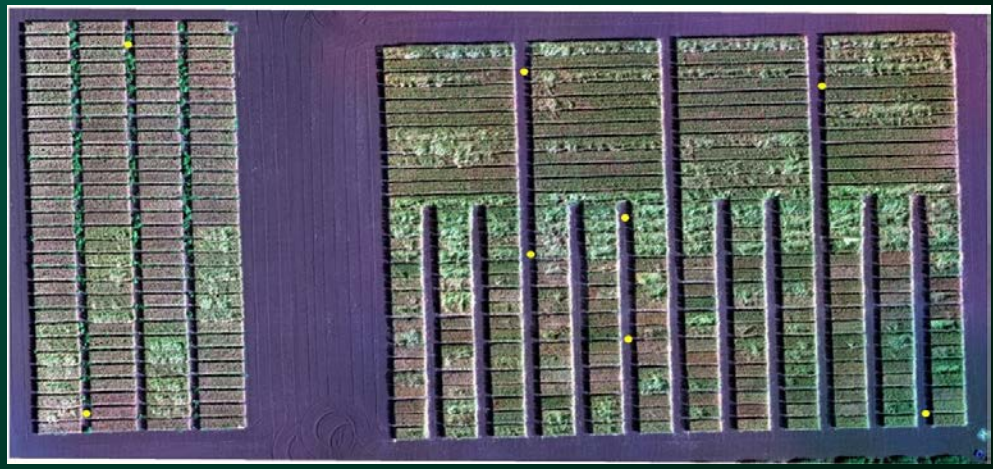
NDSU NORTH DAKOTA STATE UNIVERSITY

STUDENT FOCUSED • LAND GRANT • RESEARCH UNIVERSITY

1990s

Present



Departments/Centers Engaged in UAS Activity

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Agricultural UAS Research

MULTI-DISCIPLINARY APPROACH

Unmanned Vehicles Remote Sensing Data Collection	UAS Flight Ops under Part 107 Unmanned Ground Vehicles In-Field Sensors Satellite Imagery
Agricultural Domain Expertise	Agronomists, engineers, soil scientists, plant breeders, plant pathologists, entomologists, environmental scientists, animal scientists, rangeland scientists
Data Storage & Processing	CCAST High Performance Computing
Data Analytics	Computer Science
Agricultural Economics	Agribusiness and Applied Economics
Agricultural Experiment Resources	Greenhouse Complex, Agricultural Research Extension Centers and Private Landowner Collaborator Fields
Agricultural Outreach	NDSU Extension Service

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Agricultural Research Involving UAS At NDSU

- CHS / NDSU Collaboration at Grand Farm:
  Aerial imagery to study dicamba drift impact in soybeans and wheat
- Agronomeye / NDSU Collaboration at Grand Farm:
  Aerial imagery for decision making on water management strategies, redevelopment proposals, financial feasibility, etc.
- Nutrient management in crops – prescriptions for in-season fertilizer application
- Crop disease detection
- Crop stand counts (number of plants that emerged)
- Weed detection and identification
- Precision spot spraying by UAS
- Soil health management practices
- Crop breeding – collection of phenotype trait data on field variety plots.
- Irrigation management - optimum amount and timing of irrigation for enhanced crop yield, quality, and water productivity
- Blackbird deterrent strategies in sunflowers
- Wheat lodging detection / assessment
- Hail damage assessment
- Remote livestock tracking and animal health monitoring
- Hydrology / water management

Autonomous Research at UND

Mark Askelson
Executive Director, RIAS

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LEADERS IN ACTION

Autonomous Research at UND

- Autonomy Grand Challenge
  - Research Institute for Autonomous Systems
    - Mission: Create autonomous systems and policies that serve society
    - Structure
      - Platforms
      - Applications
      - Data Supply Chain
      - Cybersecurity
      - Policy
    - Cross-college and departments
    - Voluntary participation

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Autonomous Research at UND

- Strategic Growth Areas
  - National Security
    - DoD
      - Space Force/Command
    - DHS
    - Industry
  - Current Efforts Examples
    - AMG
    - DHS
    - *ASSURE (FAA)*
  - Activity (total active this year)
    - RIAS Led: $6M
    - RIAS Affiliated: $5.5M

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Autonomous Research at UND

- Example Current Project
  - ASSURE (FAA COE): sUAS (small Unmanned Aircraft system) Detect And Avoid
    - Objective
      - Provide answers to FAA to enable development of rules, regulations and standards for sUAS Detect and Avoid.
    - Team

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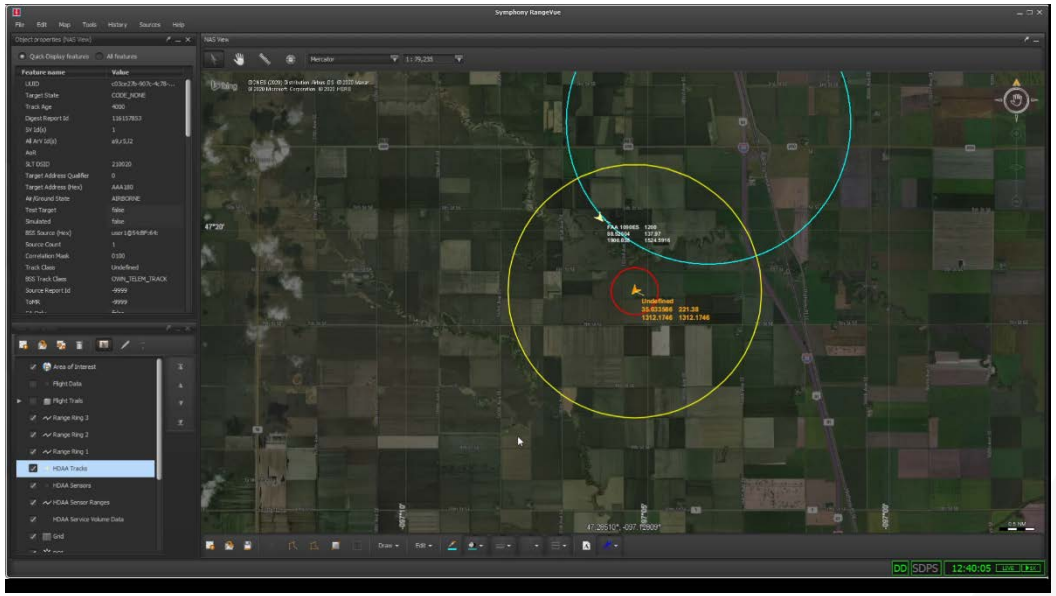
Autonomous Research at UND

