# The Day of the Drones - Airports and Unmanned Aircraft Systems Part 2

April 27, 2021

The National Academies of
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TRB
TRANSPORTATION RESEARCH BOARD

ACRP
AIRPORT COOPERATIVE RESEARCH PROGRAM

# Heather Hasper
# DHJ Alaska

- Airport Planner
- Air Traffic Controller
- Dynamic Aerial Imagery Instructor
- Airspace Coordinator
- Remote UAV Part 107 Pilot
- Commercial Instrument Rated Pilot

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1. Join the ACRP IdeaHub community
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4. Answer an ACRP survey
5. Apply the research results

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# Today's Speakers

Chris Fernando, QS-2

Glady Singh, AkitaBox

Jason Terreri, Syracuse Hancock International Airport

Presenting

ACRP Report 212: Airports and Unmanned Aircraft Systems, Volume 2: Incorporating UAS into Airport Infrastructure—Planning Guidebook, and Volume 3: Potential Use of UAS by Airport Operators

# ACRP Research Report 212

# Airports and Unmanned Aircraft Systems

## Planning for UAS and Applications by Airports

Chris Fernando, Principal and Aviation Lead
Quantitative Scientific Solutions

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ACRP AIRPORT COOPERATIVE RESEARCH PROGRAM

# Chris Fernando
# Principal Investigator

- Principal and Aviation Lead at QS-2
- Principal, Hovecon
- Co-host of No U-Turn Podcast
- Principal Investigator, ACRP 03-42, Airports and UAS
- PI and PM for multiple UAS and UAM research efforts for FAA and NASA
- BS, Aviation Management, Florida Institute of Technology

# ACRP Report 212 Oversight Panel

Heather Hasper, DHJ Alaska, San Jose, CA (Chair)

Kerry L. Ahearn, Transportation Research Board, Washington, DC

Stephen K. Cusick, Florida Institute of Technology, Melbourne, FL

Adam Durrin, Independent Consultant, Greenwich, NY

Amit Lagu, Independent Consultant, Sunnyvale, CA

Gaël Le Bris, WSP USA, Raleigh, NC

Michael R. Scott, Reno-Stead Airport, Reno, NV

Jeremy Worrall, Alaska DOT and Public Facilities, Fairbanks, AK

Michael DiPilato, FAA Liaison

Jared Raymond, FAA Liaison

Justin Barkowski, American Association of Airport Executives Liaison

Tracy Lamb, Association for Unmanned Vehicle Systems International Liaison

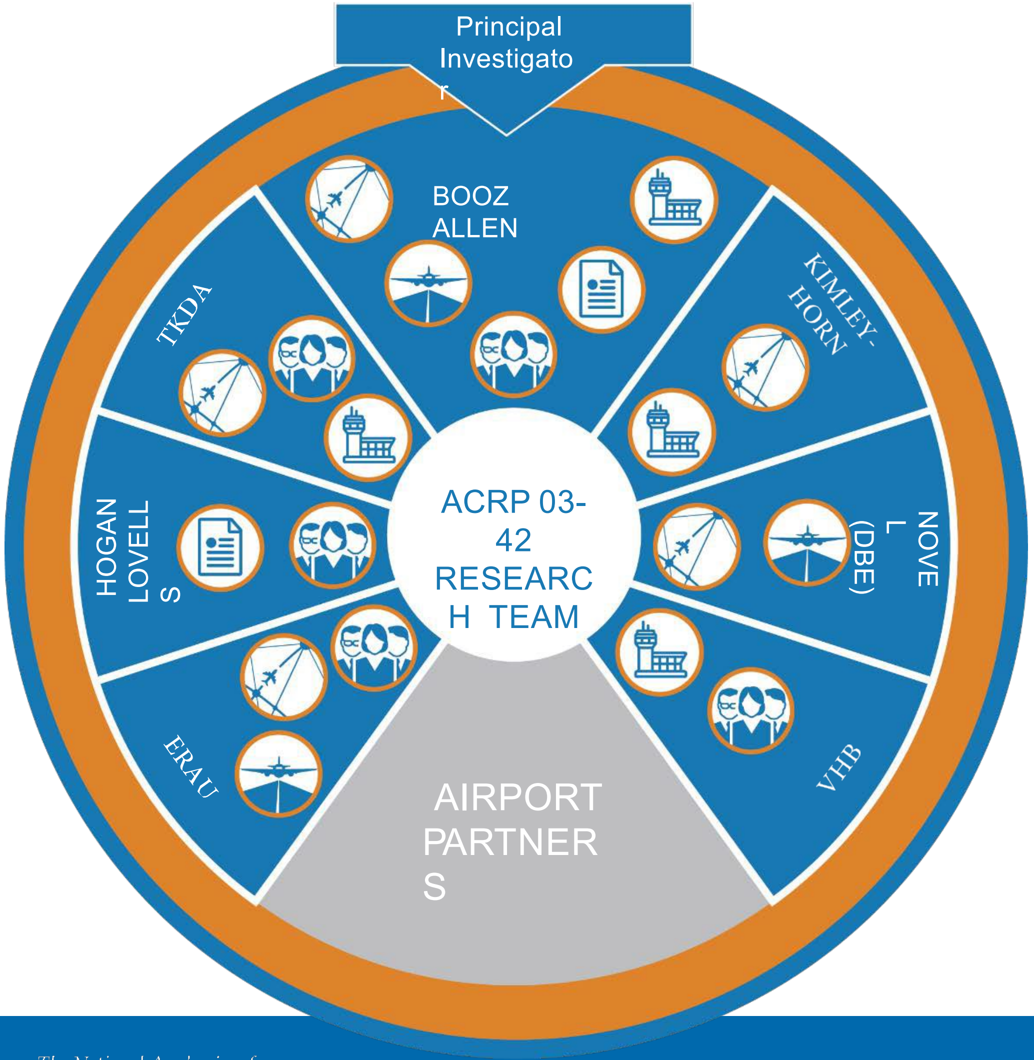
Christopher J. Oswald, Airports Council International—North America Liaison

