2015 National Rural ITS Conference

Evaluating the Use of Unmanned Aerial Systems (UAS) for Transportation Purposes

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UAS Benefits for Transportation

- Safety: removes workers (inspectors, etc.) from the roadway that may otherwise expose themselves to traffic
- Mobility: reduces congestion and user delay by minimizing the potential of a lane closure needed for conventional human based inspections
- Efficiency: quickly assess (within seconds) an asset/operations with potentially higher quality resolution data than achieved by current inspection methods
- Legacy Liability: can replace conventional assets along the network needed to support cameras, monitoring devices, etc.
- Economic Development: supports state of Michigan companies and universities developing UAS platforms and sensory technologies

MDOT Research - Evaluate the Use of UAS for Transportation Purposes

- Demonstrate how technology can provide aerial inspections for infrastructure assets
  - Roadway Assets
    - Bridges, lighting, signs, guardrail, etc.
  - Confined spaces
    - Pump stations (environmental assessment & physical conditions)
    - Entrances to sewers and culverts
- Demonstrate optical and thermal infrared technologies use to evaluate surface and structural integrity of bridge elements
- Demonstrate how a Light Detection And Ranging (LiDAR) sensor can be used to rapidly assess and inspect transportation infrastructure
- Demonstrate UAV use for monitoring traffic operations

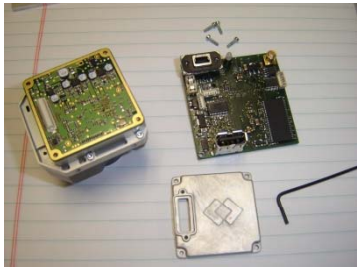
UAV Platforms

- Bergen Hexacopter ($5,400)
  - payload 12 lbs
  - 20 minute flight time
  - auto-pilot system able to fly programmed waypoints
- Mid-sized UAV – Phantom ($800)
  - 3 lbs payload
  - 25 minute flight time
- Micro UAV ($150)
  - 7-15 minute flight time
  - micro-camera payload
- Blimp ($1,000)
  - 16 ft long blimp 3.5 lbs payload
  - long periods of time in flight

UAV Sensors

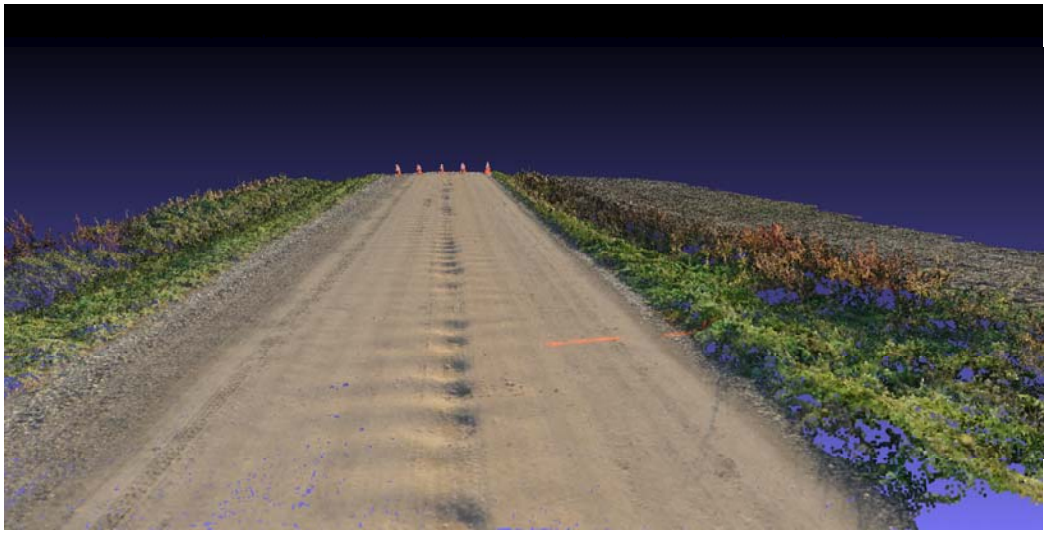
- Optical ($3,000 w/ $400 lens - $3,400)
  - characterize surface defects, generate a photo inventory w/ 3D resolution down to 1cm at 100 ft. - wt: 4 lbs
- Thermal Infrared ($4,000)
  - detection of subsurface defects such as concrete delaminations on bridges wt: 1 lb
- LiDAR ($6,300)
  - creates 3D point clouds of surfaces wt: 1 lb

