Using Drones in Your Sports Field Management Program

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What Will Be Covered

- Rules & Regulations for Flying
- Licensing
- Types of Drones
- Uses of Drones
  - Sports Fields
- Software
- Cameras
- Mapping

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What does the FAA consider a drone?

- Unmanned Aircraft System
  - “Aircraft without a human pilot onboard – instead, the UAS is controlled from an operator on the ground.”

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Different Levels of Drones

- *Consumer Drones* (Aerial Photography, Marketing, Pix4d Mapping and NDVI)
  - Mavic Pro and Phantom Series
  - $1000-$2500

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Mavic Pro

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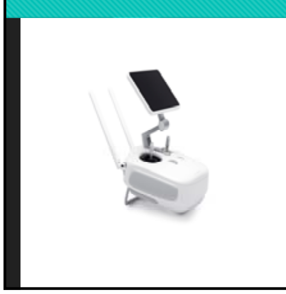
Phantom 4 Pro



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Different Levels of Drones

- *Commercial Drones* (Infrared heat sensing, search and rescue, advanced mapping, NDVI)
  - DJI Matrice and Inspire
  - $2000-$15,000
  - Both Models capable of more technical flying and high end, customizable camera attachments
  - Latest and Greatest Flir XT2 Combines 4K camera and thermal imaging in one lens. $10,000-$20,000

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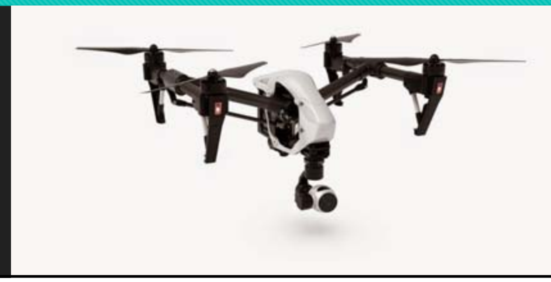
Inspire Series



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Camera attachments for Inspire

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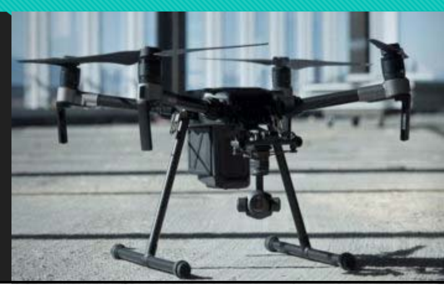
Matrice Series



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Regulations for Flying

Fly under the Special Rule for Model Aircraft (Section 336)	Fly under the FAA's Small UAS Rule (Part 107)
•Fly for hobby or recreation ONLY	•Fly for recreational OR commercial use
•Register your model aircraft	•Register your drone
•Follow community-based safety guidelines and fly within the programming of a nationwide community-based organization	•Get a Remote Pilot Certificate from the FAA
•Fly a model aircraft under 55 lbs. unless certified by a community-based organization	•Fly a drone under 55 lbs.
•Fly within visual line-of-sight	•Fly within visual-line-of-sight*
•Never fly near other aircraft	•Don't fly near other aircraft or over people*
•Notify the airport and air traffic control tower prior to flying within 5 miles of an airport	•Don't fly in controlled airspace near airports without FAA permission*
•Never fly near emergency response efforts	•Fly only during daylight or civil twilight, at or below 400 feet*
	* These rules are subject to waiver.

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What is commercial use? (Part 107)

- Any use in connection with a business:
  - Selling photos or videos taken
  - Contracted services
  - Security or telecommunications
  - Monitoring progress of work

  - Using imagery as a management decision

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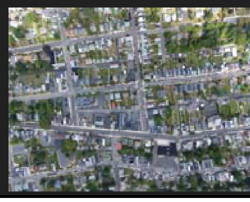
Part 107 Rules

- Register unmanned aircraft ($5 per aircraft, every 3 years)
- Unmanned aircraft must weigh less than 55 pounds
- Fly in Class G Airspace
- Keep aircraft in visual line-of-sight
- Fly at or below 400 feet
- Fly during daylight
- Fly at or below 100 mph
- Yield to manned aircraft
- Do not fly directly over people



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Becoming a Licensed Remote Pilot