Christine Gerencher, TRB Liaison

# Agenda

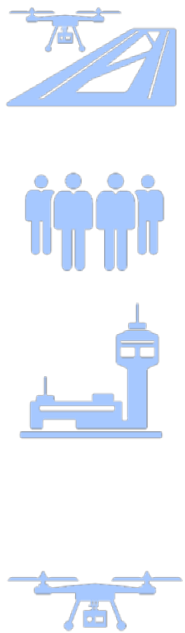
- ACRP 03-42 Team and Scope
- Research Areas
- Planning for UAS at Airports
- UAS Applications by Airports
- Demonstrations of UAS at Airports
- Highlights of IPP/BEYOND

# Research Team and Project Scope




- Value: $1M
  POP: 22 Months
  Published: July 2020
- Stakeholder Engagement
- Airspace Management
- Airport Planning
- Safety Management Systems
- Legal and Regulatory
- UAS Operators and Technology

# Research Areas



**Volume I – Managing UAS Operations in the Vicinity of an Airport**

**Volume II –** Engaging Stakeholders in UAS & Incorporating UAS into Airport Infrastructure and Planning

**Volume III –** Potential Use of UAS by Airport Operators

# Research Scope

# Research and Initiatives Supporting UAS Integration Efforts

- TRB ACRP – Integrating UAS into Airports
- FAA UAS Integration Pilot Program (IPP) and BEYOND
- FAA UAS Test Sites
- Northeast UAS Airspace Integration Research Alliance, Inc (NUAIR) in New York
- UAS corridor in Grand Folks, North Dakota
- FlyOhio and 33 Smart Mobility Corridor in Ohio

# Volume 2: Incorporating UAS into Airport Infrastructure Planning Guidebook

- Chapter 1: Introduction and background
- Chapter 2: UAS Terminology and Classifications.
- Chapter 3: Current Conditions.
- Chapter 4: Airport Opportunities, Issues, and Challenges.
- Chapter 5: Airport Infrastructure Planning for UAS.
- Chapter 6: Anticipated Future Conditions.
- 6. Appendices: Appendices A through G provide further detail into various aspects of airport planning for UAS referred to in the document.

# UAS Planning for Airports

- UAS Infrastructure Planning at Airports
  - Eastern Oregon Regional Airport (PDT) Master Plan (October 2018) is the most robust example of recent UAS infrastructure planning
  - The Airport Master Plan for the Silver Springs Airport (SPZ) in Nevada included limited reference to UAS
- Drone Port Planning
  - The Eldorado Droneport and the USA Drone Port are designed to facilitate UAS testing, research, and training.
  - The USA Drone Port or National Unmanned Robotic Research and Development Center is located near Hazard, Kentucky

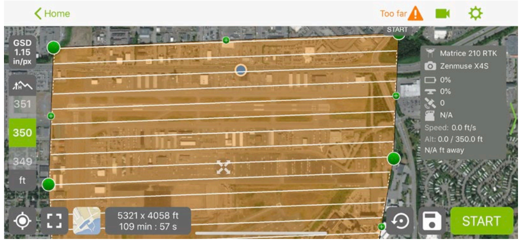
# Potential Use Cases for Airports

- Construction Monitoring
  - Capturing of time-lapse photos and video
  - Safety monitoring
  - Lighting
- Public Safety Assessments
  - Perimeter Monitoring
    - People, Vehicles, Land, Wildlife
  - Emergency Response
  - Weather Condition Assessment
  - Security alerting and patrols
- Infrastructure and Asset Management
  - Pavement/structure Inspections
  - VOR/NDB Inspection
  - ATC tower Inspection
  - Roof and HVAC inspections
  - Land surveying and mapping
  - Monitoring tree and grass growth
- Operations Support
  - Remote Tower
  - Identify Aircraft/UAS
  - Land side traffic Monitoring of Incidents
- Potential Tenant Use-Cases
  - Aircraft and hangar Inspections
  - R&D testing of new technologies
  - Education and training
- Additional Airport Use-Cases
  - Community Outreach (Documenting/Showcasing)
  - Inventory Management
  - Augment Air Traffic: ATC tower blind spots
  - Tracking movement of Vehicles
  - Airside Dining Delivery Service
  - Airside Luggage Transportation
  - Surface Condition Monitoring

# UAS for Airport Applications

## Airport Construction Surveys

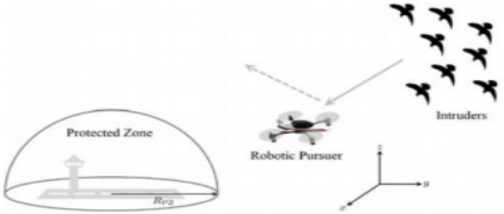
*3D Runway survey orthomosaic using DroneDeploy*