Optical Camera


Thermal Infrared Camera

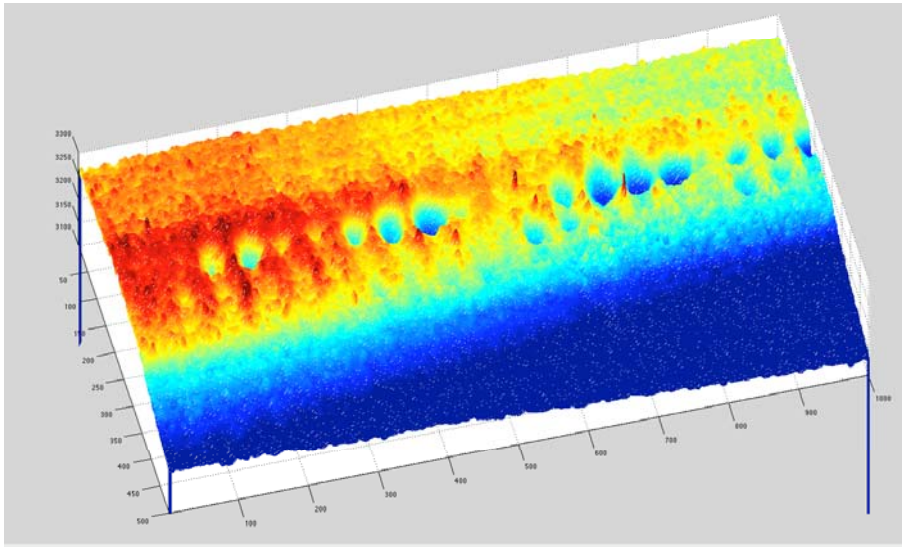

LiDAR Scanner

Mapping Condition State of Unpaved Roads



3D point cloud of an unpaved road generated using image reconstruction

Aerial photo of unpaved road from UAV



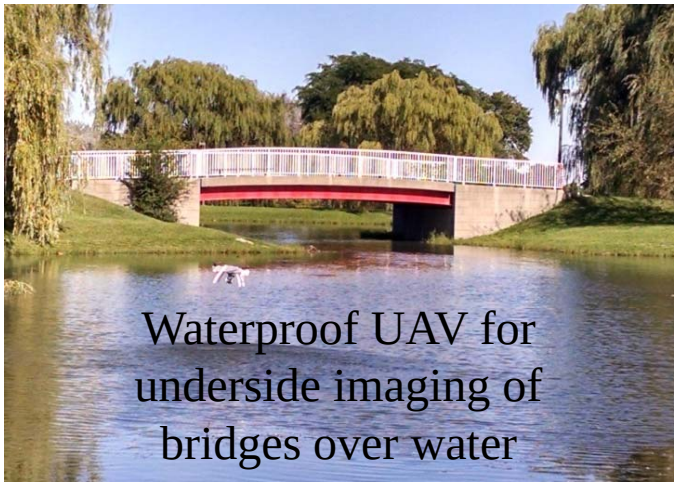
3D height field showing potholes on an unpaved road

Confined Space Inspections

- Capability to fly in confined spaces
  - MDOT Pump Stations
- Is it safe to send a person in?
  - unlit spaces
  - assess environmental condition state (air quality, etc.)
- Successfully tested with live video feed via iPhone

