  - The Federal Aviation Administration (FAA) has selected the **ASSURE (Alliance for System Safety of UAS through Research Excellence) team**, which is a Mississippi State University led coalition of research universities that includes **NGAT**, as the **Center of Excellence for Unmanned Aircraft Systems (UAS)**.
    - **NGAT will be the national team's lead for Command and Control Communications research** (i.e. development of an appropriate link between the unmanned aircraft and the control station to support the required performance of the unmanned aircraft and to ensure that the pilot always maintains a threshold level of control of the aircraft).
    - NGAT will lead all University of North Carolina system research about the safe integration of UAS into the national airspace

https://www.faa.gov/news/press_releases/news_story.cfm?newsId=18794

https://news.ncsu.edu/2015/05/nc-state-team-selected-for-faa-unmanned-aircraft-center-of-excellence/

Hundreds of potential applications





- Emergency response
- Mapping / aerial photography
- Homeland Security
- Civil Air Patrol
- Agriculture
- Mining
- Forestry
- Wildlife resources
- Transportation
- Investigation
- Drug enforcement
- Anti-terrorism
- Law enforcement
- First responder support
- Weather research
- Disaster analysis
- Airport planning
- Entertainment (filming a movie)

Emergency response

Fire management

Infrastructure management

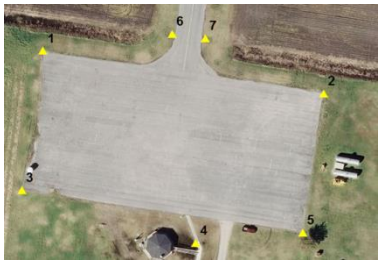
UAV imagery from NGAT

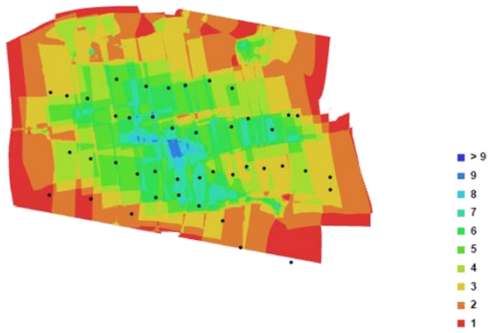
www.boshtech.com/nsuperswiper.html

- **Hyde County Airport**
  - Flew 4 flight lines and collected 127 images
    - Variable forward and side overlap
    - No surveyed ground control points (GCPs). Used 2012 statewide ortho & LiDAR

UAV imagery from NGAT

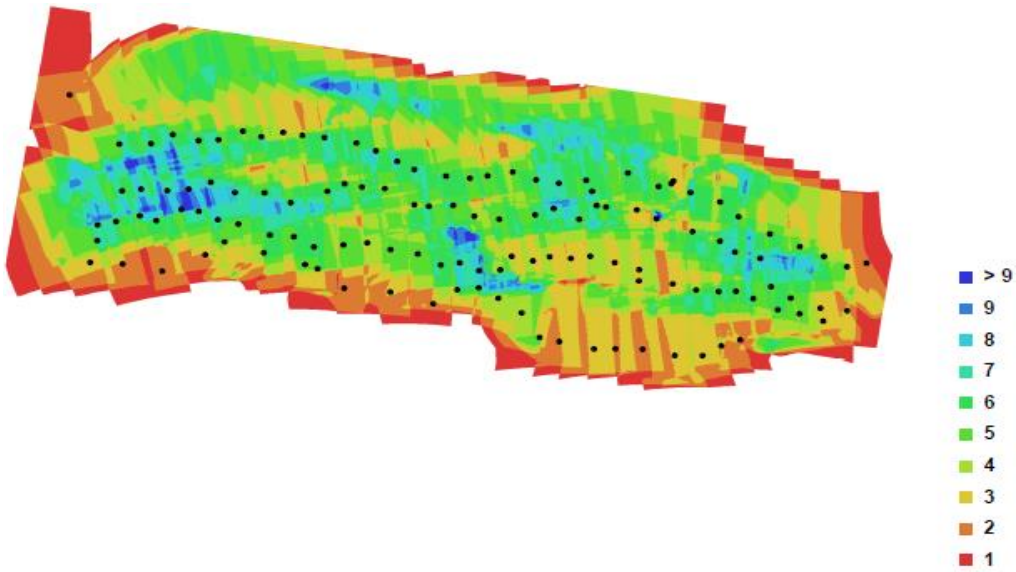
- **Hyde County Airport**
  - Initial attempt to “align” all 127 images without any GCPs failed
  - Used a subset of 44 images and 7 GCPs for alignment, which generated a camera calibration for input to subsequent processing





UAV imagery from NGAT

- **Hyde County Airport**
  - Second attempt to “align” all 127 images successful
  - Used 11 GCPs to generate orthophoto and point cloud



Current NC UAS policy activities

- FAA is THE authority today
- UAS operated by state agencies are “public aircraft”
  - **Must have a COA (Certificate of Authorization) from FAA**
  - Must meet NC requirements in addition to federal laws
- Current UAS operations by state/local agencies require approval from the State Chief Informational Officer (CIO)
- 2014 NC UAS legislation highlights
  - No UAS may be launched from any State or private property without consent. Local governments may adopt similar rules.
  - Allows civil penalty of up to $5000.00 for unwarranted surveillance by UAS.
  - Requires NCDOT Division of Aviation to develop a knowledge and skills test for operating UAS not later than May 31, 2015. Test must comply with state and federal regulations. A working group has been formed to address this test.
  - Division of Aviation is required to immediately begin developing a Commercial licensing system that complies with FAA guidelines (not yet developed). Within 60 days of FAA authorization be able to implement commercial license requirements.

Watch out!

Cases of drone near-misses are soaring:

Pilots have reported an alarming spike in near-misses with drones at New York City airports and across the nation over the past year, the feds disclosed on Wednesday.

11-22-2014

http://www.nydailynews.com/news/national/watch-cases-drone-near-misses-soaring-article-1.2025608

Federal Aviation Administration (FAA): Regulations

- **Unmanned aircraft systems (UAS)**

  UAS are inherently different from manned aircraft. Introducing UAS into the nation's airspace is challenging for both the FAA and aviation community, because the U.S. has the busiest, most complex airspace in the world. The FAA is taking an incremental approach to safe UAS integration.