*Pix4D software used to program UAS for aerial mapping*

## Perimeter Monitoring and Wildlife Management

*UAS used in perimeter monitoring and blind spot capturing*




*UAS used to herd birds away from airports*

# UAS for Airport Applications

## Infrastructure Inspections

*DJI Matrice UAS used for aerial roof inspection*


*User interface using FLIR thermal imagery for fire rescue response*

## Weather Assessment

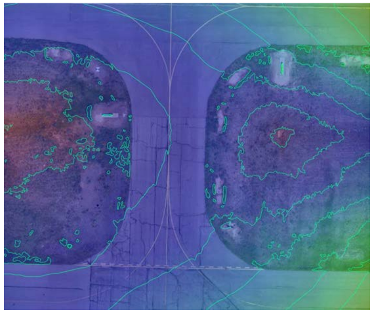
*UAS used to inspect grounded aircraft after adverse weather events*

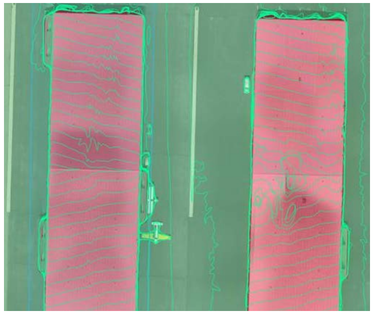
*UAS utilized for monitoring runway conditions*

# Field Demonstration at FTG

## OBJECTIVES OF THE DEMONSTRATION

- Demonstrate operation of sUAS within controlled airspace
- Establish best practices for communication between operators and ATCT
- Aerial drone data capture
- Compare traditional pavement management methodology with drone survey data and operations
- Use captured data to develop models for virtual reality and machine intelligence (VR/MI) applications

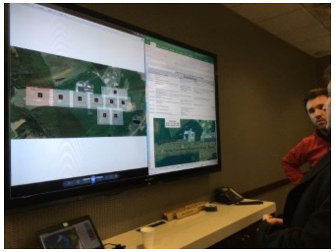





# Field Demonstration at JNX

## OBJECTIVES OF THE DEMONSTRATION

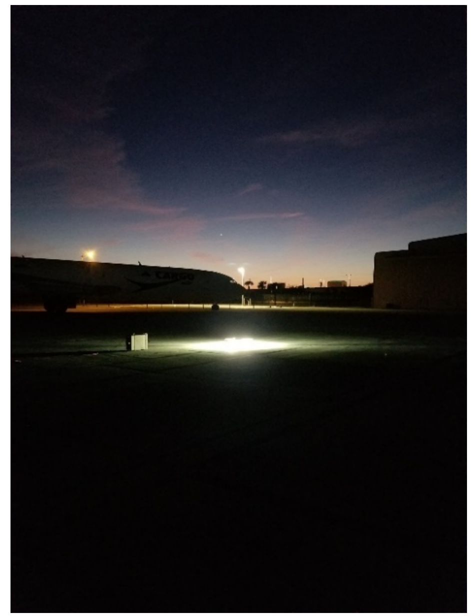
- Demonstrate operation of sUAS within uncontrolled airspace
- Operation of two drone operators concurrently with GA traffic utilizing communications best practices
- Aerial drone data capture of wildlife, pavement, and infrastructure facilities
- Develop methods to post process data for use in VR/MI applications
- Test sUAS services during nighttime operations



# Field Demonstration at SEF

## OBJECTIVES OF THE DEMONSTRATION

- Demonstrate operation of sUAS with active GA operations
- Aerial drone data capture of pavement conditions, and infrastructure facilities (ATCT, hangars, drainage)
- Demonstrate the use of tethered drones for lighting of areas for security and emergency response
- Test sUAS services during nighttime operations



# IPP/BEYOND UAS Operations

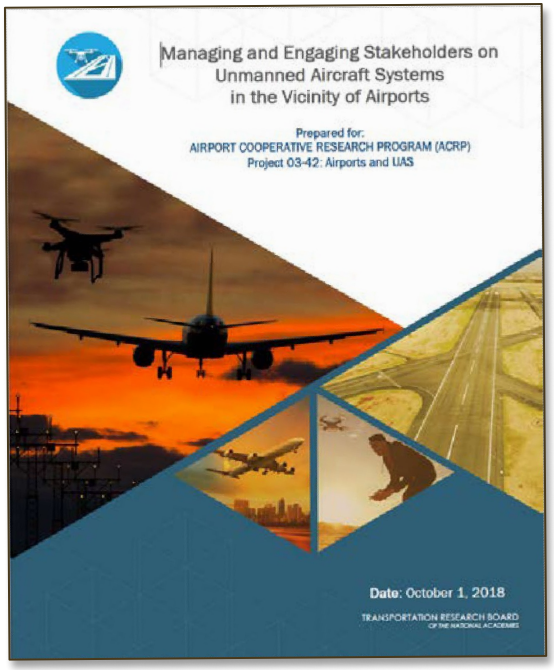
Rapidly-evolving and expanding capabilities of drone platforms and sensors have resulted in increasing numbers of applications by operators for package delivery, infrastructure inspections, and emergency response.

- Security and aircraft inspections by FedEx/MEM
- Medical package deliveries by Zipline, UPS, and Matternet
- Food and coffee delivery by Walmart with FlyTrex and Causey Aviation
- Airborne support to police in Chula Vista

Photo courtesy FedEx


Locations of routine drone package delivery operations.

# Thank You





## Chris Fernando
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## Link to Research Publications:
https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4240

## Airports and UAS, is Published as Report 212

**Volume 1:** Managing and Engaging Stakeholders on UAS in the Vicinity of Airports
**Volume 2:** Incorporating UAS into Airport Infrastructure
**Volume 3:** Potential Use of UAS by Airport Operators

Research under ACRP Project 03-42 was led by Booz Allen Hamilton in association with Embry-Riddle Aeronautical University, Hogan Lovells, Kimley-Horn and Associates, Novel Engineering, Toltz, King, Duvall, Anderson, and Associates, Vanasse Hangen Brustlin, Inc., and Astrid Aviation and Aerospace. These guidance documents identify airport-specific infrastructure and facilities needs to support UAS and describe field demonstrations to test various use cases for potential uses of UAS by airport operators.

