TEXAS A&M AGRILIFE RESEARCH

Agricultural Unmanned Aerial Systems Project

Vision

To provide global leadership in the appropriate use of unmanned aerial systems (UAS), ground vehicles, remote sensing, and data analytics to radically improve agricultural research and applications.

Mission

Facilitate a broad inter-disciplinary team to develop and use agricultural remote sensing technologies for actionable decisions by farmers and researchers and to make new biological discoveries that advance the productivity and sustainability of agriculture.

2015-2016 Success at a Glance

- Collected massive amounts of data with multiple sensors and platforms on a weekly basis throughout the growing season
- Developed a data collection and analysis work flow/procedures to communicate between researchers
- Developed algorithms/programs to analyze and share data
- Developed flight paths to insure optimal ground coverage
- Developed ground control points/reflectance tiles needed to mosaic and extract useful data
- Developed first ground vehicle to clear mature corn and sorghum and sensor suites to validate findings from UAVs
- Published 3 peer-reviewed articles and received 7 external grants

Field Research Goals for 2017

Plant Breeding: We seek to compare varieties and stress treatments in breeding

- **Corn/maize:** Stand counts, height, growth curves, drought, and heat resistance
- **Cotton:** Yield, earliness, seedling vigor, drought tolerance, plant height
- **Sorghum:** Biomass yield, grain yield, growth patterns, plant height, sugarcane aphids
- **Wheat:** Stress tolerance, disease resistance, yield potential
- **Tomatoes, Peppers, Citrus, Spinach:** canopy cover, greenness index

Agronomy: We seek to identify differences and needs in management directly applicable to farmers

- **Weed Science:** Identify herbicide-resistant and other weeds, spray injury from herbicide application
- **Cotton:** Assess cotton defoliation timing, nutrient optimization, irrigation timing and cotton root rot
- **Wheat:** Measure wheat rust and diseases pressure
- **Soils:** Identify management of stress across different soil types

Animal and Pasture: We seek to improve economic and environmental sustainability of pastures for crop and livestock production

- **Rangeland/Pastureland Management:** measure herbage mass, canopy cover, animal (livestock and wildlife) counts, nutritive value, weed encroachment, herding, scouting, etc.
- **Animal Science:** track the health status, behavior, feed-conversion performance, environmental stress, and biosecurity threats of livestock

Equipment

Fixed Wing:

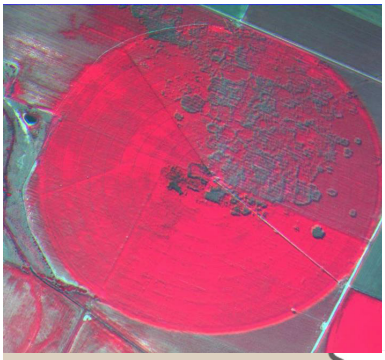
- **Lancaster IV and V** (PrecisionHawk)
- **2 UAV Mappers** (Tuffwing)
- **3 eBees** (SenseFly)

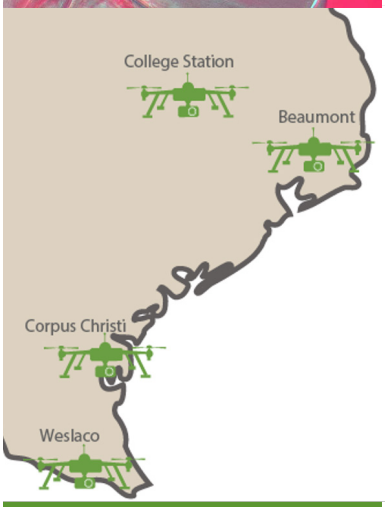
Rotary Wing:

- **Hexacopter** (Turbo Ace Infinity 6)
- **Quadcopter** (DJI Phantom 3, DJI Inspire 2, DJI Matrice, 3DR Solo)

Sensors:

- **Multispectral** (Sentek, Tetracam, Nikon, RedEdge, Sequoia)
- **RGB** (GoPro, Nikon, Sony)
- **Hyperspectral** (Headwall)
- **LiDAR** (Velodyne)
- **Thermal** (FLIR VUE, ICI)