- **Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap**
- **Different Types of UAS Operations**
  - **Public operations** (governmental)
  - **Civil operations** (non-governmental)
  - **Model aircraft** (hobby or recreation *only*)

https://www.faa.gov/uas/

Federal Aviation Administration (FAA): Regulations

- **Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap**

  The first annual UAS Roadmap addresses current and future policies, regulations, technologies and procedures that will be required as UAS operations increase in the nation's airspace.

https://www.faa.gov/uas/media/UAS_Roadmap_2013.pdf

Federal Aviation Administration (FAA): Regulations

- **Public operations (governmental)**

  Public aircraft operations are limited by federal statue to certain government operations within U.S. airspace. Title 49 U.S.C. § 40102(a)(41) provides the definition of "Public Aircraft" and § 40125 provides the qualifications for public aircraft status. **Whether an operation qualifies as a public aircraft operation is determined on a flight-by-flight basis, under the terms of the statute**. The considerations when making this determination are:

  - Aircraft ownership
  - Operator
  - Purpose of the flight
  - Persons on board the aircraft

http://www.faa.gov/uas/public_operations/

Federal Aviation Administration (FAA): Regulations

- **Public operations (governmental)**

  The **FAA Modernization and Reform Act of 2012** directed the FAA to:

  "allow a government public safety agency to operate unmanned aircraft ***weighing 4.4 pounds or less****, if operated*

  i. Within the **line of sight of the operator**

  ii. **Less than 400 feet [122 m] above the ground**

  iii. **During daylight conditions**

  iv. Within **Class G airspace [uncontrolled]**

  v. **Outside of 5 statute miles from any airport**, heliport, seaplane base, spaceport, or other location with aviation activities."

https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153 http://www.gpo.gov/fdsys/pkg/CRPT-112hrpt381/pdf/CRPT-112hrpt381.pdf

Federal Aviation Administration (FAA): Regulations

- **Public COAs**

  For public aircraft operations (PAOs), the FAA issues a Certificate of Waiver or Authorization (COA) that permits public agencies and organizations to:

  - Operate a particular aircraft,
    - For a particular purpose
    - In a particular area
  - Allows an operator to use a defined block of airspace
  - Includes special safety provisions unique to the proposed operation
  - Usually issued for a specific period (up to two years)

http://www.faa.gov/uas/public_operations/

Federal Aviation Administration (FAA): Regulations

- **Public COAs**

  The FAA works with these organizations to develop conditions and limitations for UAS operations to ensure they do not jeopardize the safety of other aviation operations.

  – The objective is to issue a COA with parameters that ensure a level of safety equivalent to manned aircraft.
    - UAS does not operate in a populated area
    - Aircraft is observed, either by someone in a manned aircraft or someone on the ground, to ensure separation from other aircraft in accordance with right-of-way rules.

  – Common public uses today include:
    - Law enforcement
    - Firefighting
    - Border patrol
    - Disaster relief
    - Search and rescue
    - Military training
    - Other operations

http://www.faa.gov/uas/public_operations/

Federal Aviation Administration (FAA): Regulations

- **Public COAs**

  The FAA manages public aircraft COAs through its COA Online system (https://ioeaaa.faa.gov/oeaaa/):

  – Agency must submit a "**declaration letter**" from the city, county, or state attorney's office assuring the FAA that:

    - The proponent is recognized as a political subdivision of the government of the State
    - The proponent will operate its unmanned aircraft in accordance with 49 USC. § 40125(b) (not for commercial purposes)

      Note: An agency's accountable executive cannot self-certify their agency is a "public" agency.

  – The typical COA application approval process is completed within 60 business days of receipt, provided there are no submittal errors, missing information, or safety or airspace issues.

  – Email the **FAA/UAS Integration Office** (9-AJR-36-UAS@faa.gov) to get started.

http://www.faa.gov/uas/public_operations/media/Decision_Flowcharts_for_PAO.pdf

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**

  Any operation that does not meet the statutory criteria for a public aircraft operation is considered a civil aircraft operation and must be conducted in accordance with all FAA regulations applicable to the operation.

  There are two methods of gaining FAA authorization to fly civil (non-governmental) UAS:

  – Section 333 Exemption – a grant of exemption in accordance with Section 333 AND a civil Certificate of Waiver or Authorization (COA);
    - To perform commercial operations in low-risk, controlled environments.
    - Instructions for filing a petition for exemption.
  – Special Airworthiness Certificate (SAC) – applicants must be able to describe how their system is designed, constructed, and manufactured, including engineering processes, software development and control, configuration management, and quality assurance procedures used, along with how and where they intend to fly.

https://www.faa.gov/uas/civil_operations/

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**
  - Section 333 Exemption

    By law, any aircraft operation in the national airspace requires a certificated and registered aircraft, a licensed pilot, and operational approval. Section 333 of theFAA Modernization and Reform Act of 2012 (FMRA) grants the Secretary of Transportation the authority to determine whether an airworthiness certificate is required for a UAS to operate safely in the National Airspace System (NAS).

    - This authority is being leveraged to grant case-by-case authorization for certain unmanned aircraft to perform commercial operations prior to the finalization of the Small UAS Rule, which will be the primary method for authorizing small UAS operations once it is complete.
    - Process provides operators who wish to pursue safe and legal entry into the NAS a competitive advantage in the UAS marketplace, thus discouraging illegal operations and improving safety. It is anticipated that this activity will result in significant economic benefits. The FAA Administrator has identified this as a high priority project to address demand for civil operation of UAS for commercial purposes.

https://www.faa.gov/uas/civil_operations/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - Model aircraft operations are for hobby or recreational purposes only.
  - The FAA has partnered with several industry associations to promote the Know Before You Fly campaign to educate the public about using unmanned aircraft safely and responsibly.
    - Founded by the Association for Unmanned Vehicle Systems International (AUVSI), the Academy of Model Aeronautics (AMA), and the Small UAV Coalition in partnership with the Federal Aviation Administration (FAA) to educate prospective users about the safe and responsible operation of unmanned aircraft systems (UAS).
    - Prospective UAS operators want to fly, and fly safely, but many don't realize that, just because you can buy a UAS, doesn't mean you can fly it anywhere, or for any purpose. Know Before You Fly provides prospective users with the information and guidance they need to fly safely and responsibly.

https://www.faa.gov/uas/model_aircraft/ http://knowbeforeyoufly.org/about-us/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - Individuals flying for hobby or recreation are strongly encouraged to adhere to the following safety guidelines:
    - Fly below 400 feet and remain clear of surrounding obstacles
    - Keep the aircraft within visual line of sight at all times
    - Remain well clear of and do not interfere with manned aircraft operations
    - Don't fly within 5 miles of an airport unless you contact the airport and control tower before flying
    - Don't fly near people or stadiums
    - Don't fly an aircraft that weighs more than 55 lbs
    - Don't be careless or reckless with your unmanned aircraft – you could be fined for endangering people or other aircraft

https://www.faa.gov/uas/model_aircraft/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - Having fun means flying safely! Hobby or recreational flying doesn't require FAA approval, but you must follow safety guidelines. Any other use requires FAA authorization.

https://www.faa.gov/uas/publications/model_aircraft_operators/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - The statutory parameters of a model aircraft operation are outlined in Section 336 of Public Law 112-95 (the FAA Modernization and Reform Act of 2012).
    - An individual who flies his/her UAS **within the scope of these parameters** does not require permission to operate a UAS.
    - Any flight **outside these parameters** (including any non-hobby, non-recreational operation) requires FAA authorization.
    - For example, using a UAS to take photos
      - **Recreational:** If for your personal use
      - **Non-recreational:** If for compensation or sale to another individual

https://www.faa.gov/uas/civil_operations/

Federal Aviation Administration (FAA): **Proposed** regulations

- **Small UAS Notice of Proposed Rulemaking (NPRM)**

  The FAA has proposed a framework of regulations that would allow routine use of certain small UAS in today's aviation system, while maintaining flexibility to accommodate future technological innovations. Note: The Public comment period ended 4-24-2015.