- Schedule a test at a Knowledge Testing Center (usually at airports)
- Pass initial aeronautical knowledge test
- Complete FAA Form 8710-13 for a Remote Pilot Certificate
- Pass TSA Background Check
- Complete recurrent training course or knowledge test (again) every 24 months

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Taking the Knowledge Test

- Regulations
- Airspace classifications
- Weather
- Aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communications
- Performance of aircraft
- Effects of drugs and alcohol
- Decision making
- Airport Operations
- Maintenance & preflight inspections

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Airspace Restrictions

- Security Sensitive Restrictions
- Temporary Flight Restrictions (TFRs)
- Restricted or Special Use Airspace
- Stadiums and Sporting Events
- Wildfires
- Airports

- Use http://knowbeforeyoufly.org

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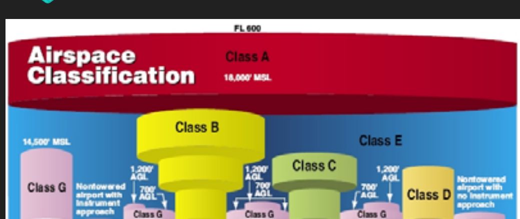
Airspace Classification



https://www.faasafety.gov/gslac/ALC/course_content.aspx?cID=42&sID=505&preview=true

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https://skyvector.com/

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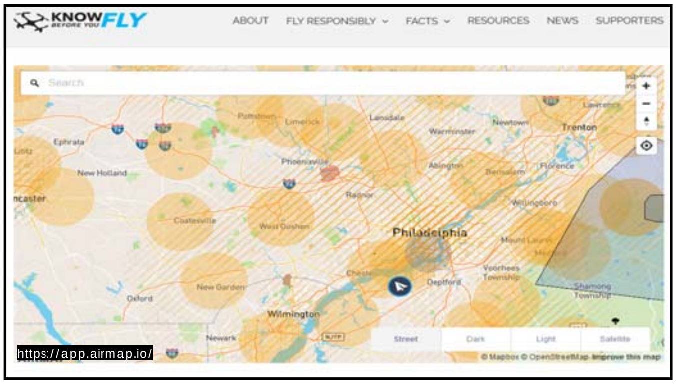

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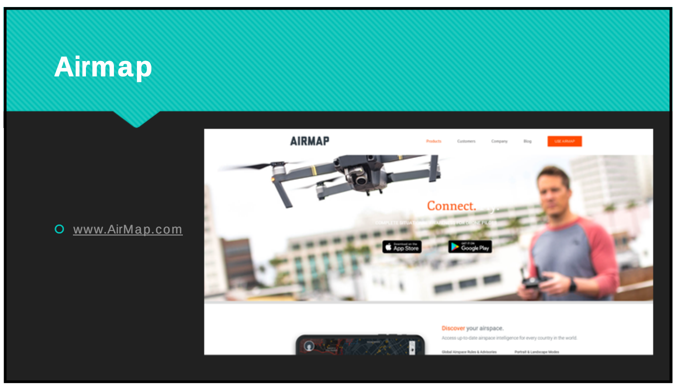

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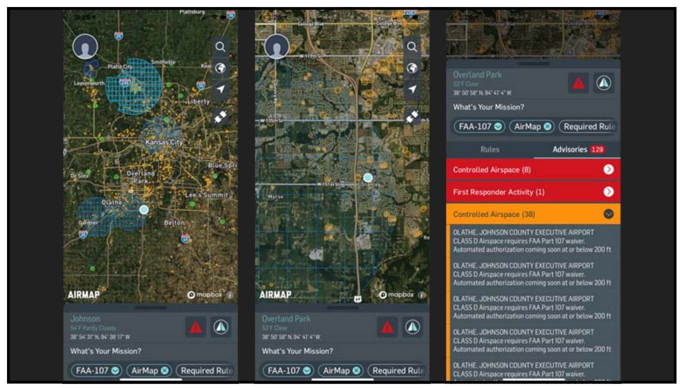

