

Rangeland Resource Assessment, Monitoring, And Management Using Unmanned Aerial Vehicle-based Remote Sensing

or



How can you legally fly with all the "new" FAA regulations on the use of UAVs, and is it affordable?

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Introduction

We own and fly a small Unmanned Aerial Vehicle (UAV). The system consists of an airplane, weighing about 22 lbs., a catapult launcher, and a computer control system, all costing \$48,000. It comes with a video camera and a consumer grade digital camera (10 mp). But we are in the process of replacing the video camera with a 6-band multispectral camera (Tetracam MiniMCA). Purchase from a UAV manufacturer that supplies not only training but continuing technical support is recommended.



Frequently Asked Questions and Answers

What are the capabilities of the Jornada MLB Bat-3 UAV?

Specifications for MLB Bat-3 UAVs

Power	Gas	Max Altitude	3,048 m
Wingspan	1.8 m	Endurance	5 hrs
Length	1.4 m	System Cost	\$48,000
Gross Weight	10 kg	Sensors	Video, digital camera
Payload Weight	1.1 kg	Manufacturer	MLB Co.
Max Speed	30.9 m/s	Launch	Catapult
Operational Speed	18.0 m/s	Landing	On Wheels

Do you make use of all the UAV capabilities?

Answer: Unfortunately not because of FAA regulations for flying in the U.S. National Airspace System (NAS) which are very similar to flying manned aircraft. A whole set of regulations are under preparation but will not be available for 5-10 years in final form.

What do the FAA regulations not allow that you would like to do?

Answer: Launch UAV, send it out 16 km to study area, go into photo flight pattern, return to landing site, all autonomously.

Reason we can't do this: The UAV external pilot has to remain in line-of-sight contact with the aircraft at all times for emergency control purposes, this is about 0.8-1.1 km.



Line-of-sight must be maintained by the external pilot at all times, so if distance exceeds 1.1 km, we must move the external pilot.

Then, what are the steps necessary to fly in FAA-NAS?

Steps in order to fly UAVs in the National Airspace System Under FAA Regulations

1. Qualifications, Exams, Training (Examples)

- FAA Ground School (for external and internal pilots)
- Second class or higher FAA airman's medical certificate
- FAA Private Pilot's License (Pilot-in-Command)

2. Application for Certificate of Authorization (COA) (Examples)

- Ownership of UAV by public government entity
- Submit COA application with a 3-6 month waiting period

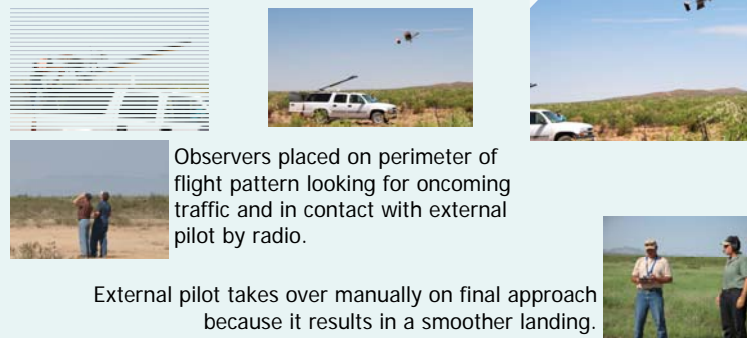
3. Flying the UAV (Examples)

- Receive COA and fly according to all specifications in COA
- Pre-flight planning to
 - establish home location coordinates for use after launch and in case of loss of link to UAV
 - establish flight pattern for travel to and from test site and for photography over test site with desired forward and sidelap; always maintain line-of-sight contact
- Flight Mission
 - issue Notice to Airman (NOTAM) 48 hours before flight
 - conduct flight crew briefing before flight and de-briefing after flight
 - conduct airplane and control center checklists

4. Documentation (Example)

- Update log books and keep complete records

Catapult launch and radio control landing



Sequence of Jornada Bat-3 smooth landing.

