Unmanned Aircraft Systems for Mapping: Aerial Information System Lab Oregon State University

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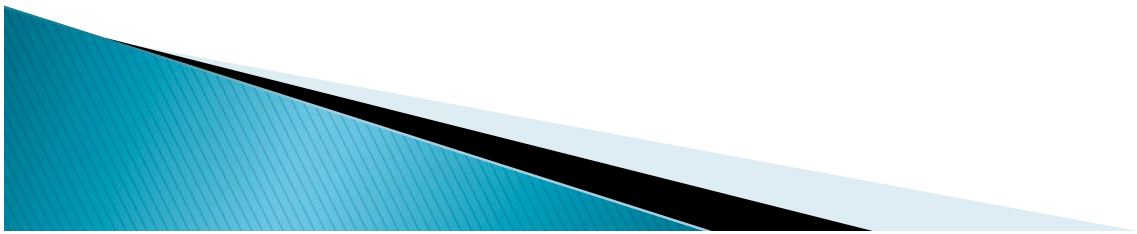
Overview

- Regulatory climate of UAS
- OSU Aerial Information System (AIS) Laboratory capabilities and platforms
- Past project examples
- Current project examples
- Vegetation response to moisture
- OSU involvement in response to FAA UAS COE RFP



UAS Regulatory Environment

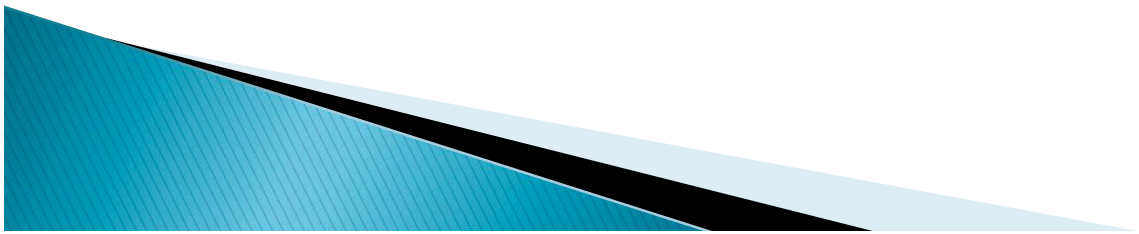
- FAA Modernization Act
  - Signed into law in 2013
  - “Integrate UAS into the NAS system” or else
- National Test Site Competition
  - 25 proposals from 24 states
  - Oregon teams with Alaska and scores!
  - Pan-Pacific UAS Test Range Complex
    - Oregon: Pendleton, Tillamook, and Warm Springs
- UAS flights in other areas require a COA
  - Certificate of Authorization

Certificate of Authorization

- Only public entities can file
  - OSU was the first in Oregon
- An exhaustive description of
  - Platform
  - Communications
  - Safety procedures
  - Flight ops
- Tied to a single platform and specific area
- Good for two years with the possibility of extension

OSU AIS Laboratory

- OSU has:
  - 29 active COAs
  - 2 pending COAs
  - Oregon, Washington, Montana, Oklahoma
  - Flown UAS in Turkey and Indonesia
- Dedicated to UAS flights for remote sensing
  - Forestry
  - Agriculture
  - Fish and Wildlife
  - Search and Rescue
- http://ais.forestry.oregonstate.edu/