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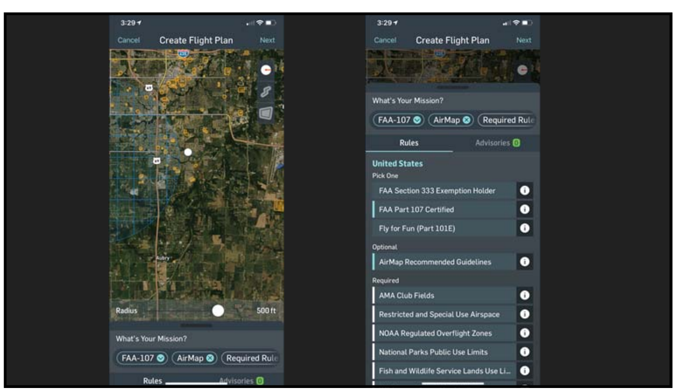

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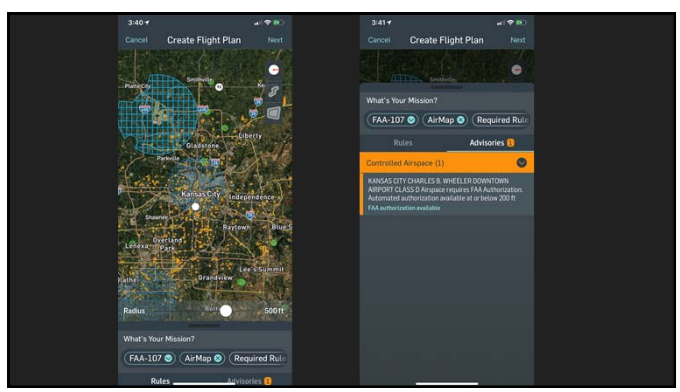

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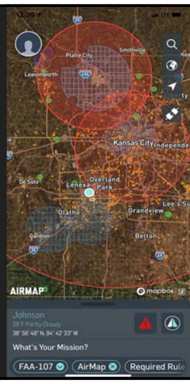

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METARs (Meteorological Aerodrome Report)

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METAR: KPHL [Philadelphia Intl]
METAR: KPHL 192054Z 00000KT 7SM FEW120 SCT220 BKN280 10/06 A3001 RMK AO2 SLP162 T01000056 56020

- Station Identifier – Philadelphia
- Date and Time – (Day of month – 19, 19:16 Zulu)
- Wind
- Visibility
- Cloud Cover
- Forecasts

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TAFs (Terminal Aerodrome Forecasts)

KPHL [Philadelphia Intl]
TAF: KPHL 191916Z 1919/2024 VRB02KT 5SM HZ SCT012 BKN200
FM192100 21003KT P6SM BKN200
FM200200 VRB03KT 6SM BR BKN015
FM200500 VRB03KT 2SM BR OVC005
FM201600 30009KT P6SM BKN025

- Station Identifier – Philadelphia
- Date and Time – (Day of month – 19, 19:16 Zulu)
- How long it is valid for
- Weather conditions and clouds
- Forecasts

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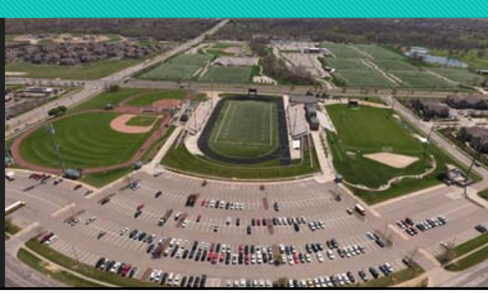
Blue Valley District Activity Complex



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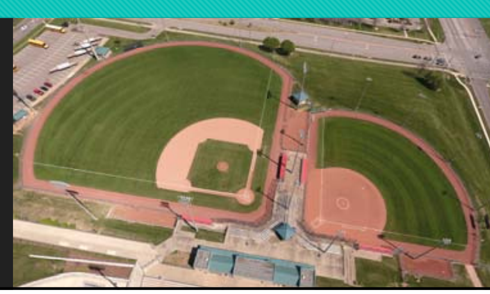
Blue Valley District Activity Complex



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Uses in Sports Field Complex

- Market your properties and show off your hard work!
  - Bonds
  - Create database of photos to track field usage.
- Goal mouths (compare to games played)
- Fertility
- Irrigation coverage

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Bond Photo

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Irrigation Audits

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Fertility

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Goal Mouth April 2017

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Goal Mouth October 2017

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Goal Mouth October 2017

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Pix 4d vs Drone Deploy

PIX4D DroneDeploy

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Pix4D Mapping

- Create large accurate maps of your properties
- Cheaper than Surveyor
- Measure elevation changes, track construction projects and measure amounts of product piled on the surface.
- 3D Models

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PIX4d Vs Drone Deploy

- Purchase software and process photos locally on Desktop
- Cost approximately $5000.00
- Expert program/ more customizations and options.