  – Operational limitations for small UAS (under 55 pounds) conducting non-recreational operations
    - Limit flights to daylight, visual-line-of-sight operations, height ≤500 ft, and speed ≤100 mph
    - Must yield right-of-way to other aircraft (manned or unmanned)
    - Optional use of a visual observer
  – Operator certification
    - Pass an aeronautical knowledge test
    - Be vetted by the Transportation Security Administration (TSA)
  – Aircraft registration and marking

Please read the handout "*Overview of Small UAS Notice of Proposed Rulemaking*"

https://www.faa.gov/uas/nprm/

Overview of Small UAS Notice of Proposed Rulemaking

Summary of Major Provisions of Proposed Part 107 The following provisions are being proposed in the FAA's Small UAS NPRM.	
Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the operator or visual observer. • At all times the small unmanned aircraft must remain close enough to the operator for the operator to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly involved in the operation. • Daylight-only operations (official sunrise to official sunset, local time). • Must yield right-of-way to other aircraft, manned or unmanned. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways. • Maximum airspeed of 100 mph (87 knots). • Maximum altitude of 500 feet above ground level. • Minimum weather visibility of 3 miles from control station. • No operations are allowed in Class A (18,000 feet & above) airspace. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission • No person may act as an operator or VO for more than one unmanned aircraft operation at one time. • No careless or reckless operations. • Requires preflight inspection by the operator. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Proposes a microUAS option that would allow operations in Class G airspace, over people not involved in the operation, provided the operator certifies he or she has the requisite aeronautical knowledge to perform the operation.

Operator Certification and Responsibilities	• Pilots of a small UAS would be considered "operators".
	• Operators would be required to:
	  o Pass an initial aeronautical knowledge test at an FAA-approved knowledge testing center.
	  o Be vetted by the Transportation Security Administration.

	○ Obtain an unmanned aircraft operator certificate with a small UAS rating (like existing pilot airman certificates, never expires). ○ Pass a recurrent aeronautical knowledge test every 24 months. ○ Be at least 17 years old. ○ Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the proposed rule. ○ Report an accident to the FAA within 10 days of any operation that results in injury or property damage. ○ Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is safe for operation.
Aircraft Requirements	• FAA airworthiness certification not required. However, operator must maintain a small UAS in condition for safe operation and prior to flight must inspect the UAS to ensure that it is in a condition for safe operation. Aircraft Registration required (same requirements that apply to all other aircraft). • Aircraft markings required (same requirements that apply to all other aircraft). If aircraft is too small to display markings in standard size, then the aircraft simply needs to display markings in the largest practicable manner.
Model Aircraft	• Proposed rule would not apply to model aircraft that satisfy all of the criteria specified in Section 336 of Public Law 112-95. • The proposed rule would codify the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

NC UAS legislation

- Enacted as part of the Appropriations Act of 2014
  - **Ratified:** by the NC General Assembly on 8-2-2014
  - **Signed:** by Governor Pat McCrory on 8-7-2014

    http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744

  - **Sections:**

§ 143B-426.38A:	Government Data Analytics Center; ring requirements	§ 14-7.45:	Crimes committed by use of unmanned aircraft systems
§ 63-95:	Training required for operation of unmanned aircraft systems	§ 14-280.3:	Interference with manned craft by unmanned aircraft systems
§ 63-96:	License required for commercial operation of unmanned aircraft systems	§ 14-401.24:	Unlawful possession and use of unmanned aircraft systems
§ 15A-300.1:	Restrictions on use of unmanned aircraft systems	§ 14-401.25:	Unlawful distribution of images
§ 15A-300.2:	Regulation of launch and recovery sites	§ 113-295:	Unlawful harassment of persons taking wildlife resources

NC UAS legislation

- House Bill 4: *Clarify Unmanned Aircraft System Law*
  - **Purpose:**
    - To clarify that State agencies have authority to procure & operate UAS upon approval of the State CIO
    - To modify NC UAS regulation to conform to FAA guidelines
  - **Status:** The NC House passed it on 4-29-2015 by 106-5. It has not yet passed the NC Senate. The NC Senate's Ag/Environment/Nat Res committee is reviewing it.

§ 143B-426.38A:	Government Data Analytics Center; ring requirements
§ 63-95:	Training required for operation of unmanned aircraft systems
§ 63-96:	License required for commercial operation of unmanned aircraft systems
§ 15A-300.1:	Restrictions on use of unmanned aircraft systems
§ 15A-300.2:	Regulation of launch and recovery sites
§ 14-7.45:	Crimes committed by use of unmanned aircraft systems
§ 14-280.3:	Interference with manned craft by unmanned aircraft systems
§ 14-401.24:	Unlawful possession and use of unmanned aircraft systems
§ 14-401.25:	Unlawful distribution of images
§ 113-295:	Unlawful harassment of persons taking wildlife resources

NC UAS legislation

- The details of this legislation are too important to be presented in a single summary slide.
- Format:
  - Underlined: Text added by House Bill 4
  - Not included: Text deleted by House Bill 4
  - **RED FONT**: What you **cannot** do (e.g. take pictures of people without consent)
  - **GREEN FONT**: What you are **allowed** to do (e.g. use infrared for mapping purposes)
  - **BLUE FONT**: What you are **required** to do (e.g. pass a knowledge test)

NC UAS legislation

- **§ 143B-426.38A - SECTION 7.16.(e)**

  Until December 31, 2015, the State [Chief Information Officer] CIO shall have the authority to approve or disapprove

  (i) the procurement or operation of an unmanned aircraft system by agents or agencies of the State or a political subdivision of the State and

  (ii) the disclosure of personal information about any person acquired through the operation of an unmanned aircraft system by agents or agencies of the State or a political subdivision of the State.

  When making a decision under this subsection, the State CIO may consult with the Division of Aviation of the Department of Transportation. The State CIO shall immediately report to the Joint Legislative Oversight Committee on Information Technology and the Fiscal Research Division on all decisions made under this subsection.

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744

NC UAS legislation

- **§ 63-95. Training required for operation of unmanned aircraft systems**

(b) The **Division [Division of Aviation/NCDOT] shall develop a knowledge test for operating an unmanned aircraft system that complies with all applicable State and federal regulations and shall provide for administration of the test**.

- **The test shall ensure that the operator of an unmanned aircraft system is knowledgeable of the State statutes and regulations regarding the operation of unmanned aircraft systems.**
- The Division may permit a person, including an agency of this State, an agency of a political subdivision of this State, an employer, or a private training facility, to administer the test developed pursuant to this subsection, provided the test is the same as that administered by the Division and complies with all applicable State and federal regulations.