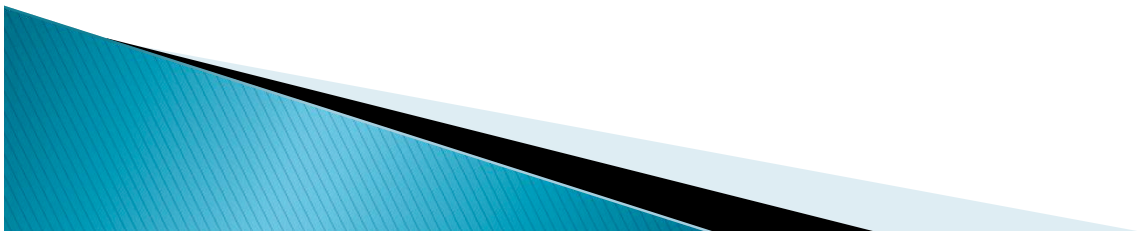


AIS Laboratory Flights

- 2014
  - Salmon Surveys – South Umpqua River, OR
  - Burn Severity Mapping – Corvallis, OR
  - Biomass Grinding Estimation – Eugene, OR
  - Digital Modeling of Forest Canopy Structure – Trimble UH – *International (Indonesia)*
  - Swiss Needle Cast Detection – Beaver – Blodgett, OR
  - Wildfire Burn Severity – Beaver – Warm Springs, OR
  - Vineyard Vigor Mapping – Matrix – Amity, OR
  - Golden Eagle Carcass Detection – Matrix – Warm Springs, OR
  - Forest Regeneration Survey – Matrix & Beaver – Oregon
  - Fiber Optic Cable Measurements – Matrix – Oregon
  - Digital Terrain Modeling with UAS LIDAR – Gwaihir – Pending
- 2013
  - Orchard Mapping – Beaver Series – *International (Turkey)*
  - Search and Rescue – Pulse Vapor – McDonald Forest, Corvallis OR
- 2012
  - Forest Imaging – Prioria Maveric – McDonald Forest, Corvallis OR

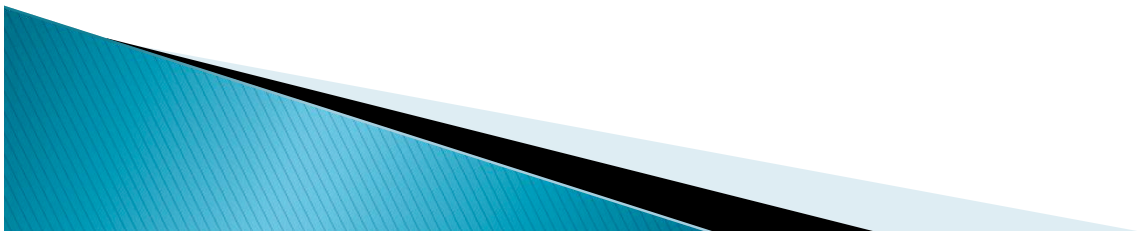
AIS Laboratory Sensors

- Velodyne HDL-32E LIDAR
- Advanced Navigations Spatial Dual Inertial Measurement Unit (IMU)
- Canon S100/S110
- Canon S100/S110 IR Converted
- Canon G15 NIR Converted
- GoPro Hero 3+
- Sony Nex 5T
- Sony Nex 5T NIR Converted



AIS Laboratory Platforms

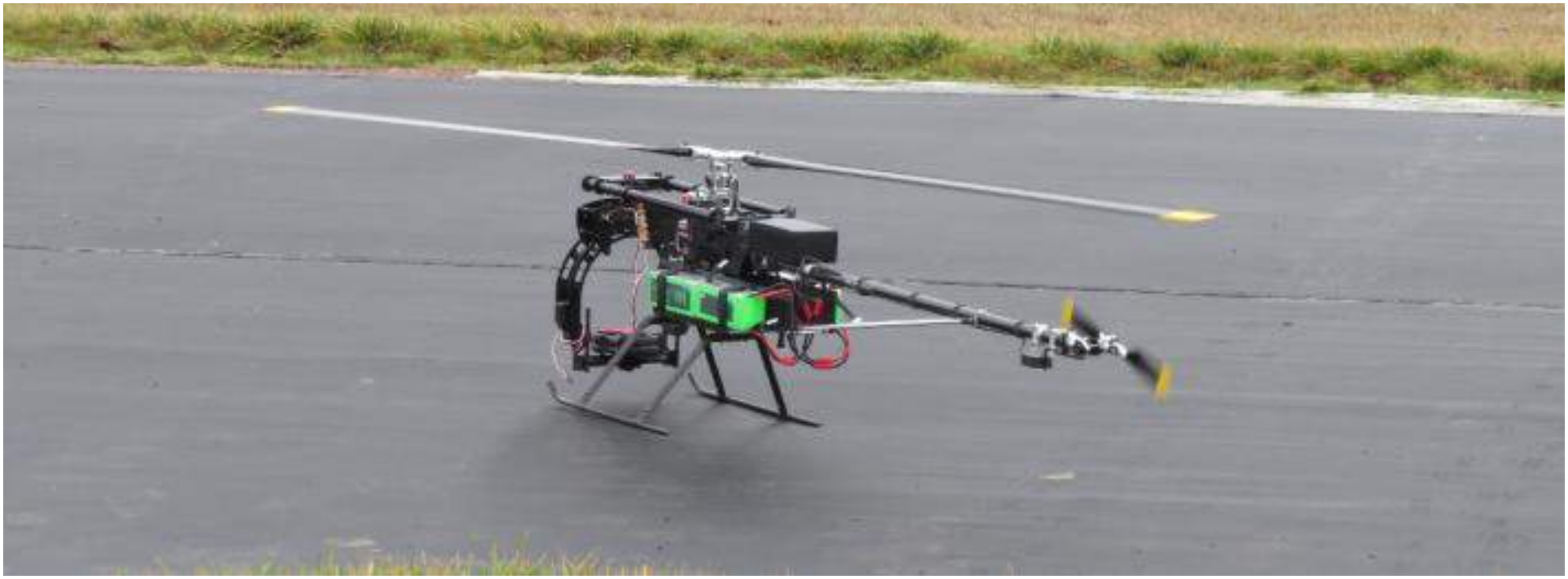
- Albatross (1)
- Beaver (4)
- Bixler (2)
- Gwaihir (1)
- Matrix (2)
- Volitare (2)