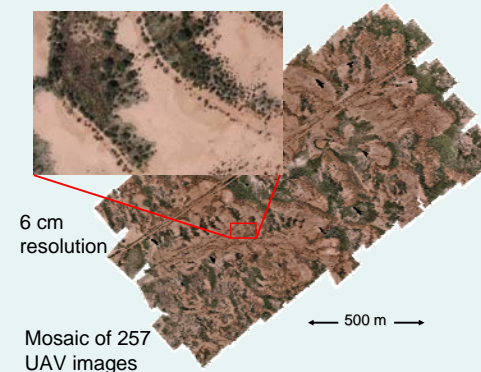
What other things must be done?

- Grade a short runway which can only be 50 m and can just be a slightly improved dirt road without fencing on either side.
- Flight plan not only needs to be done to assure overlapping images at study area but also needs to be arranged to move the pilot and the UAV in incremental steps. This is because we do not have sense-and-avoid capabilities.

Map of a UAV flight operation in the NAS at the JER. The initial external pilot (EP) position is at P0. The UAV is launched at the red cross position into the launch orbit, and is then moved to the H1 holding orbit. Once the EP has moved from P0 to P1, the UAV acquires imagery over the first flight area in the northwest near P1. After completion, the UAV is moved back to H1. The EP moves back to P0. The UAV is moved to the H2 holding orbit. The EP travels to P2. The UAV then acquires imagery over the second flight area in the east near P2. The same procedure is repeated for the southern flight area near P3 and the return to the landing site. The objective is to keep the UAV within visual range and control of the EP.

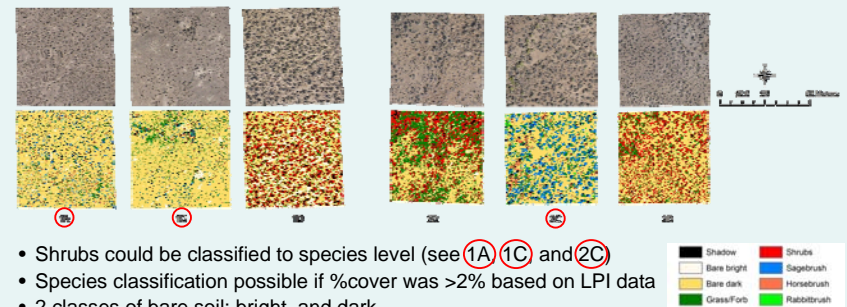


What products can result?



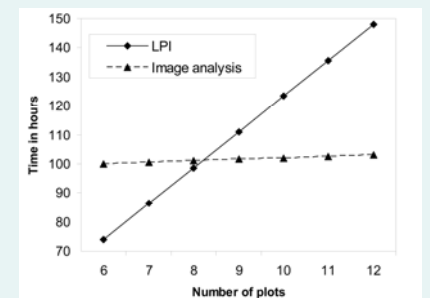
Off line, image data needs to be downloaded upon landing and those individual data need to be processed with our custom software to produce orthorectified image mosaics from 200-400 images.

Idaho Mission (at ARS Reynolds Creek Watershed, funded by BLM)



- Shrubs could be classified to species level (see 1A, 1C and 2C)
- Species classification possible if %cover was >2% based on LPI data
- 2 classes of bare soil: bright, and dark

UAV Image Analysis becomes more cost effective than the ground-based LPI Approach when study plots > 8. When comparing UAV classification with LPI data, R² values range from 0.86-0.98.



Outcome

1. This method is legal but somewhat slow. It takes at least 4 times as long to get the data and much more time planning the missions, BUT, we get the data we need.
2. We now have a highly trained UAV flight crew who potentially can fly anywhere in the United States. Two of the crew have their FAA private pilot's licenses. The flight team has allowed us to be recognized as working on the cutting edge of civil UAV applications.
3. We are integrating different remote sensing approaches into the National Airspace System.
4. We have an operational system that can acquire UAV data over rangelands which make up 50-70% of the Earth's land cover.
5. We are hoping that this positive experience will be worked into FAA regulations in a way that takes note of the remote and isolated lands which we fly over on a regular basis.



Please ask any questions that are not answered here.