(c) **No agent or agency of the State, or agent or agency of a political subdivision of the State, may operate an unmanned aircraft system within the State without completion of the test set forth in subsection (b) of this section**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-95.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (a) **No person shall operate an unmanned aircraft system, as defined in G.S. 15A-300.1, in this State for commercial purposes unless the person is in possession of a permit issued by the Division [Division of Aviation/NCDOT] valid for the unmanned aircraft system being operated**. Application for such permit shall be made in the manner provided by the Division. Unless suspended or revoked, the permit shall be effective for a period to be established by the Division not exceeding eight years.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

(b) **No person shall be issued a permit under this section unless all of the following apply:**

(1) The person is at least 17 years of age.

(2) The person possesses a valid drivers license issued by any state or territory of the United States or the District of Columbia.

(3) **The person has passed the knowledge test for operating an unmanned aircraft system as prescribed in G.S. 63-95(b).**

(4) **The person has satisfied all other applicable requirements of this Article or federal regulation.**

(c) **A permit to operate an unmanned aircraft system for commercial purposes shall not be issued to a person while the person's license or permit to operate an unmanned aircraft system is suspended, revoked, or canceled in any state.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

(d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

(1) A system for classifying unmanned aircraft systems based on characteristics determined to be appropriate by the Division.

(2) A fee structure for permits.

(3) A permit application process.

(4) **Technical guidance for complying with program requirements.**

(5) **Criteria under which the Division may suspend or revoke a permit.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

  (6) **Criteria** under which the **Division may waive permitting requirements for applicants currently holding a valid license or permit to operate unmanned aircraft systems issued by another state** or territory of the United States, the District of Columbia, **or the United States**.

  (7) A **designation of the geographic area within which a licensee shall be authorized to operate** an unmanned aircraft system.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

  (8) **Requirements** pertaining to the **collection, use, and retention of data by permitees obtained through the operation of unmanned aircraft systems**, to be established in consultation with the State Chief Information Officer.

  (9) **Requirements for the marking of each unmanned aircraft system operated pursuant to a permit** issued under this section sufficient **to allow identification of the owner of the system and the person issued a permit to operate it**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

  (10) A **system for providing agencies that conduct** other **operations within regulated airspace** with the **identity and contact information of permittees** and the **geographic areas within which the permittee is authorized to operate** an unmanned aircraft system.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (e) **A person** who **operates an unmanned aircraft system for commercial purposes other than as authorized** under this section shall be **guilty of a Class 1 misdemeanor**.

The NC Court System lists the following **sentences (days)** for a **Class 1 misdemeanor** based on the convicted person's prior conviction level (http://www.nccourts.org/Courts/CRS/Councils/spac/Documents/Misd_Chart_120113.pdf).

	Prior conviction level		
Class	I (No prior convictions)	II (1-4 prior convictions)	III (≥5 prior convictions)
1	1-45 days community punishment	1-45 days community / intermediate punishment	1-120 days community / intermediate / active punishment

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (f) The Division may issue rules and regulations to implement the provisions of this section.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=h4

NC UAS legislation

- **SECTION 34.30.(h) of the Appropriations Act of 2014**

  The **Division of Aviation** of the Department of Transportation **shall develop and implement the knowledge and skills test** required by G.S. 63-95, as enacted in subsection (g) of this section, **no later than May 31, 2015**, and **shall report to the Joint Legislative Transportation Oversight Committee on the status of implementation by June 15, 2015**.

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744

NC UAS legislation

- **SECTION 34.30.(i) of the Appropriations Act of 2014**

  The **Division of Aviation** of the Department of Transportation **shall immediately begin developing the licensing system for commercial operation** required by G.S. 63-96, as enacted in subsection (g) of this section, and **shall ensure that the system complies with Federal Aviation Administration (FAA) guidelines on commercial operation**, as those guidelines become available. **Within 60 days of issuance of the FAA guidelines and authorization by the FAA for commercial operations** to begin, the **Division shall implement the licensing system** required by G.S. 63-96, as enacted in subsection (g) of this section.

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744

NC UAS legislation

- **SECTION 34.30.(j) of the Appropriations Act of 2014**

  Except as authorized under Section 7.16(e) of S.L. 2013-360, as amended by Section 7.11(a) of S.L. 2014-100, no operation of unmanned aircraft systems by agents or agencies of the State or a political subdivision of the State shall be authorized in this State until the knowledge test required by G.S. 63-95, as enacted in subsection (g) of this section, has been implemented.

  No operation of unmanned aircraft systems **for commercial purposes shall be authorized** in this State **until the FAA has authorized commercial operations and the licensing system required** by G.S. 63-96, as enacted in subsection (g) of this section, **has been implemented**."

- **SECTION 5 of House Bill 4, which has not yet passed, would override the above**

  Prior to the implementation of the knowledge test and permitting process required by G.S. 63-96, any person authorized by the FAA for commercial operation of an UAS in this State shall not be in violation of that statute, provided that they:

  – Make application for a State permit for commercial operation within 60 days of the full implementation of the permitting process and
  – Are issued a State commercial operation permit in due course.

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(a) Definitions. - The following definitions apply to this Article:

(1) **Manned aircraft:** An aircraft, as defined in G.S. 63-1, that is operated with a person in or on the aircraft.

(2) **Model aircraft:** An aircraft, as defined in G.S. 63-1, that is mechanically driven or launched into flight and that meets all of the following requirements:

a. Is flown solely for hobby or recreational purposes.

b. Is not used for payment, consideration, gratuity, or benefit, directly or indirectly charged, demanded, received, or collected, by any person for the use of the aircraft or any photographic or video image produced by the aircraft.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(a) Definitions. - The following definitions apply to this Article:

(3) **Unmanned aircraft:** An aircraft, as defined in G.S. 63-1, that is operated without the possibility of human intervention from within or on the aircraft and that does not meet the definition of model aircraft.

(4) **Unmanned aircraft system:** An unmanned aircraft and associated elements, including communication links and components that control the unmanned aircraft that are required for the pilot in command to operate safely and efficiently in the national airspace system.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(b) General Prohibitions. – Except as otherwise provided in this section, **no person, entity, or State agency shall use an unmanned aircraft system to do any of the following:**

(1) **Conduct surveillance** of:

a. A **person or a dwelling** occupied by a person and that dwelling's curtilage **without the person's consent**.

b. **Private real property without the consent of the owner, easement holder, or lessee of the property**.

(2) **Photograph an individual, without the individual's consent, for the purpose of publishing** or otherwise publicly disseminating the photograph. **This subdivision shall not apply to newsgathering, newsworthy events, or events or places to which the general public is invited**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(c) **Law Enforcement Exceptions**. – Notwithstanding the provisions of subsection (b) of this section, the use of unmanned aircraft systems by **law enforcement agencies of the State or a political subdivision of the State is not prohibited** in the following instances:

(1) **To counter a high risk of a terrorist attack** by a specific individual or organization if the United States Secretary of Homeland Security or the Secretary of the North Carolina Department of Public Safety determines that **credible intelligence indicates that such a risk exists**.