OSU AIS Platform: Matrix

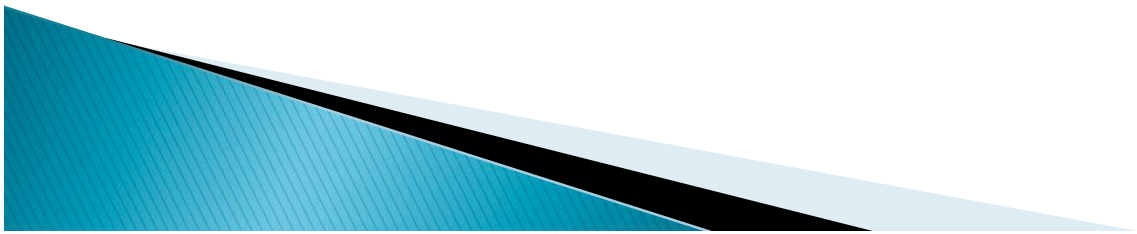
OSU AIS Platform: Beaver Series

OSU AIS LiDAR Platform: Gwaihir



Prioria Maveric- Getting Started

- McDonald Forest
  - October 2012 flight- First approved COA in Oregon
- Compact airplane with flexible wings
- Electrical power
- Get at look at the forest
- Journal article
  - Wing, M.G., J. Burnett, J. Sessions, J. Brungardt, V. Cordell, D. Dobler, and D. Wilson. 2013. Eyes in the sky: Remote sensing technology development using small unmanned aircraft systems. Journal of Forestry 111(5):341-347.