- Pay Monthly Fee and Drone Deploy processes photos in the “cloud”
- $1000-$3000 per year. Pro and Business
- Great for Beginner; lower startup costs

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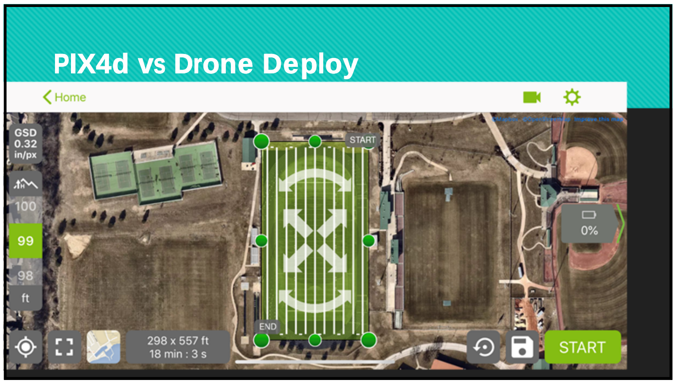

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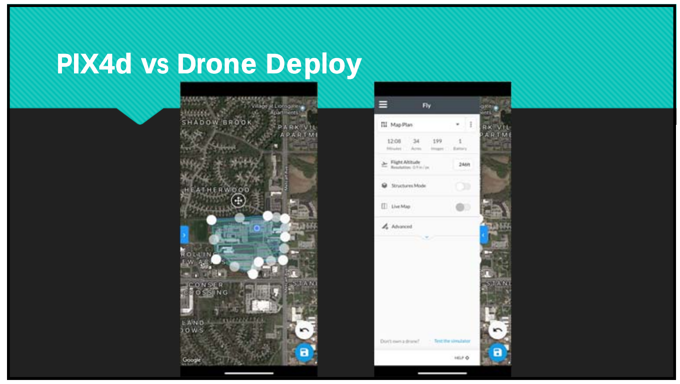

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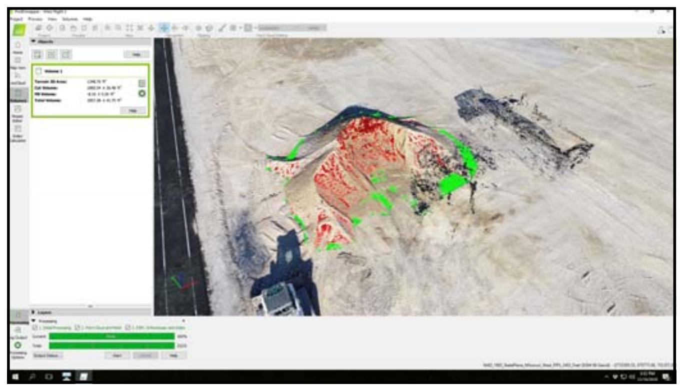

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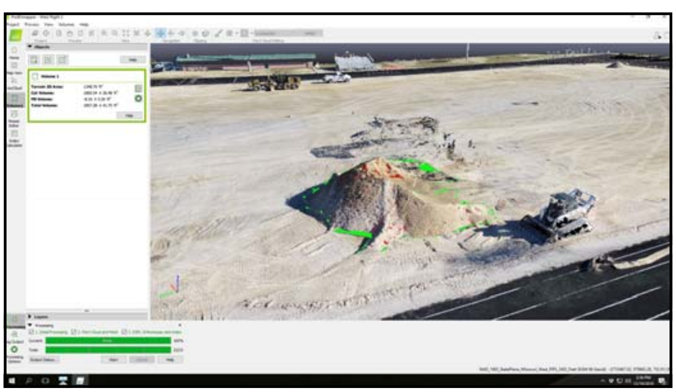