(2) **To conduct surveillance in an area** that is within a law enforcement officer's plain view when the officer is **in a location the officer has a legal right to be**.

(3) **If the law enforcement agency first obtains a search warrant authorizing the use of an unmanned aircraft system**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(c) **Law Enforcement Exceptions**. – Notwithstanding the provisions of subsection (b) of this section, the use of unmanned aircraft systems by **law enforcement agencies of the State or a political subdivision of the State is not prohibited** in the following instances:

(4) If the law enforcement agency possesses reasonable suspicion that, under particular circumstances, **swift action is needed to prevent imminent danger to life** or serious damage to property, **to forestall the imminent escape** of a suspect or the **destruction of evidence, to conduct pursuit of an escapee or suspect**, or to facilitate the **search for a missing person**.

(5) **To photograph gatherings to which the general public is invited on public or private land**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

  (d) Limitations on Use of Special Imaging Technology. – **Commercial and private unmanned aircraft systems may be equipped with infrared or other thermal imaging technology subject to the provisions of this subsection**. Infrared or other similar thermal imaging technology equipment shall be **for the sole purpose of scientific investigation**; **scientific research; mapping and evaluating the earth's surface, including terrain and surface water bodies** and other features**; investigation or evaluation of crops**, **livestock**, or **farming operations; investigation of forests and forest management;** and other similar **investigations of vegetation or wildlife**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

  (e) **Any person who is the subject of unwarranted surveillance**, or **whose photograph is taken** in violation of the provisions of this section, **shall have a civil cause of action against the person, entity, or State agency that conducts the surveillance** or that uses an unmanned aircraft system to photograph for the purpose of publishing or otherwise disseminating the photograph. In lieu of actual damages, **the person whose photograph is taken may elect to recover five thousand dollars ($5,000) for each photograph or video that is published** or otherwise disseminated, **as well as reasonable costs and attorneys' fees and injunctive or other relief as determined by the court**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

  (f) **Evidence obtained or collected in violation of this section is not admissible as evidence in a criminal prosecution in any court of law in this State except when obtained or collected under the objectively reasonable, good-faith belief that the actions were lawful.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.2. Regulation of launch and recovery sites**

  (a) **No unmanned aircraft system may be launched or recovered from any State or private property without consent.**

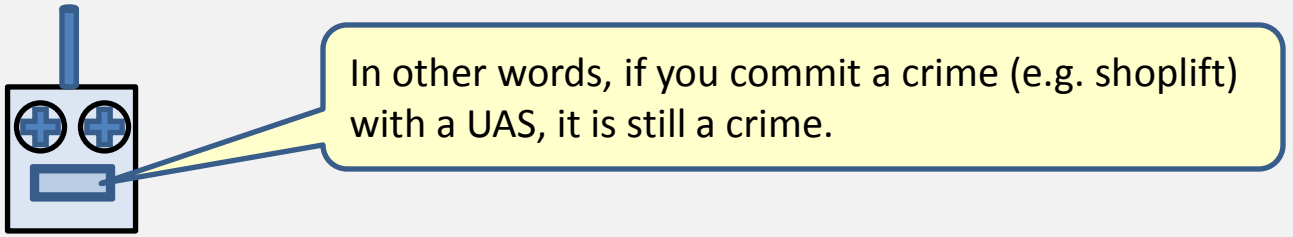
  (b) **A unit of local government may adopt an ordinance to regulate the use of the local government's property for the launch or recovery of unmanned aircraft systems.** (2014-100, s. 34.30(a).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.2.html

NC UAS legislation

- **§ 14-7.45. Crimes committed by use of unmanned aircraft systems**

  All crimes committed by use of an unmanned aircraft system, as defined in G.S. 15A-300.1, while in flight over this State shall be governed by the laws of this State, and the **question of whether the conduct by an unmanned aircraft system while in flight over this State constitutes a crime by the owner of the unmanned aircraft system shall be determined by the laws of this State**. (2014-100, s. 34.30(b).)



http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-7.45.html

NC UAS legislation

- **§ 14-280.3. Interference with manned aircraft by unmanned aircraft systems**

  (a) **Any person who willfully damages**, **disrupts the operation of**, or otherwise **interferes with a manned aircraft** through **use of an unmanned aircraft system**, while the manned aircraft is taking off, landing, in flight, or otherwise in motion, is **guilty of a Class H felony**.

The NC Court System lists the following **sentences (months)** for a **Class H felony** based on the convicted person's prior record level (http://www.nccourts.org/Courts/CRS/Councils/spac/Documents/FelonyChart_1013MaxChart.pdf).

	Prior record level					
Felony class	I (0-1 pt)	II (2-5 pts)	III (6-9 pts)	IV (10-13 pts)	V (14-17 pts)	VI (18+ pts)
H	5-6 months	6-8 months	8-10 months	9-11 months	12-15 months	16-20 months

NC UAS legislation

- **14-401.24. Unlawful possession and use of unmanned aircraft systems**

(a) It shall be a **Class E felony for any person to possess or use an unmanned aircraft or unmanned aircraft system that has a weapon attached**.

	Prior record level					
Felony class	I (0-1 pt)	II (2-5 pts)	III (6-9 pts)	IV (10-13 pts)	V (14-17 pts)	VI (18+ pts)
E	20-25 mons	23-29 mons	26-33 mons	30-38 mons	35-44 mons	40-50 mons

(b) It shall be a **Class 1 misdemeanor for any person to fish or to hunt using an unmanned aircraft system**. http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-401.24.html

(c) The following definitions apply to this section:

(1) To fish: As defined in G.S. 113-130.

(2) To hunt: As defined in G.S. 113-130.

(3) Unmanned aircraft: As defined in G.S. 15A-300.1.

(4) Unmanned aircraft system: As defined in G.S. 15A-300.1

(5) Weapon. - Those weapons specified in G.S. 14-269, 14-269.2, 14-284.1, or 14-288.8 and any other object capable of inflicting serious bodily injury or death when used as a weapon.

NC UAS legislation

- **14-401.24. Unlawful possession and use of unmanned aircraft systems**

  (d) This section **shall not prohibit possession or usage of an unmanned aircraft or unmanned aircraft system that is authorized by federal law or regulation.** (2014-100, s. 34.30(d).)

A Raven, which is a surveillance and recon UA that the Army trains with at Fort Bragg, being launched in Afghanistan.

http://www.fayobserver.com/military/officials-larger-drones-to-be-added-to-fort-bragg-arsenal/article_b2043156-d1dc-5bf5-a113-8c68570689e6.html

An MQ-1C Gray Eagle (Sky Warrior), which is a combat UA capable of carrying missiles and laser-guided bombs, that will be added to Fort Bragg's arsenal and fly over sparsely populated areas of NC.

http://www.militaryfactory.com/imageviewer/ac/gallery-ac.asp?aircraft_id=785

Presumably, this article was included so that North Carolina regulations would not prohibit the U.S. military from flying unmanned aircraft over the state.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-401.24.html

NC UAS legislation

- **§ 14-401.25. Unlawful distribution of images**

  It shall be a **Class A1 misdemeanor to publish or disseminate, for any purpose, recorded images taken by a person or non-law enforcement entity through the use of infrared or other similar thermal imaging technology attached to an unmanned aircraft system**, as defined in G.S. 15A-300.1**, and revealing individuals, materials, or activities inside of a structure without the consent of the property owner.** (2014-100, s. 34.30(e).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-401.25.html

NC UAS legislation

- **§ 113-295. Unlawful harassment of persons taking wildlife resources**

(a) It is **unlawful** for a person **to interfere intentionally with the lawful taking of wildlife resources or to drive, harass, or intentionally disturb any wildlife resources for the purpose of disrupting the lawful taking of wildlife resources.**

It is **unlawful to take or abuse property, equipment, or hunting dogs that are being used for the lawful taking of wildlife resources**.