Maveric Imagery

Pulse Vapor

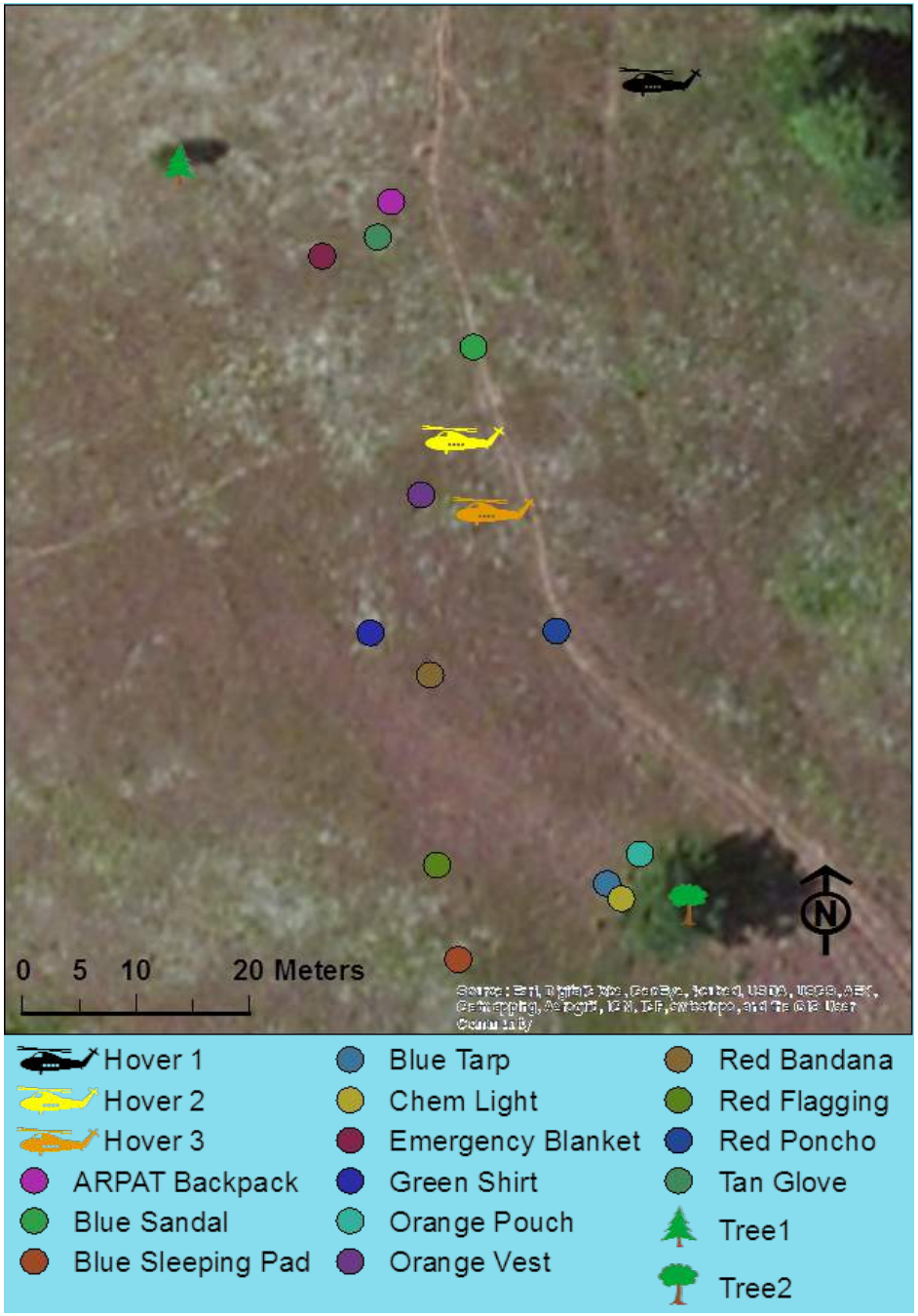
- Small frame helicopter
- Electrically powered
- EO and IR video
- Search and Rescue Demo
  - July 24, 2013
  - McDonald Forest
  - About a dozen different objects
  - Three students!
  - Two forest sites
- Publication in review

Pulse Vapor

- Flight Video

SAR Results

- Many SAR objects reliably detected
- Detection success was heavily influenced by factors such as distance, object size, material, and color
- In direct sun light, the EO sensor performed more reliably than the LWIR sensor in detecting objects
- The LWIR sensor was preferable to the EO sensor when tracking human subjects or in shady environments



Beaver Series: Ritewing Zephyr II

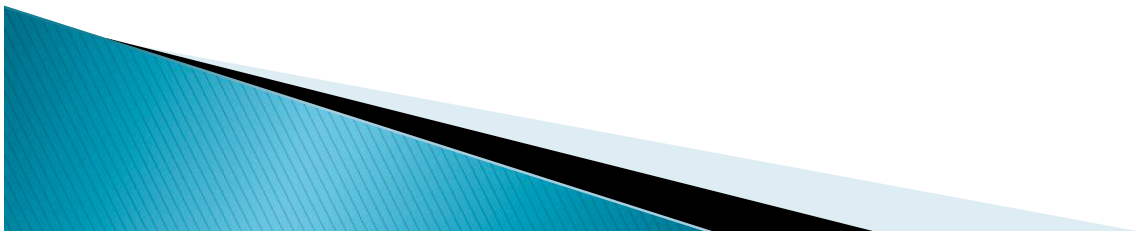
- In house product developed by AIS Lab
  - Generous help from Seth Johnson of VDOS
- Flown in Turkey in May 2013
  - Works flawlessly
- EO imagery with Canon S100
- Journal article:
  - Wing, M.G., J. Burnett, S. Johnson, A. Akay, and J. Sessions. In press. A low-cost unmanned aerial system for remote sensing of forested landscapes. International Journal of Remote Sensing.