# Day of the Drones- Part Two

## Asset and Facility Management with UAS

***(and related technology solutions for Airports and beyond)***


**Glady Singh**

**AkitaBox, Inc.**


**27 April, 2021**

# Glady Singh
# Infrastructure and UAS Technology Consultant

- GM, Federal Solutions and Innovation, AkitaBox
- Technology and Innovation Chair, SAME Facility Asset Management Community of Interest (SAME FAM COI)
- Diversity Equity and Inclusion Program Lead- AkitaBox
- GM, Federal Solutions, PrecisionHawk *(former)*
- Senior Associate, Booz Allen Hamilton *(former)*
- Change Management Practitioner, Georgetown University
- Brownie Girl Scouts Troop Leader

# Agenda

- UAS Innovation Focus To Date (To Support Government)
- Potential UAS Applications Across Asset Lifecycle
- Getting Airborne- Approval Coordination for On Airport UAS Ops
- SE2020 Project Overview/ Example Planning Detail
- Example Innovation in Action- UAS Applications
- Broader Remote-Sensing Applications

# UAS Innovation Focus to Date

*Efforts designed to support federal Government*

- Broaden awareness of UAS technology trends to inform and support the Government's efforts with UAS technology adoption
- Elevate confidence on adoption via pilot projects demonstrating technology in action without imposing undue mission risk
- Evaluate available COTs platforms to help ensure they are cyber-sound and secure, developing tailored risk mitigation with proposed applications
- Ensure compliance with government policies and regulation, recommending enabling policies based on demonstrated research
- Boost acquisition confidence evaluating technology procurement options and program support models based on requirements
- Beyond UAS data capture, accelerate data and analysis workflows with AI and visualization to support across the infrastructure lifecycle (vs. traditional inspection and management approaches)

# Potential UAS Applications for Airports

*Across the Infrastructure Lifecycle*

**Plan** → **Design** → **Build/ Commission** → **Operate/ Maintain** → **Recapitalize/ Decommission**

- Airport layout plan and design (ALP/ALD) baseline assessments
- Lighting inspections (runway/light mast poles)
- Incident management
- Emergency response planning and post-disaster assessments
- Runway, taxiway, apron, roadway condition assessment and inspection
- Airport infrastructure inspections (facilities, towers)
- Obstruction removal/debris/litter management
- Vegetation encroachment/ weed management
- Airport improvements/construction updates
- Floodplain mapping/storm water/drainage
- Security/perimeter fence monitoring
- Wildlife management
- IR/thermal imaging concrete surface conditions
- Aerial Site Surveys/Façade condition assessments


Obstruction Removal


Roof Inspection


Master Planning


Project Monitoring


Facility Management

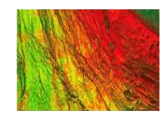

Disaster Damage Assessment


Infrastructure Assessment

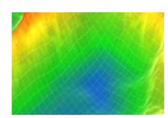

3D Map Generation


Environmental Change Detection

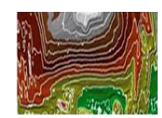

Coastal Mapping


LiDAR Mapping


Lighting Inspections


Volume Measurement


Pavement Analysis


Topographic Mapping


Disaster Response

# UAS On/Near Airport Approval Coordination

*FAA Safety Management System Safety Risk Management (SRM)*

**SRM Participants: Change Proponent, Facilitator, Panel (voting) Members, SMEs, Observers**

- The FAA continues to work to integrate small UAS (Part 107) operations into the airport environment through the development of a national on-airport document change proposal (DCP) to evaluate proposed changes in the NAS
- In parallel, FAA AJI facilitates garnering approval to conduct on airport UAS operations through the Safety Risk Management (SRM) Panel; focused on evaluating proposed change in the NAS using a framework to identify potential hazards of concern, assess severity and impact of risk and appropriate risk controls
- FAA SRM Panel reviewed our detailed Site Survey Plan and 2-3 day interactive discussion to review detailed documentation of proposed operations and accompanying mitigations
- Two conducted SRM panels to date (CLT and GSO) and gained SRM Panel confidence of our intended operations has us on path to approval given the controls and mitigations being employed to conduct safe operations

## Project Team

*Project Sponsor & FAA Onsite Liaison*

Booz | Allen | Hamilton®

*Quality Assurance and Data Security*

R.E.Y. Engineers

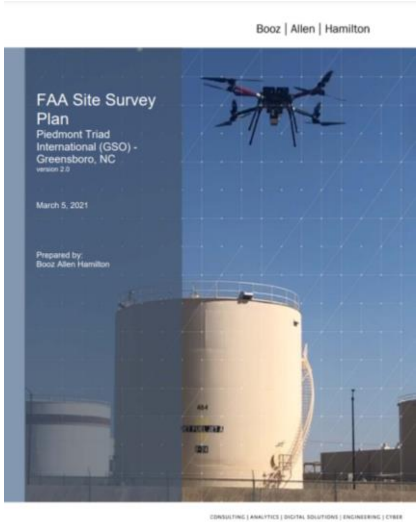
*sUAS Data Capture*

AkitaBox

*Technical/Data Processing*

# Flight Team/Site Survey Plan Components

*Seasoned Team and Documentation to Support UAS Operations*




**Remote Pilot in Command (RPIC)**

*Operates/controls the air vehicle from the Ground Control Station (GCS). Responsible for executing flight mission without distraction.*

