Airborne Remote Sensing at the University of Maryland Eastern Shore: A 15 Year History

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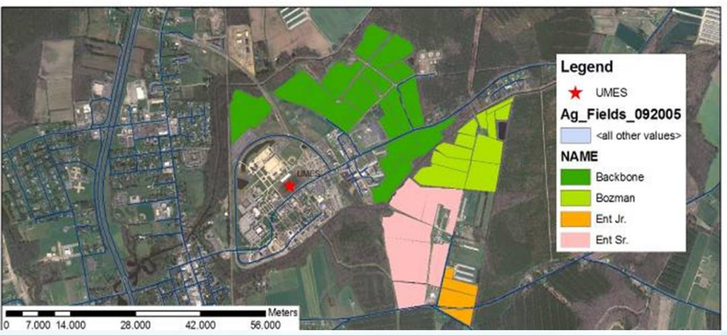


Figure 2. Centers for PA & RS research at UMES.

Figure 3. UMES Yield Monitoring Equipment.

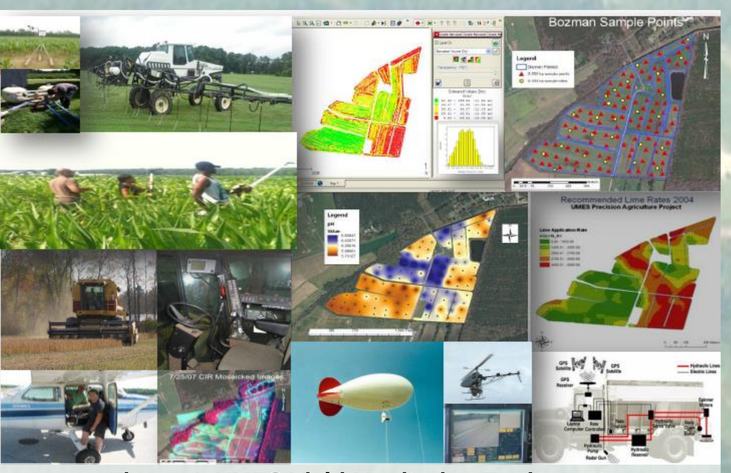
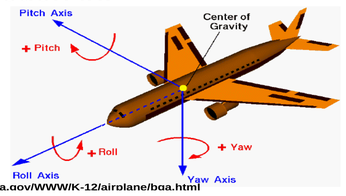


Figure 4. UMES Yield Monitoring Equipment.

- Fly aircraft over areas of interest with a nadir view camera
- Bodies in flight are not always level
- Induced error from motion in:
  - Pitch
  - Roll
  - Yaw



http://www.grc.nasa.gov/WWW/K-12/airplane/bga.html

Aerial Imagery provides users with insight into crop health studies, yield estimates, land use patterns studies.

Figure 5. Relevance of Aerial Imaging in Precision Agriculture

Figure 6. Undergraduate Multidisciplinary Earth Science Airborne Instrumentation Research (UMES-AIR)

Abstract

Remote sensing projects from various airborne platforms have been ongoing at the University of Maryland Eastern Shore (UMES) for more than 15 years. Much of this effort has been focused on supporting and enhancing precision agriculture efforts on the campus. One of the first projects included remote aerial imaging from platforms such as helium blimps with support from NASA Goddard Space Flight Center's (GSFC) Wallops Flight Facility(WFF) on a project titled UMESAIR: Undergraduate Multidisciplinary Earth Science Airborne Imaging Research . The NASA GSFC'S WFF is about 25 miles from campus and this made active participation of some NASA engineers and scientists possible in this experiential learning endeavor. Engineering and Engineering Technology majors led the project efforts but the participation was open to all students from other STEM disciplines (Nagchaudhuri, et al., 2002). Continued efforts led to the development of "AIRSPACES": Aerial Imaging and Remote Sensing for Precision Agriculture and Environmental Stewardship, that was supported by Maryland Space Grant Consortium (MDSGC). The AIRSPACES project served as a catalyst to involve the faculty and students in the Aviation program at UMES and develop the capability of aerial imaging from manned airplanes (Cessna 172) using color infrared (CIR) digital cameras, as well as smaller remotely operated model airplanes (Nagchaudhuri, et al., 2006; Ladd, et al.,2006 Nagchaudhuri, et al., 2007; Nagchaudhuri, et. al, 2008; Nagchaudhuri, et. al, 2011). In 2007, UMES researchers and their collaborators began exploring kites for acquiring airborne remote sensing data, greatly easing training requirements. This led to the development of the Aeropod, a NASA technology developed specifically for kite based remote sensing and in-situ observations. This poster will describe the evolution of Unmanned Aerial Systems (UAS) activities, their multidisciplinary nature, and the involvement of the Aviation Sciences program for the support of operations in precision agriculture at UMES. The most current efforts, which include a 3dRobotics Multicopter, will also be discussed.

Introduction

1. What is Precision Agriculture (PA)?

- A method of optimizing agricultural inputs to improve economics and minimize environmental impacts.

Right product - Right time - Right place

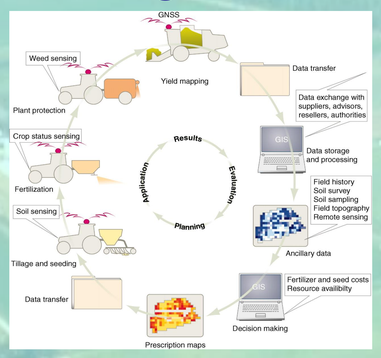


Figure 1. Precision Agriculture is driven by technology and research

2. GIS, GPS, & Remote Sensing

- **Geographic Information System (GIS):**
  Geospatial Data Management, Display, and Analysis Software.
- **Global Positing System (GPS):**
  Constellation of 24 Satellites that transmits signal to ground based receivers.
- **Remote Sensing (RS):**
  Data acquisition about objects or phenomena without making direct physical contact with them.

3. Unmanned Aerial Systems (UAS)

- Unmanned aircraft (UA) and associated support equipment, control stations, data links, telemetry, communications and navigation equipment, etc., necessary to operate the UA.

Our Efforts

- UMES Air
- Manned Aircraft Imaging
- First Gen UAV's
- Aerokats Kite Aerial Imaging & Remote Sensing
- FAA COA
- Second Gen UAV
- Mission Planning, Systems Operation, & Data Analysis

Current & Future Challenges

1. Safe and efficient data collection:
   - Aviation
     - Procedures, mission planning, resource management
2. Data processing to create meaningful and actionable products to end users at a marketable price

Acknowledgements

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Figure 7. Student UAS Platforms.

Figure 8. Advanced Aerial Imaging Platforms: Terrahawk Equipped 172, Rotomotion Robotic Helicopter, & TwinCam

Figure 9. TwinCam: Low-cost Video cameras provide color and near-infrared for Normalized Difference Vegetative Index (NDVI)

Figure 10. AEROKATS: Joint Kite Aerial Imaging venture with NASA Collaborators

Figure 11. 3DRobotics X8 Aerial operations and Sample Data.