This subsection **does not apply to a person who incidentally interferes with the taking of wildlife resources while using the land for other lawful activity such as agriculture, mining, or recreation**.

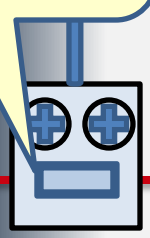
This subsection also does not apply to activity by a person on land he owns or leases. **Violation of this subsection is a Class 2 misdemeanor for a first conviction** and a **Class 1 misdemeanor for a second or subsequent conviction**.

(a1) It is **unlawful to use an unmanned aircraft system**, as defined in G.S. 15A-300.1, **to violate subsection (a) of this section. Violation of this subsection is a Class 1 misdemeanor.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_113/gs_113-295.html

This statute was originally enacted in 1987, which was well before UAS technology emerged.

Article **(a1)** was added to specify that using a UAS to harass hunters would qualify as interference.



NC UAS legislation

- **§ 113-295. Unlawful harassment of persons taking wildlife resources**

(b) The Wildlife Resources Commission may, either before or after the institution of any other action or proceeding authorized by this section, institute a civil action for injunctive relief to restrain a violation or threatened violation of subsection (a) of this section pursuant to G.S. 113-131.

The action shall be brought in the superior court of the county in which the violation or threatened violation is occurring or about to occur and shall be in the name of the State upon the relation of the Wildlife Resources Commission.

The court, in issuing any final order in any action brought pursuant to this subsection may, in its discretion, award costs of litigation including reasonable attorney and expert-witness fees to any party. (1987, c. 636, s. 3; 1993, c. 539, s. 864; 1994, Ex. Sess., c. 24, s. 14(c); 2014-100, s. 34.30(f).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_113/gs_113-295.html

Path to a UAS program

Obtain Support

- Leadership
- Key Community Partners
- Expertise / Knowledge Source

Initial Research

- Anticipated Missions
- Potential locations
- Airspace
- Staffing impact
- Risk Management
- Product options

Develop Integration Plan

- Familiarization
- Training
- Community education
- Identify initial missions
- Timelines

Obtain Funding and Purchase

- Aircraft
- Ground support equipment
- Maintenance supplies
- Training
- Staffing

Obtain FAA Certificate of Authorization (CoA)

- Specific to aircraft type and location
- Follow prescribed SOPs and C2 requirements
- Require FAA approved training
- Line of sight monitoring
- Not to be used for commercial benefit

Start Flight Ops

- On-location familiarization
- Scenario-based training
- Mission authorizations (warrants, DoD deconfliction, land owner approval)
- FAA reporting

Steps to implementing UAS technology into your enterprise

1. How would you use it?:
   a. If you want to map large areas (e.g. fields, surface mines, large construction sites, or pipelines) that have open areas for launching and landing, then get a fixed-wing UAS.
   b. If you want to map small areas (e.g. home parcels or small construction sites) or conduct a close-up inspect of infrastructure items (e.g. bridges, power poles, or dams) that may or may not have large open areas for launching and landing, then get a multirotor UAS.

Steps to implementing UAS technology into your enterprise

2. Would it be profitable?: Conduct a cost-benefit analysis
   a. **Costs:**
      1). Equipment and software
      2). Training on equipment and software
      3). Administrative costs for applying for an FAA Section 333 Exemption AND an FAA civil Certificate of Waiver or Authorization (COA), which will both eventually be replaced by an FAA commercial license and an NC commercial permit.
      4). Time spent preparing for the FAA aeronautical test & the NC UAS regs test
   b. **Benefits:**
      1). Scaled aerial imagery in RGB and infrared
      2). Point clouds, TINs, DEMs, and DSMs
      3). Sensor readings (thermal, multispectral, LiDAR, gas) and streaming live video

Steps to implementing UAS technology into your enterprise

2. Would it be profitable?: Conduct a cost-benefit analysis
   c. Study the "***UAS – Business Decision in Private Practice***" presentation by Joe Bruno, PLS

http://www.ncgs.state.nc.us/Documents/UAS%20Business.pdf

Steps to implementing UAS technology into your enterprise

3. Research various UAS models for the UAS type (fixed-wing or multirotor) that would best fit your needs
   a. Take your time, because:
      1). Equipment costs will get cheaper each year.
      2). Equipment capabilities will increase each year.
   b. Study the presentations from the UAS-Geomatics conferences:
      1). 2013 conference (http:// www.uav-g.org/presentations_online.htm)
      2). Upcoming 2015 conference (http://www.uav-g-2015.ca/), which will be held Aug 30 – Sept 2, 2015 in Toronto, Ontario

Steps to implementing UAS technology into your enterprise

4. Get a recreational version and practice on it

   a. Although this advice is far more important for potential multirotor users than for fixed-wing users, because the fixed-wing UAS models basically fly themselves along preset routes, it is still a good idea to familiarize yourself with flying a small aircraft that costs $100 rather than with an aircraft costing tens of thousands of dollars.

      Hint: Watch the Extreme Drone Crashes - Compilation 2015 video (https://www.youtube.com/watch?v=P9rnTk6FBzs).

   b. Buy from a local hobby store rather than from an online source. Why?

      1). You can ask for advice on which model to purchase as a trainer model:

- Blade Nano QX (http://www.bladehelis.com/Products/Default.aspx?ProdID=BLH7600) for indoor practicing
- Dromida Ominus (http://dromida.com/air/dide01xx-ominus/index.html) for outdoor practicing

Steps to implementing UAS technology into your enterprise

4. Get a recreational version and practice on it

   b. Buy from a local hobby store rather than from an online source. Why?

      2). You can ask about local sites to fly your aircraft and meet other people who really know their stuff!

      Note: The Academy of Model Aeronautics (www.modelaircraft.org/clubsearch.aspx) lists 14 sites within 75 miles of Sylva.