**Visual Observer (VO)**

*Accompanies RPIC along the flight path and maintains visual line of sight of sUAS; monitors for potential threats in surrounding flight areas*

**FAA Onsite Liaison**

*Responsible for interfacing with FAA, airport personnel, and any interested stakeholders as necessary. Communicates with ACTC personnel.*

**Survey Director**

*Ensures safety practices (e.g., normal ops procedures, disconnect protocols) and quality checks are maintained.*

## Key Aspects in Site Survey Plan

- Flight Parameters
  - Flight patterns, Geofencing, Landing/Take off Zones
- Survey Equipment Descriptions
  - Platform
  - Data Storage Platform
- Site Survey Plan Description
- Operations and Risk Mitigations
  - Personnel, Flight Execution
  - Hazards
  - Communications / Radio Operations
  - Go/No Go Criteria
- Data Management
  - Data Sources
  - Data Specifications

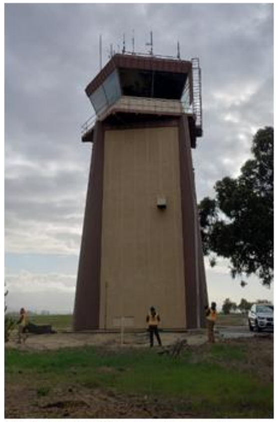
# FAA SE2020 Task Order Pilot Project

*Booz Allen Hamilton: UAS Operations/Infrastructure Inspections*

*Part of an FAA-sponsored project to test and evaluate process and procedures for use of sUAS on/near airport operations for infrastructure assessments at Class D, C, and B airports*

- To **detail and garner approval for requested change to the NAS** — processes, equipment, coordination, and information control systems designated for data capture on safely with proposed mitigations.
- The end-result and objective of the sUAS flight is to collect a rich visual data of visual data on to be inspected assets—with insights into critical infrastructure condition.

## SUCCESSFUL OPERATIONS TO DATE AT UNCONTROLLED AND CLASS D AIRPORTS RESULTED IN THE CAPTURE OF FIVE ASSETS AND A TERRAIN/OBSTACLE SURVEY; CLT AND GSO NEXT



*SNS TOWB Air Traffic Control Tower*

*SNS Glide Slope Navigation*

*VOR Navigation Facility*

*SNS RCLR Comms Tower*

*MRY ASR Radar Facility*

# Example: UAS Flight Operations On/Near Airport

*UAS Demonstration at SNS and OAR Airport*

## Flight Parameters

- Team started project with uncontrolled and Class D airspace operations; successfully completed 29 flights across 4 days at SNS and OAR to capture RCLR, VOR, Glide Slope and ATCT assets
- Vertical and orbit flight patterns with Nadir shots of the top of the asset where permissible
- Average flight time: 20-40 min
- 5-6m away from structure
- Mitigations:
  - Equipment outage requested/granted for ASR, (for enhanced safety from potential power emittance)
  - Visual Observers
  - Ground Control Station
  - Sterile Cockpit with take-off/landing zone marked with cones
  - Evaluated and changed take off locations to maintain VLOS and navigate safely around guy wires

ASR Tower: UAS RGB Visual Data Capture

RCLR Tower: UAS RGB Visual Data Capture

# Flight Operations and Safety

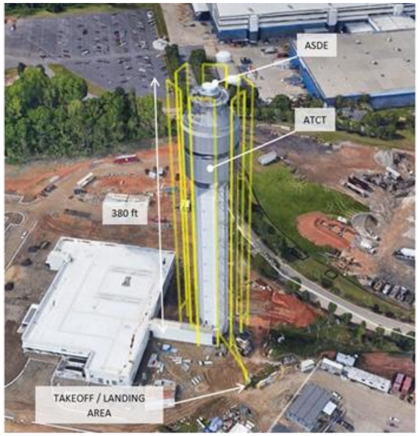
*Strong Communication and Safety Protocol*

- Flight operations to be conducted in accordance with 14 CFR Part 107. The team complies with all Certificate of Waiver/Authorization (COA) stipulations in addition to any tower instructions for reporting airport position and intentions at towered airports.
- If any safety/flight issues arise during operations, the RPIC will immediately recall the aircraft or discontinue operations until resolved. If the sUAS needs to be grounded, UAS is prompted to achieve a specific safe altitude and come straight down to the launch site.

  The RPIC maintains final responsibility for safe flight and the UAS launch decision. The Airfield Control Tower is the approving entity authorizing flight within controlled airspace; team adheres to any coordination requirements provided by the Airfield Control Tower.