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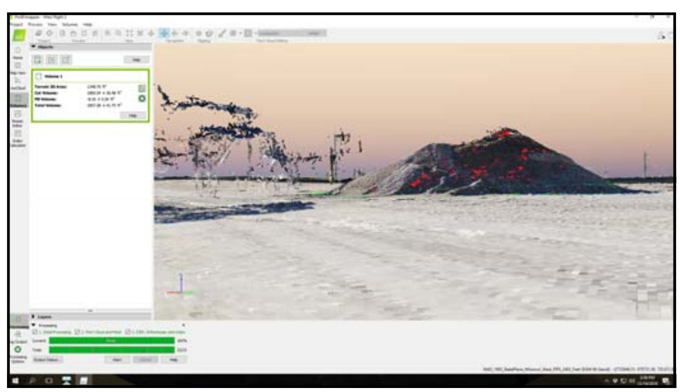

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NDVI Imaging

- What is NDVI? (Normalized Difference Vegetation Index)
- Display traditional Cameral Lens VS NDVI Lens
- Football Fields before and after season to show wear patterns.

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NDVI on Phantom 4

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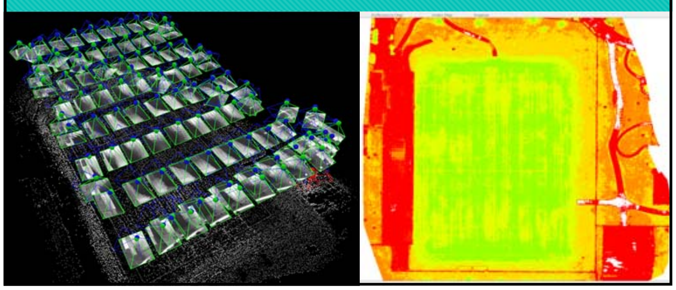
NDVI Photos



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Traditional Camera vs NDVI Blue Valley West Baseball

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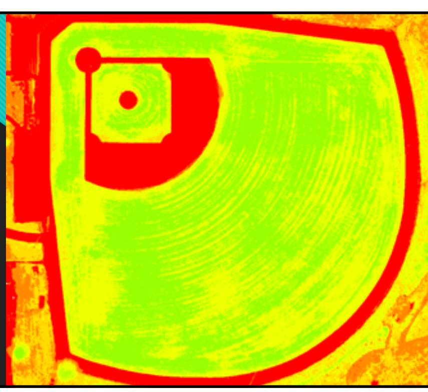

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Traditional Camera vs NDVI Blue Valley West Baseball

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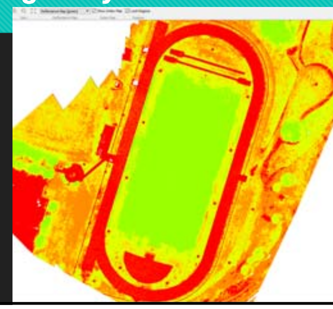
NDVI Image July Pre football season



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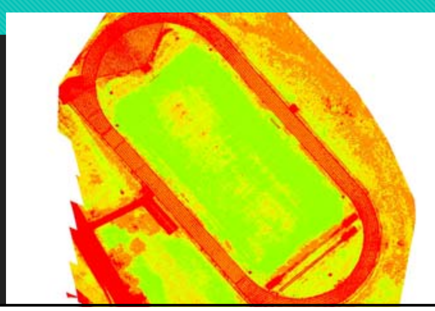
NDVI Image Mid October Post Football Season



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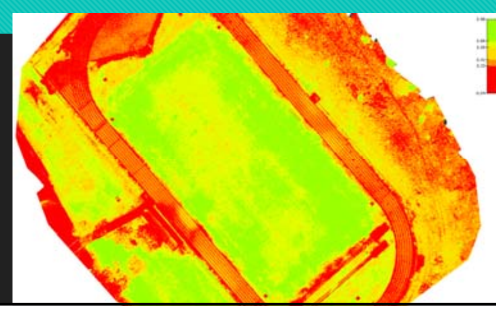
NDVI Mid December