Strategy and Teams

Develop a pipeline for agricultural researchers (basic through applied) and farmers to obtain useful data from unmanned aerial vehicles (UAVs), remote sensing, and ground vehicles. Leverage each researcher's expertise and interest for maximum gain:

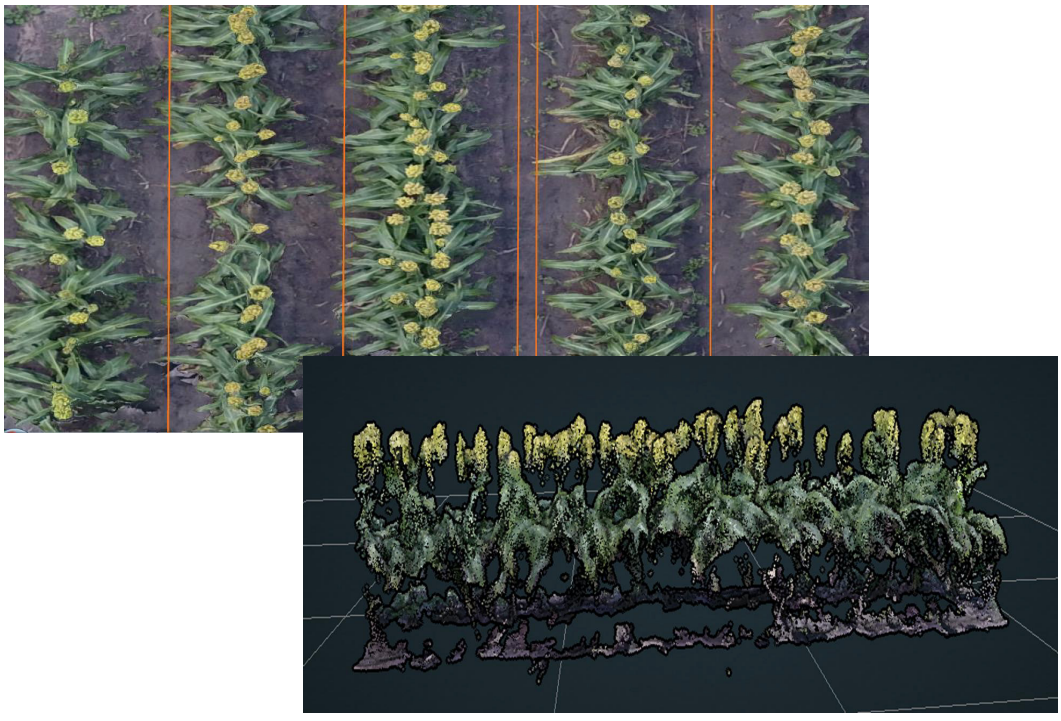
- ***Flight Operations team*** (Mechanical Engineering, Ecosystem Sciences) coordinate with the FAA, plan flight missions, execute flights, and collect useable data
- ***Sensors team*** (Agricultural Engineering, Ecosystem Sciences) manage the sensors used onboard the UAVs, ensure that the image data received by other researchers is of high quality
- ***Data Management team*** (Geography, Ecosystem Sciences) conduct pre-processing to geographically correct images, construct image mosaics, develop algorithms to detect features, extract features from the image, works with other researchers to develop analytic technique
- ***Field Research team*** (Plant Breeding, Crop Science, Soil Science, Weed Science, Plant Pathology, Entomology, Animal Science, and Ecosystems Sciences etc.) primary data users for addressing practical and biological questions. Evaluate quality with respect to the ground-truth data they collect; develop and use analytic tools in order to facilitate basic and applied research. Work with farmers to translate findings
- ***Economic and Social Science team*** (Economics, Social Sciences) address questions of value, acceptance, and ethics in the use of UAS technologies in agriculture
- ***Administration team*** provides and manages funds, coordinates meetings and initiatives, and assists and encourages faculty members in garnering external funding for follow-up research

Participants

Currently, the Texas A&M AgriLife Research project engages over 40 faculty members and over 20 graduate and undergraduate students at four locations across the state.

Seed funding

AgriLife Research, the agricultural research arm of the Texas A&M University System, initiated, funded, and executed the UAS Research Program that began in 2014. ***We are actively seeking public and private partners to support and expand this research project.***



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