# Example: UAS Mission Planning on Airport

*CLT Air Traffic Control Tower (ATCT) /Airport Surface Detection Equipment (ASDE)*






- **Flight Operations:**
  - 11 Structures for inspection
  - 3 - 4 Twenty-minute flights per structure depending on size/height
  - 2 - 4 Landing Zones (LZ); adjacent corners
  - 5M distance for inspection
  - Geofenced with Sterile Cockpit around AO (Area of Operations)
  - Once at location, RPIC and S/O confirm flight direction
  - UAS to stay at or below peak height of structure unless require overhead nadir image (ensure no oncoming traffic and airspace is clear)

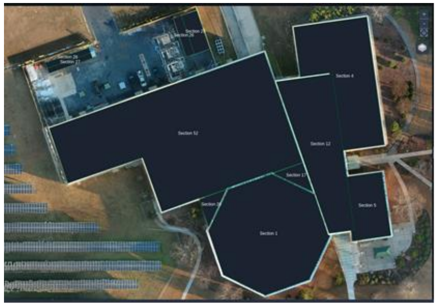
- **Hazards:**
  - 75 FT East structure to fence line
  - 120 FT East are power lines
  - The 11 structures are in line with runway 18R; manned take-offs/landings throughout the day
  - All 11 structures are on a hillside (ensure proper footing placement during walkaround)
  - Vegetation on each side of structures
  - Will ensure proper flight planning at each structure
  - 40-50 Ft to active roadway between structures 1 and 2 just north of runway 18R
  - Freeway is 665 Ft West of structure 11 (closes structure to freeway)

# Example: UAS Roof Inspection - TRACON Facility

*Visual and Thermal Imagery with Detailed Roof Inspection Report*

## DEMONSTRATED CAPABILITIES

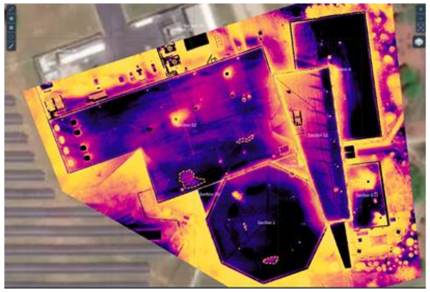
- Demonstrate operation of sUAS with antenna farm equipment outage for enhanced safety (RF max 10 watts)
- Preprogrammed flight (grid) capture with COTs UAS dual visual/thermal camera
- Stitched orthomosaic and AI-powered inventory and identification of roof system equipment with measurements
- AI-powered roof condition assessment from captured imagery detecting roof anomalies and degradation; re-inspect for changes
- Auto-generated roof report to memorialize roof assembly inventory and assessment to validate investment planning for operations and maintenance and recapitalization
- Work orders and repairs with assembly cost data integrated from RS Means



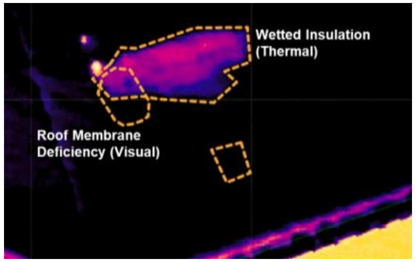
Roof Systems

Roof Assessment (Visual)

Roof Measurement & Takeoff



Roof Assessment (Thermal)