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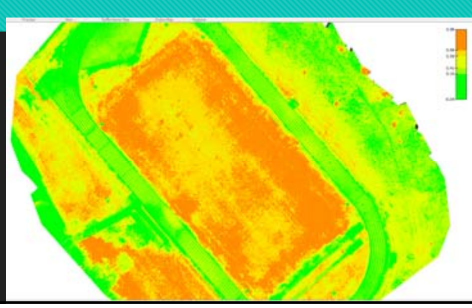
NDVI Inverted



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NDVI Plots

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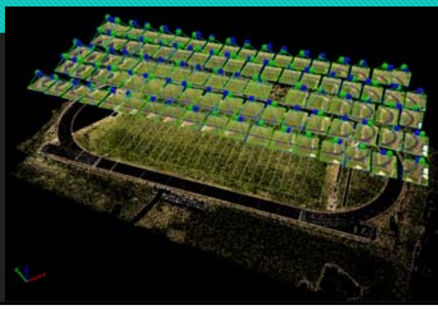
NDVI Plots



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NDVI Quality Report

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	93562
In 3 Images	38436
In 4 Images	20268
In 5 Images	11514
In 6 Images	7712
In 7 Images	5193
In 8 Images	3770
In 9 Images	2785
In 10 Images	1908
In 11 Images	1480
In 12 Images	1104
In 13 Images	828
In 14 Images	606
In 15 Images	422
In 16 Images	333
In 17 Images	209
In 18 Images	179
In 19 Images	106

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FAA UAS Integration

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

Program Overview

Beginning in 2017, the Unmanned Aircraft System (UAS) Integration Pilot Program (IPP) has brought state, local, and tribal governments together with private sector entities, such as UAS operators or manufacturers, to accelerate safe drone integration. The program is helping the U.S. Department of Transportation (USDOT) and Federal Aviation Administration (FAA) craft new rules that support more complex low-altitude operations by

- Identifying ways to balance local and national interests related to drone integration
- Improving communications with local, state and tribal jurisdictions
- Addressing security and privacy risks
- Accelerating the approval of operations that currently require special authorizations.

The program has created a meaningful dialogue on the balance between local and national interests related to drone integration, and provide actionable information to the USDOT on expanded and universal integration of drones into the National Airspace System.

The IPP Lead Participants are evaluating a host of operational concepts, including night operations, flights over people and beyond the pilot's line of sight, package delivery, detect-and-avoid technologies and the reliability and security of data links between pilot and aircraft. Fields that could see immediate opportunities from the program include commerce, photography, emergency management, agricultural support and infrastructure inspections.

UAS INTEGRATION PILOT PROGRAM
U.S. Department of Transportation
Federal Aviation Administration

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FAA UAS Integration Pilot Program

- City of Reno, Nevada
- University of Alaska-Fairbanks
- North Dakota Dept of Transportation
- North Caroline Dept of Transportation
- Memphis-Shelby County Airport Authority
- Lee County Mosquito Control District, Ft. Myers Florida
- Kansas Dept of Transportation
- City of San Diego, California
- Innovation Investment Authority, Herndon, Virginia

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Kansas Dept. of Transportation

- Beyond visual line of sight operations in Rural areas.
- It seeks to leverage a statewide unmanned traffic management system to facilitate precision agriculture operations.

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K-State Polytechnic Research FAA Grant

- **Power Infrastructure Inspection**
- Research includes exploration of UAS relevance to provide high-fidelity inspection data of key power infrastructure elements, such as power lines and associated support equipment, inspection of wind turbine blades for signs of deterioration, as well as unusual hot spots associated with transformers and other equipment at power substations. We also have experience in volumetric coal-pile analysis, power plant inspections, and even internal boiler inspections. Using UAS in these applications reduces the "down time" associated with traditional inspection methodologies, while reducing risk to personnel at the same time.
- **Mapping of Natural Resources**
- Kansas State Polytechnic was selected by the U.S. Bureau of Land Management to help monitor the different stages of health of their land, including some archaeological and prehistoric sites. Kansas State Polytechnic monitors aspects such as vegetation growth, decline, and species invasion. Photos are taken with UAS and manipulated by highly technical software to create a 3D model that can be evaluated each year.

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Summary

- Rules & Regulations for Flying
- Licensing
- Types of Drones
- Uses of Drones
  - Sports Fields
- Software
- Cameras
- Mapping

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