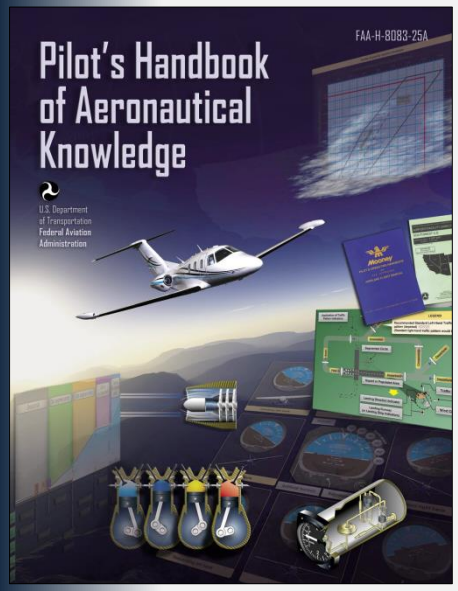
      3). You can ask for advice on which battery charger to purchase.

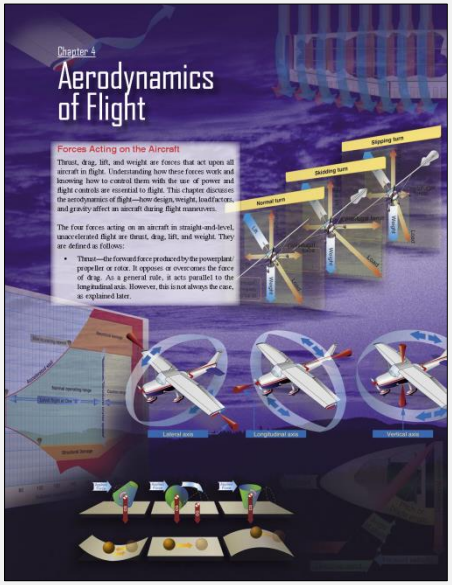
      Note: The small multirotors come with a USB battery charger, which you can charge off of your computer or a phone charger. Unfortunately, a phone charger's amperage is generally higher than what the USB charger can handle and my computer seemed hotter than normal when I used it to charge my batteries.

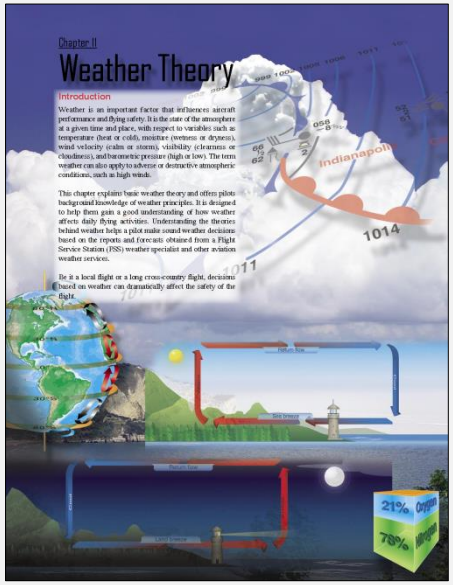
Therefore, a hobby store staff recommended purchasing a good battery charger, such as a Venom Pro 3 (http://www.atomikrc.com/products/venom-pro-charger-3-lipo-and-nimh-battery-charger), that can charge multiple battery types and an adapter that can charge multiple batteries at time (http://www.atomikrc.com/products/venom-1-cell-battery-charge-adapter-micro-jst-jst-ph).

Steps to implementing UAS technology into your enterprise

5. Start studying for the FAA aeronautical test
   a. Study the [Pilot's Handbook of Aeronautical Knowledge]





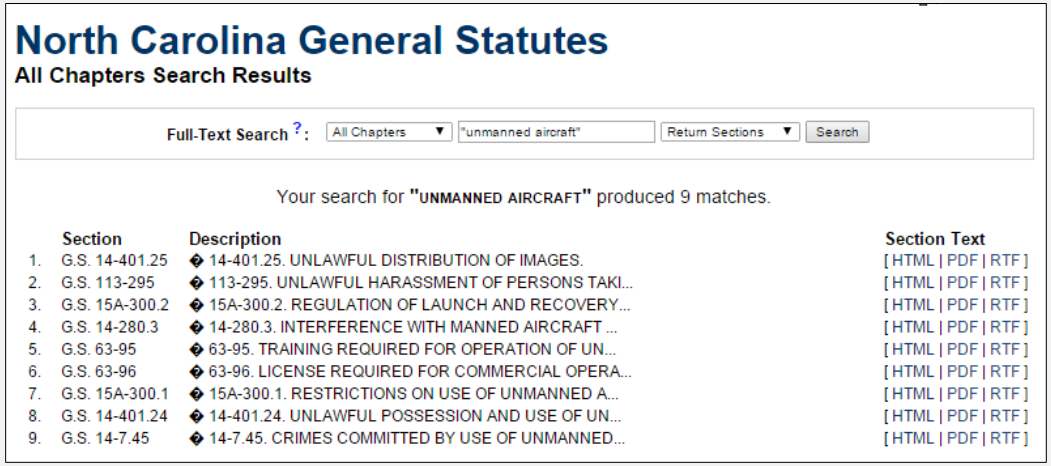


http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/

Steps to implementing UAS technology into your enterprise

6. Start studying for the NC UAS regulations test
   a. Review the NC regulations section of this presentation
   b. Check for updates on each listed UAS regulation as well as for any new UAS legislation (http://www.ncleg.net/gascripts/Statutes/StatutesSearch.asp?searchScope=All&searchCriteria=%22**unmanned**+**aircraft**%22&returnType=Section)

NCGA
NORTH CAROLINA GENERAL ASSEMBLY



North Carolina General Statutes

All Chapters Search Results

Full-Text Search ?: All Chapters | "unmanned aircraft" | Return Sections | Search

Your search for "UNMANNED AIRCRAFT" produced 9 matches.

	Section	Description	Section Text
1.	G.S. 14-401.25	14-401.25. UNLAWFUL DISTRIBUTION OF IMAGES.	[HTML | PDF | RTF]
2.	G.S. 113-295	113-295. UNLAWFUL HARASSMENT OF PERSONS TAKI...	[HTML | PDF | RTF]
3.	G.S. 15A-300.2	15A-300.2. REGULATION OF LAUNCH AND RECOVERY...	[HTML | PDF | RTF]
4.	G.S. 14-280.3	14-280.3. INTERFERENCE WITH MANNED AIRCRAFT ...	[HTML | PDF | RTF]
5.	G.S. 63-95	63-95. TRAINING REQUIRED FOR OPERATION OF UN...	[HTML | PDF | RTF]
6.	G.S. 63-96	63-96. LICENSE REQUIRED FOR COMMERCIAL OPERA...	[HTML | PDF | RTF]
7.	G.S. 15A-300.1	15A-300.1. RESTRICTIONS ON USE OF UNMANNED A...	[HTML | PDF | RTF]
8.	G.S. 14-401.24	14-401.24. UNLAWFUL POSSESSION AND USE OF UN...	[HTML | PDF | RTF]
9.	G.S. 14-7.45	14-7.45. CRIMES COMMITTED BY USE OF UNMANNED...	[HTML | PDF | RTF]

http://www.ncleg.net/gascripts/Statutes/StatutesSearch.asp?searchScope=All&searchCriteria=%22**unmanned**+**aircraft**%22&returnType=Section/

Steps to implementing UAS technology into your enterprise

7. Become familiar with NC airspace
   a. Request the following items from the NCDOT Division of Aviation (http://www.ncdot.gov/aviation/products/):
      1). North Carolina Aeronautical Chart
      2). North Carolina 2015-16 Airport Guide (www.ncdot.gov/aviation/download/AirportGuide.pdf)

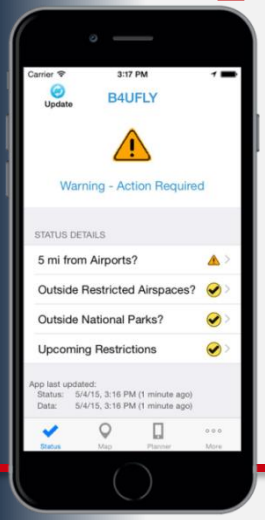
http://www.ncdot.gov/aviation/products/

Steps to implementing UAS technology into your enterprise

7. Become familiar with NC airspace

   b. Install the B4UFLY app, which is an easy way to determine whether there are any restrictions or requirements in effect at the location where you want to fly a UAV.