# Example: UAS Pavement Inspection VA Campus

*West LA VA Medical Center Campus*

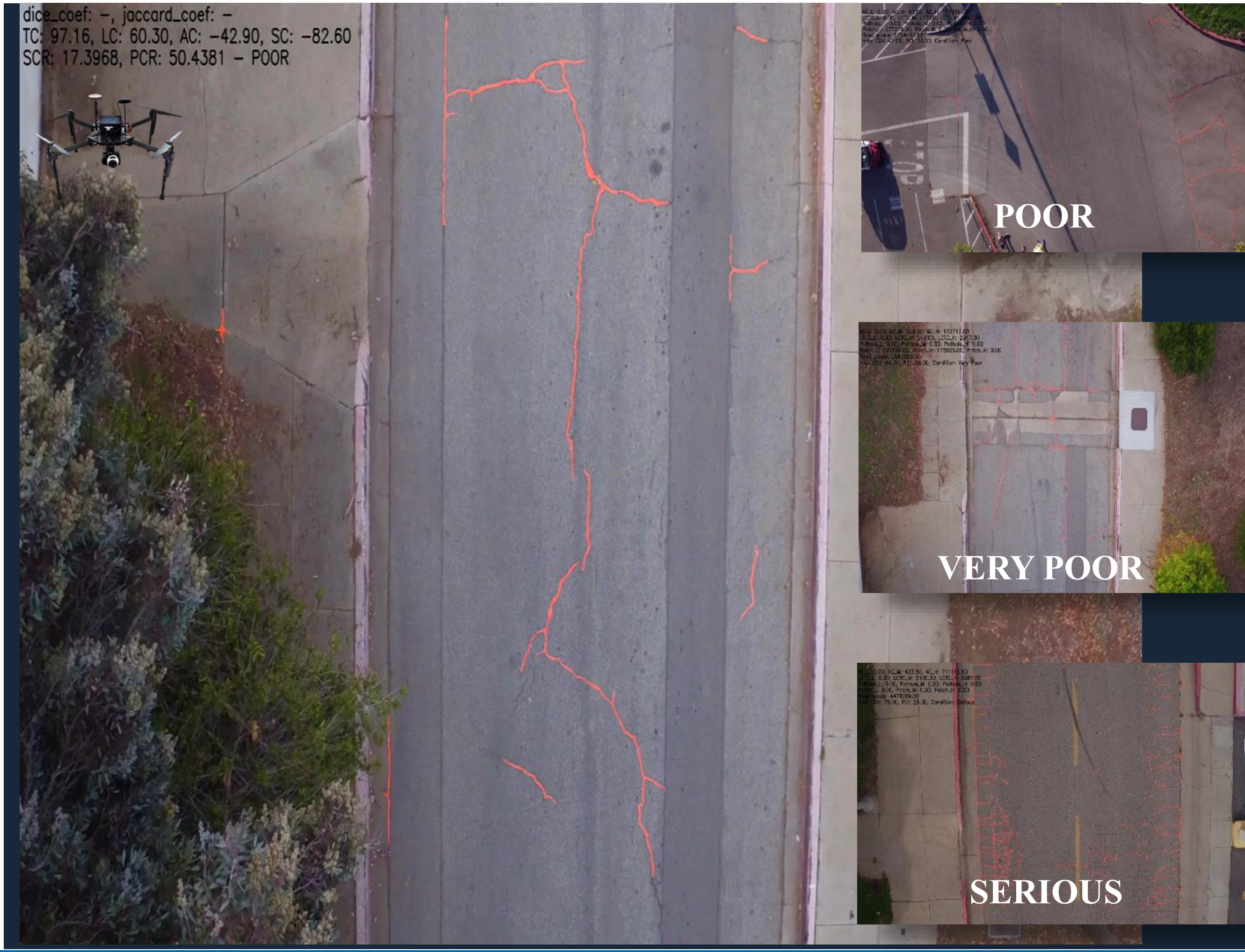
## DEMONSTRATED CAPABILITES

**Drone imagery with AI to autonomously assess pavement condition**

- Automated USACE Pavement Condition Index algorithms
- Effectively provided increased accuracy and detailed assessment compared to traditional inspection method
- 100% condition baseline for 25% less time and resources

**Airport Benefit:**

- Reduced Runway Closure/Site Time
- Detect Crack/Spalling Anomalies
- Quicker/Better Data Outputs



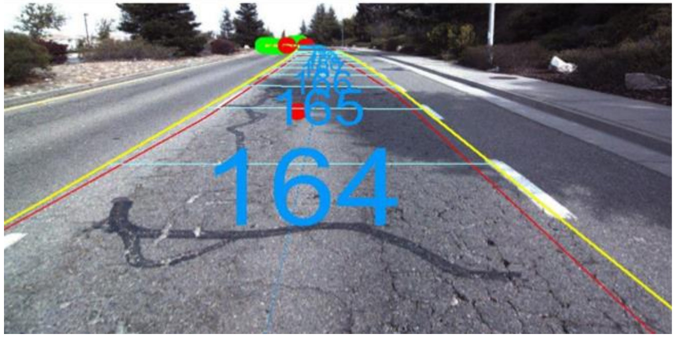
# Broader Remote-Sensing Applications

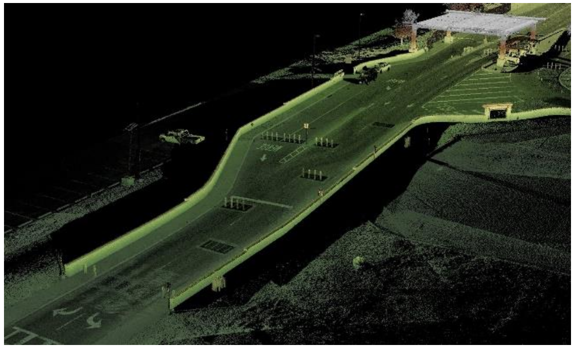
*Vehicle-based LiDAR/Visual Pavement Inspection*

## VMX-250-CS6 SYSTEM (VEHICLE –BASED LIDAR/VISUAL CAPTURE)

- 250 lb., mounted system operated by two-person vehicle LiDAR team
- LiDAR data post processed in appropriate coordinates with static GPS base station and on-board GPS and IMU data
- Both elevation and intensity measures are recorded:
- Elevation data for pavement distress analysis
- Intensity data to render a detailed 'picture' of road surface to identify paint markings, lane widths, etc.
- Condition data to spatially identify rutting, corrugation, potholes, bumps and depressions


*Mounted View Riegl VMX-250*



*Vehicle-mounted LiDAR and video capture; lane and aerial view with distress colorized and linework*

# Broader Remote-Sensing Applications

*Mobile scanning equipment to create detailed 3D models (digital twin)*

**GROUND SCANNING SYSTEM:**

NavVis VLX

- Wearable, 3D unit equipped with 2 LiDAR scanners and 4 360-degree cameras
- Corresponding data analysis tool: Bluebeam Revu iPad application

*NavVis VLX Touch Technology Viewer (above) and Mobile LiDAR Scanner (left)*

*Navis VLX Data Capture in Action*

*Paracosm PX-80 Handheld LiDAR*

# Thank You

Glady Singh
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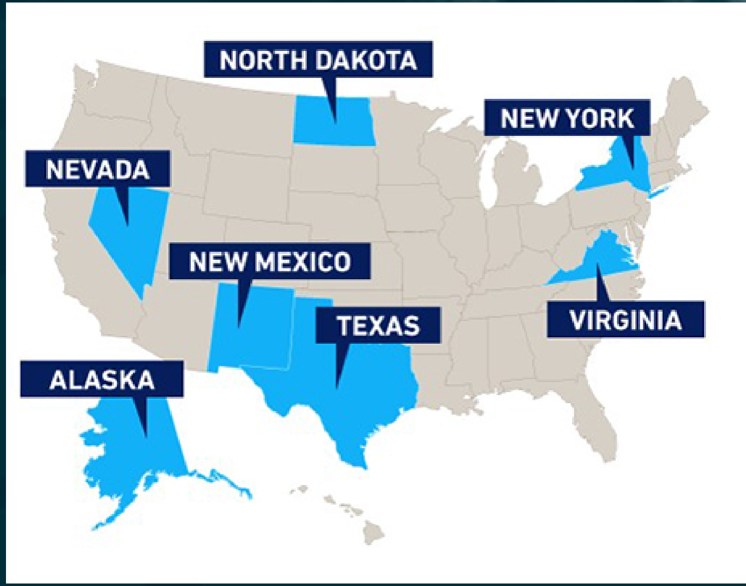
# How UAS Opportunities Benefit SYR

