Evaluating the Use of Unmanned Aerial Vehicles for Transportation Purposes
Presentation Outline

- Overview NCHRP 20-68A, UAS Domestic Scan 17-01
- Overview Proposed NCHRP UAS Problem Statement for Bridge Inspection/Management
- Overview Proposed UAS Pooled Fund Study
- Michigan DOT Proposed Phase III UAS Research
- FHWA EDC-5 UAS
- How data are currently being made available for use by transportation agencies
“The scan focus and objectives shall provide a better understanding of the proactive use of this technology as well as the *return on investment and its benefits* to the surface transportation community. This scan will **assist the accelerated national deployment of the technology by providing “Getting Started” guidance and case studies of successful applications of UAS.** The scan will also provide valuable information concerning where additional development and research might be needed to support the increased use of this technology.”
Scan participants reviewed applications of UAS by Surface Transportation Agencies from 12 states:

- Alaska
- California
- Colorado
- Georgia
- Iowa
- Kentucky
- Michigan
- Minnesota
- New Jersey
- Ohio
- North Carolina
- Utah
Scan 17-01 Team Members Home States and selected host/invited states

Team Member Home State

Primary Study Sites
Domestic Scan 17-01
Summary of Initial Findings

- Findings from four days of presentations, group discussions and participant notes.
- The scan team settled on the seven themes below for “Getting Started with UAS.”
  1) Executive Support
  2) Organizational Structure
  3) Policy and Regulation
  4) Safety and Risk Management
  5) Training and Crew Qualifications
  6) Public Relations
  7) Application and Operation
Proposed NCHRP UAS Problem Statement for Bridge Inspection/Management

Evaluating and implementing UAS into bridge inspection and management methods (24-months)

Objectives:

1. Determine which bridge element types are most suited to UAS assessment.
2. Assess UAS operation training requirements for state DOT personnel and the usefulness of hiring a third party service.
3. Compare and contrast the types of data collected via UAS to traditional methods.
4. Determine what types of required bridge management data cannot be collected via UAS and compare to traditional methods.
5. Compare UAS collected data to data collected by an inspector with respect to data type, quality, cost, time required, traffic impact, or other.
Proposed UAS Pooled Fund Study

Development of an Integrated UAS Validation Center (36-months)

Objectives:

- Safety in constrained locations where line of site is limited.
- Imaging system performance in poorly lit environments.
- Control of the UAS while flying between large steel girders.
- Adequate resolution of the imaging system for detecting the damage of interest.

The objectives of the study are two-fold:

- Development of the specific criteria a given UAS must meet for each particular application.
- Determining how to validate that a given UAS meets the required criteria.
Objective:

- Integration of Unmanned Aerial Systems Data Collection into Day-to-Day Usage for Transportation Infrastructure/Program Asset Management and Systems Operations (3-year)

- Develop and deploy four use cases from MDOT Sections specifically: Traffic Operations surveillance monitoring/STOC Video, Bridge Inspection, Construction Inspection (i.e., quantities, roadway surface condition state inspections, etc.), Design Surveys.

  - Traffic Operations (streaming camera images to a TOC)
  - Bridge Inspection Assessment (photos & infrared images)
  - Construction Inspection (cut/fills, grade changes, pvt placement, etc.)
  - Design Surveys (LiDAR point cloud compared to current method – Mobile Terrestrial LiDAR)
Unmanned Aerial Systems (UAS)

Contacts: James Gray and Connie Yew

- Washington - aerial roadway surveillance and potentially for situational awareness for avalanche control.
- North Carolina - construction inspections and perform accident scene reconstructions.
- New Jersey - structural inspections, real-time construction project monitoring, traffic incident management, aerial 3D corridor mapping, emergency response assessments, and traffic congestion assessments.
- Ohio - traffic monitoring, emergency response operations, and construction inspections.
Bridge asset management & condition assessment optical imagery: examples
Bridge asset management & condition assessment thermal imagery: examples
Analyzing thermal results

UAV Data
Uncle Henry Rd Bridge
Thermal Imaging 11/14/16
Thermal - Optical Algorithm Derived Delaminations
STR#9289 Saginaw, MI

- Area Excluded From Analysis
- Thermal - Optical Algorithm Delaminations

Total Delamination Area = 97.3 sq ft
Bridge asset management & condition assessment LiDAR imagery: examples

Bridge with linear interpolation assumption
Automated spall detection: Uncle Henry Rd bridge

UAV Data
Uncle Henry Rd Bridge
Hillshade Relief
Application Detected Spalls
STR#9289 Saginaw, MI

Uncle Henry Rd Detected Spalls

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Quantifying condition states

- Quantitative measurements of distress features can be calculated and applied to condition states used by transportation departments.

- Spans are digitized in a GIS using bridge plans that are georeferenced to an aerial image of the bridge.

- UAV-collected data can feed into this element-level condition state monitoring – Also inform deterioration models.