Zephyr II Components

Component	Cost
2.4 GHz Tx/Rx	$360
4500 mAh 11.1 V LiPo	$30
Airspeed Sensor	$25
ArduPilot APM 2.5	$160
Canon S100	$300
RiteWing Zephyr II	$325
TTC Radio	$86
uBlox GPS Module	$76
Voltage Regulator	$15
Total	$1,377

Zephyr Turkey Flight

- Flights
  - Perfect launch
  - Good launch
- Image

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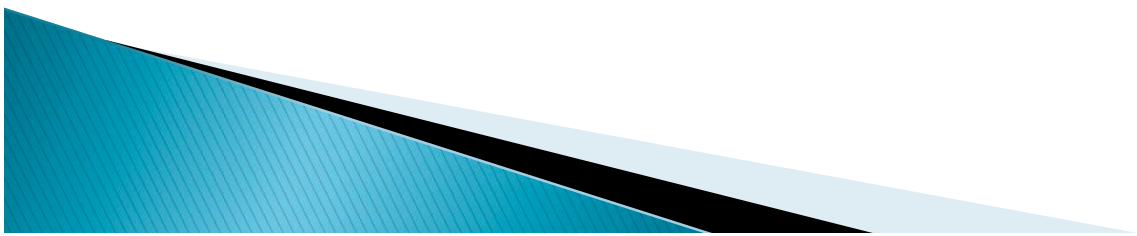
Current research: Biomass

- Biomass products are ground up
- Loaded into trucks for incineration
- Dry chips often result in a truck not being able to reach desirable capacities
- Solution: build a “hurler” that can propel biomass grindings into a truck at speeds up to 90 mph



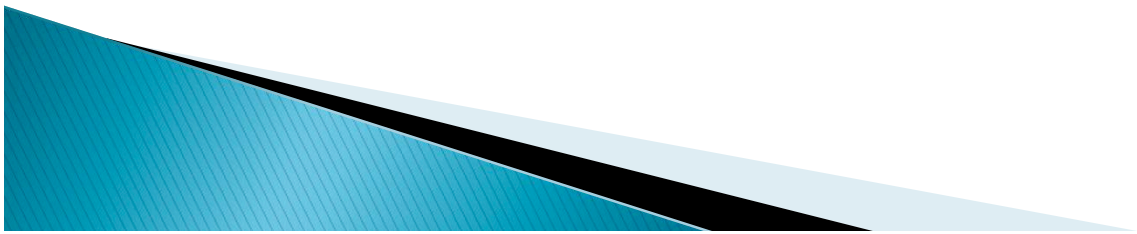
The answer is three (3)

Action video

Structure from motion

Wineries

- 905 vineyards in Oregon produced over 50,000 tons of grapes in 2012
  - $116 million
  - All 2012 production stats were increases over 2011
- $10,000 annual revenue per acre in some cases for fine wines
- Beaver Series and Matrix



Two pending COA applications

- Eugene to Portland, west beyond the coastline
  - Quadcopter
  - LiDAR copter

ASSURE

Alliance for System Safety of UAS through Research Excellence

- Drexel University
- Embry-Riddle Aeronautical University
- Kansas State University
- Mississippi State University
- Montana State University
- New Mexico State University
- North Carolina State University
- Oregon State University
- University of Alabama-Huntsville
- University of Alaska-Fairbanks
- University of Kansas
- University of North Dakota
- Wichita

- Two FAA UAS test sites
- Three FAA research centers
- 5 airfields
- 100+ UAS fleet

- Air Traffic Control Interoperability
- Airport Ground Operations
- Command and Control
- Detect and Avoid
- System Performance
- Privacy Practices for UAS Operations
- System Engineering
- Unmanned Aircraft Pilot Training and Pilot Certification

Thank you for listening

- My thanks to:
  - Jon Burnett (OSU PhD Student)
  - Seth Johnson (VDOS)
  - Josh Brungardt (Paradigm)
  - Vic Cordell (Paradigm)
  - Many others who have helped push OSU UAS applications forward