**H. Jason Terreri, IAP, A.A.E.**
**Executive Director**
**Syracuse Regional Airport Authority**

SYR®

# Regional Approach to UAS

- NY Governor Andrew Cuomo laid out the state’s plan to make Central New York and the Mohawk Valley a global center for UAS testing and innovation
- Griffiss Test site established in Rome, NY and managed by NUAIR (Northeast UAS Airspace Integration Research)
- A City Center Innovation Hub with a $12.5M development grant to include an inside drone testing facility in the Syracuse Technology Garden
- GENIUS NY – a $3M annual business accelerator competition focused on UAS startups. Companies come from around the world to participate



# UAS Community

- UAS Business Community:
  - Lockheed Martin, L3-Harris, AIS, Saab, SRC and Gryphon Sensors
- Education Partnerships:
  - Syracuse University:
    - Thales (UTM)
    - NUAIR Aerospace engineering internships
- Workforce Development:
  - Monroe Community College - the first New York institution to help educate a new generation of drone pilots and technicians
  - Onondaga Community College - degree tracks in Electromechanical Drone Technology and Geospatial Science & Technology

# 50 Mile Drone Corridor


The corridor will allow the government and private companies to test UAS beyond visual lines of site

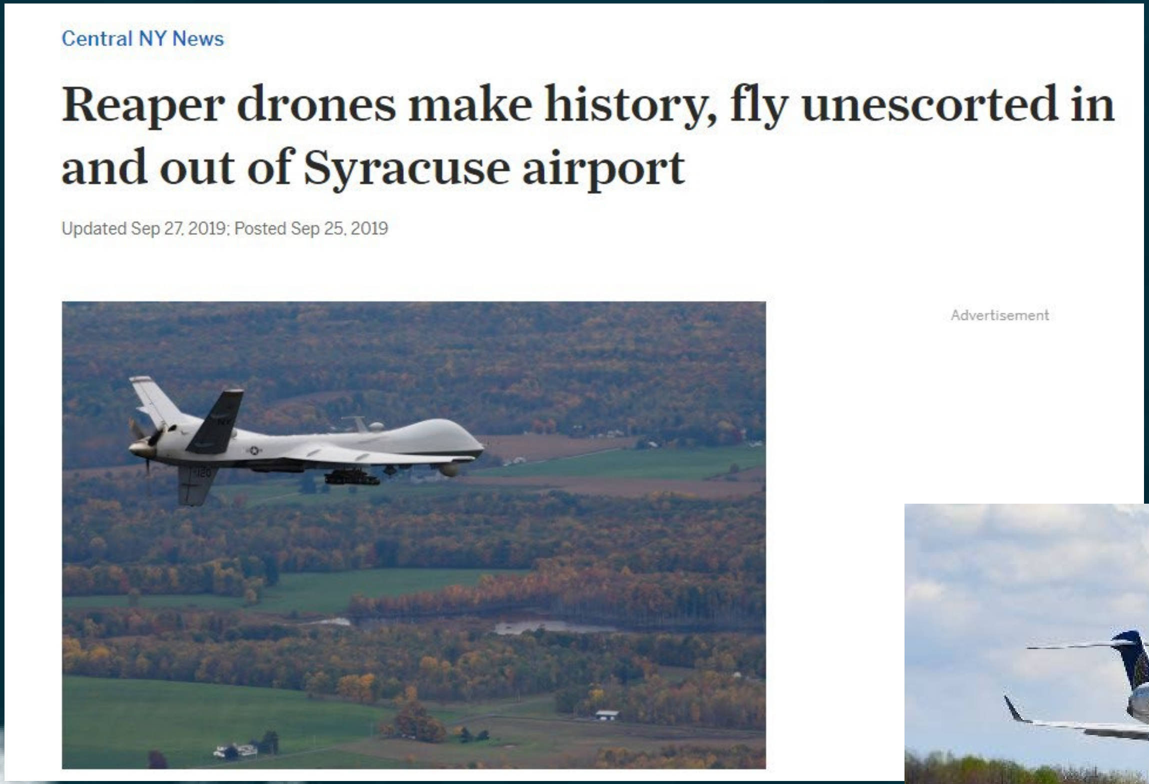
# UAS Benefits for SYR

- We believe SYR is an economic engine and catalyst for this community
- Our ability to contribute to technology and concept advances further the development investments being made in Syracuse and CNY Region
- Recognition by industry that Syracuse is a good place to do business and to pursue innovations in the UAS market

# UAS Integration at SYR

- SYR selected to host the FAA's Airport Unmanned Aircraft System(s) (UAS) Detection and Mitigation Research Program
  - 24-month Commitment
  - FAA will evaluate at least 10 different technologies

# SYR Operations


Central NY News

Reaper drones make history, fly unescorted in and out of Syracuse airport

Updated Sep 27, 2019; Posted Sep 25, 2019

Advertisement

Syracuse is the only commercial airport in the US to have integrated UAS operations with commercial traffic

# UAS Test Flight – ILS Calibration

- Partnered with Thales to test ILS “flight check” using a drone
- Operating during runway closure related to pavement improvement
- 6 flights to test:
  - Course Alignment & fluctuation
  - Localizer width
  - Glide Slope width
  - Glide Path angle and fluctuation

# Flight Operation Area

- **All maneuvers, equipment, home locations remain in the shaded blue zone**

# Planning for the future

- Received FAA Approval to include UAS infrastructure planning in our Master Plan update (expected start 2Q2021)

- UAS needs now included in all our planning efforts

# Questions?