Enhancing the Value of Precision Ag Data with Unmanned Aerial Systems (UASs)

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Unmanned Aerial Systems (UASs)

Current FAA Regulations

UASs
UAV, cameras, communications, auto-pilot

Applications
Current FAA Regulatory Environment

• Public UASs can fly under a Certificate of Authorization (COA).
  – Government entities at the Federal & State levels
    • Universities
    • Law Enforcement
    • Fish and Wildlife
    • NRCS
    • USGS
  – UAS that meets the qualifications and conditions required for operation of a public aircraft.
  – Private companies can partner with Government entities to fly under the entity’s COA
Current FAA Regulatory Environment

- No commercial UASs activity is currently authorized outside of the Arctic.
  - Commercial UAS flights have met with cease and desist letters & civil fines

<table>
<thead>
<tr>
<th>Hobby or Recreation</th>
<th>Not Hobby or Recreation</th>
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<tbody>
<tr>
<td>Flying a model aircraft at the local model aircraft club</td>
<td>Receiving money for demonstrating aerobatics with a model aircraft</td>
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<tr>
<td>Taking photographs with a model aircraft for personal use</td>
<td>A realtor using a model aircraft to photograph a property that he/she is trying to sell and publishing the photos in a real estate listing</td>
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<tr>
<td>Using a model aircraft to move a box from point to point without any kind of compensation</td>
<td>Delivering packages to people for a fee</td>
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<tr>
<td>Viewing a field to determine whether crops need water when they are grown for enjoyment</td>
<td>Determining whether crops need to be watered that are grown as part of a commercial farming operation</td>
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Current FAA Regulatory Environment

• Section 333 - Regulatory Exemptions that would allow UAS to operate commercially with FAA approval before an UASs rule is adopted.
  – Industries that have sought exemptions
    ✓ Motion Pictures (MPPA) - Granted September 25th 2014
    ✓ Precision agriculture
    ✓ Electric power line and pipeline inspection
    ✓ Oil and gas flare stack inspection

FAA mandated to develop a 5 year roadmap for “safe integration” of UASs by September 30, 2015.
Unmanned Aerial Systems (UASs)
Unmanned Aerial Vehicles (UAVs)

**Multirotor UASs**
- Vertical takeoff and landings
- Ability to hover
- Limited flight time
- Difficult to fly if not fully automated
- Requires fully automated flight features for full usability

**Fixed-Wing UASs**
- Hand/catapult launched
- Longer flight time, can cover a lot of area
- Difficult to fly if not fully automated
- Requires fully automated flight features for full usability
- Minimal maintenance, modest expenses

AgriEye

senseFly
**Flight Coverage**

- **Field Size:** ≈ 40 acres
- **Flight Speed:** ≈ 16 ft/sec
- **Flight Time:** 18 minutes

- **Field Size:** ≈ 92 acres
- **Flight Speed:** ≈ 16 ft/sec
- **Flight Time:** ≈ 42 minutes

**Battery Technology is Evolving**
Communications
GPS/Autopilot
Cameras

UASs are a Platform to Collect Precision Ag Data

- Video - Get live video feed on monitor, laptop or tablet
- R, G, B Cameras (Red, Green and Blue)
- Multispectral Cameras (R, G, B, NIR)
- Hyperspectral Imaging Cameras
- Thermal Imaging Cameras
- Lidar (Elevation)

Camera Technology is Rapidly Evolving!
Integrating UASs in Your Farming Operation

What are you hoping to do with the data?

Flying
- The type of UAS you need
- The type of camera you need

Data Processing
- Do you process the data yourself
- Computing power requirements
- How do you move and store data

Agronomic Decisions
- Are you set-up to use the data?

Are you set-up to use the data?
Directed Scouting

Gives you a bird’s eye view

- Equipment
  - UASs – Rotary-Wing
  - GPS/Autopilot
  - GoPro video camera
  - Gimbal camera mount
  - Ability to live stream video to the ground
  - Monitor, laptop, tablet or smartphone
Directed Scouting

- Directed Scouting
  - Diseases
  - Insects
  - Weeds
  - Crop Progress
  - Crop Stress

Diseases

Crop Progress

Weeds
Mapping

- **Equipment**
  - UAS – Fixed-Wing or Multicopter
  - GPS/Autopilot
  - Camera
  - Laptop, tablet
  - Internet access

- AgriEye
- Precision Drone
- Precision Scout
- Trimble UX5
- Altavian NOVA F6500
Integrating UASs in Your Farming Operation

- Mapping
  - Replanting Decisions
  - Drainage Issues
  - Crop Insurance Claims
  - VRA Crop Inputs
  - Yield Estimation
  - Soil/Vegetation Moisture Monitoring
Mapping
Variable Rate Application of Crop Inputs

Factors Influencing the Data
- Sunlight Intensity
- Sun Angle
- Time of Day

The Technology is Evolving!
Stressed Plants Have Higher Leaf Temperatures

Factors Influencing the Data
- Cloud cover
- Wind

Mapping
Plant Health Monitoring

The Technology is Evolving!

ROBOFLIGHT

Cornerstone Mapping
Processing the Data

Mapping Requires

• Stitching pictures together
• Orthorectifying the image
• Georeferencing the image
• Process the data
• Generate a useable map
Processing the Data

You Process the Data

- Open source software (VisualSFM & CMVS)
  - Free!

- Agisoft Photoscan Pro
  - ~$3500

- Pix4D
  - Rent or..
  - ~$8500

- Vendor Supplied Software
  - Included in the price of the UASs
Processing the Data

Third Party Vendors

- **Dronemapper**  [dronemapper.com/](dronemapper.com/)
  - 1 sq. mi. ~ $60
  - (high res. $180)

- **ROBOFLIGHT**  [roboflight.com/](roboflight.com/)
  - AgPixel
  - ~$500/year

- **New Startup Companies**
Flight Coverage

Field Size: ≈ 40 acres
Flight Speed: ≈ 16 ft/sec
Flight Time: 18 minutes
Number of Pictures: 37
File Size: ≈ 111 MB

Field Size: ≈ 92 acres
Flight Speed: ≈ 16 ft/sec
Flight Time: ≈ 42 minutes
Number of Pictures: 152
File Size: ≈ 450 MB
Processing the Data
Questions to Think About

• Moving data around
  – What kind of internet speed do you have
  – Consumer grade internets are built for download not upload
  – Companies may throttle your internet with too much use

The Industry is Evolving!
Take Home Message

• UASs have the potential to make your farming operation more sustainable
• Know what you want to do with a UAS before buying one
• Directed scouting is the easiest application
• Mapping brings about data processing challenges
• Potential for inaccurate data without proper data capture and processing
• While UASs maybe fun to fly, don’t consider them toys
Questions