- ASSURE sUAS Detect And Avoid (cont.)
  - Modeling to determine requirements to maintain well clear status
    - Well clear is safe separation between aircraft.
  - Flight testing
    - Test plan for determining Detect And Avoid system performance.
    - Flight testing



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Autonomous Research at UND

- Example Past Project
  - LD-CAP (Limited Deployment-Cooperative Airspace Project)
    - 2011-2017
    - Objectives
      - Evaluate Cooperative Autonomous Sense and Avoid
      - Develop advanced transponders (NDSU & Appareo)
    - Team

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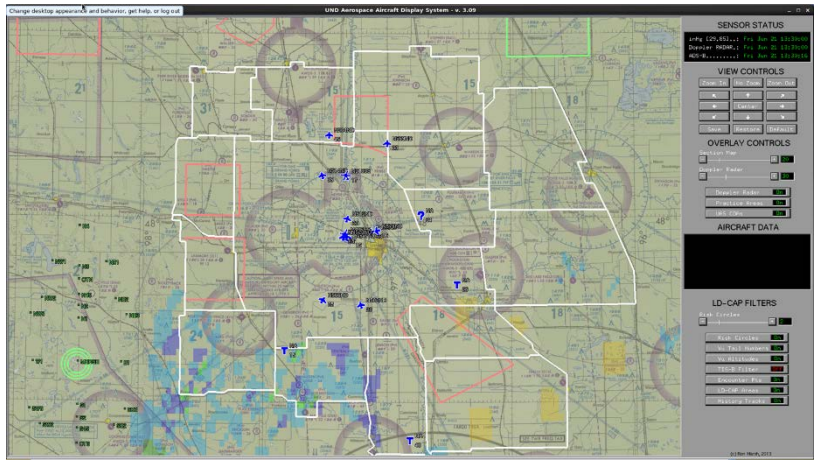
- LD-CAP (continued)
  - Testing



  - Avionics
    - Appareo

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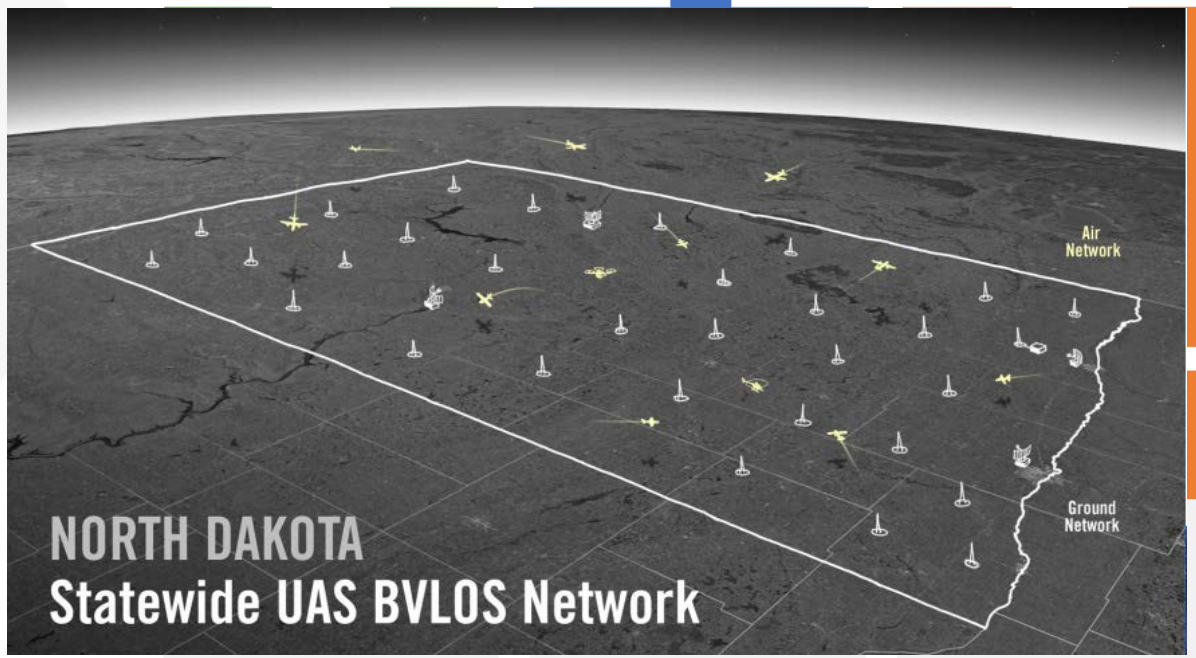

Cooperative DAA

Foundational

UND & NDSU

Industry Impact

L3Harris

Appareo

Synthesis

Blueprint for Statewide BVLOS Effort

Successes include GFAFB & Xcel BVLOS

GFAFB

Grand Sky

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Autonomous Research at UND

Mark Askelson
Executive Director, RIAS

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LEADERS IN ACTION