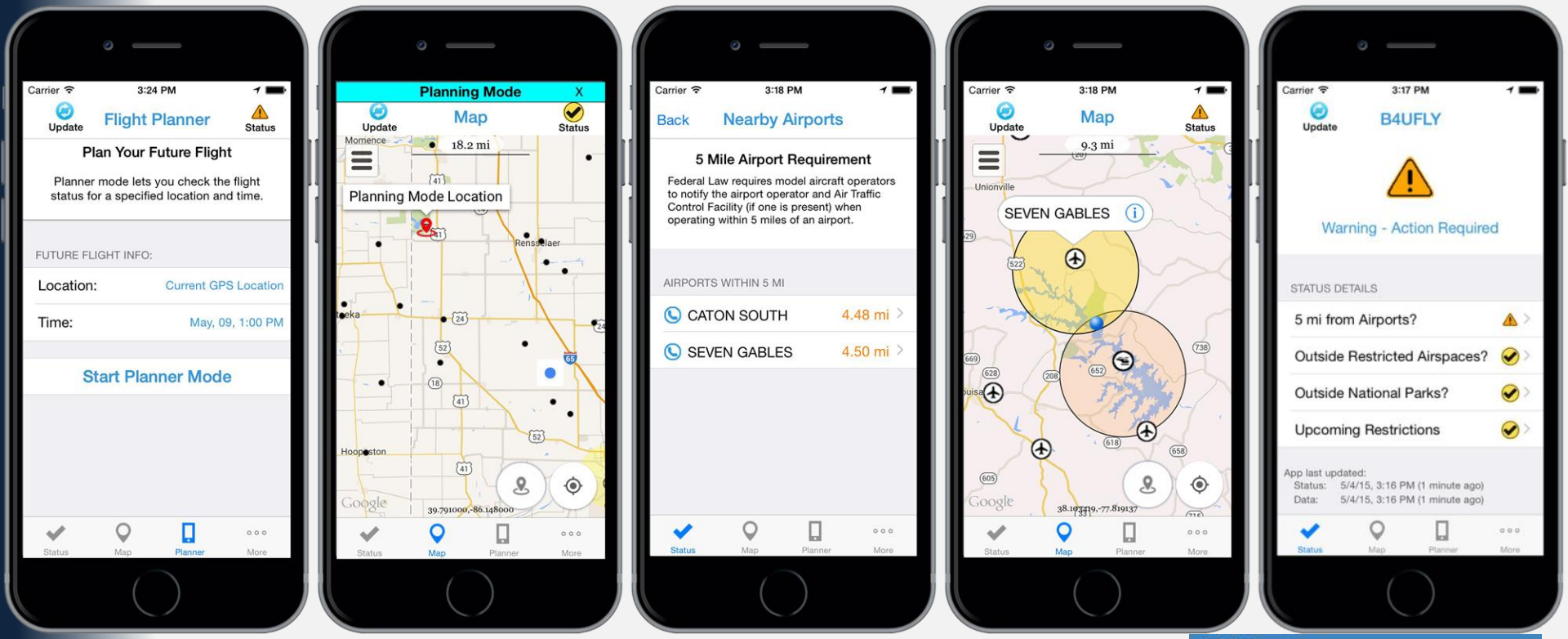
   - FAA plans to release the iOS app to ~1,000 beta testers during the summer of 2015 and then run the test for several months. Eventually, the agency will release the app to the general public and make an Android version.
   - Key features:
     - A "Planner Mode" for future flights in different locations
     - A clear "status" indicator that immediately informs the operator about his/her current or planned location. Information on the parameters that drive the status indicator
     - Informative, interactive maps with filtering options
     - Contact information for nearby airports
     - Links to other FAA UAS resources and regulations



FAA B4UFLY Smartphone App

http://www.faa.gov/uas/b4ufly/

FAA: B4UFLY Smartphone App



FAA B4UFLY Smartphone App

http://www.faa.gov/uas/b4ufly/

North Carolina
Emergency Management

EMERGENCY MANAGEMENT EMAP Accredited ACCREDITATION PROGRAM

N★C DPS DEPARTMENT OF PUBLIC SAFETY

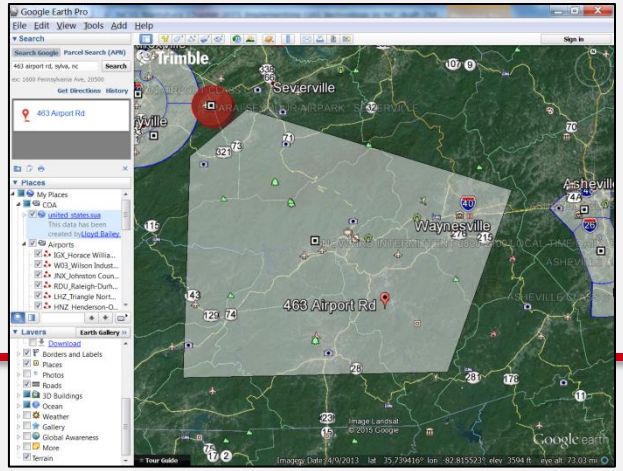
Steps to implementing UAS technology into your enterprise

7. Become familiar with NC airspace

   c. Install Google Earth Pro (http://www.google.com/earth/), which is now free using your email address as your username and “GEPFREE” as the license key, onto your computer

      1). Load the “All of US” airspace KMZ file from the Worldwide Soaring Turnpoint Exchange (http://soaringweb.org/Airspace/NA/HomePage.html)

      2). Draw a 5-mile radius around all the airports (not shown on the Google Earth image below) listed on the FAA aeronautical charts, because if your desired mapping site is within 5 miles of an airport, then you will need to contact that airport to request permission to use a UAS.



http://www.ncdot.gov/aviation/products/

Conclusion

- Tremendous potential
- Costs (equipment, software, training on the equipment and software, and education about aeronautics and regulations), but the equipment cost will get cheaper each year and the equipment capabilities will increase each year.
- Safety: Yourself, bystanders on the ground, and manned aircraft