Traffic Operations

Construction site imaging



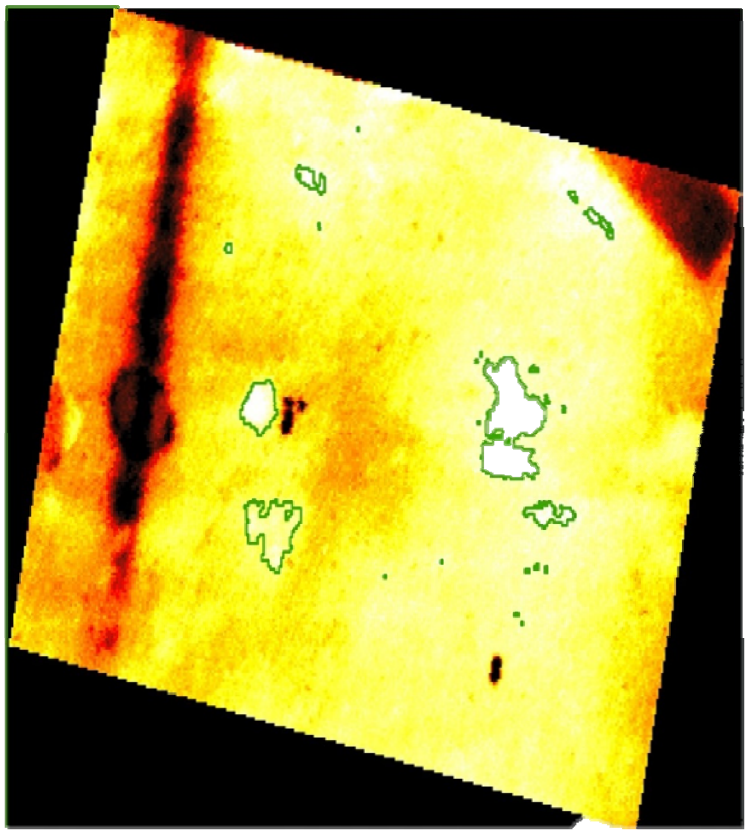
Waterproof UAV for underside imaging of bridges over water

Non-Destructive Evaluation of Bridge Elements

- Used to detect surface conditions
  - Bridge deck delamination, potholes, cracks, patching, etc.
- Overlapping imagery can be used to generate 3D models to characterized condition state of deck bridge

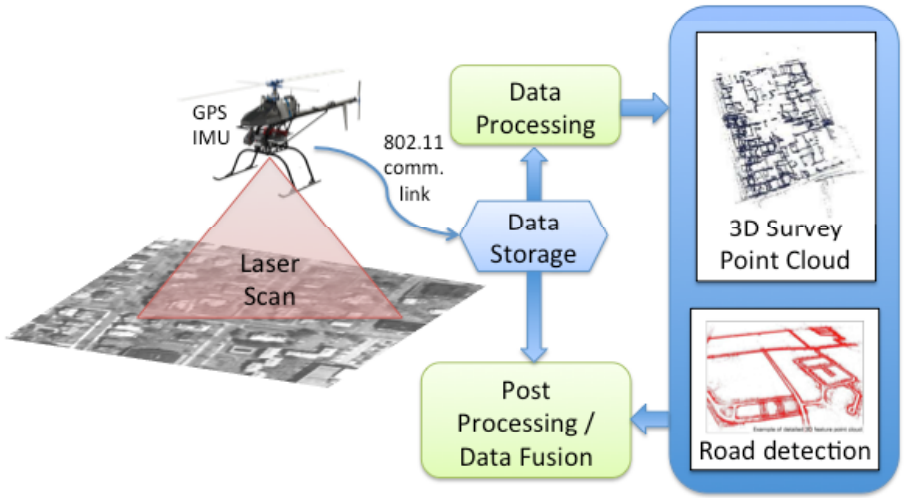
Aerial Thermal Infrared Scanning

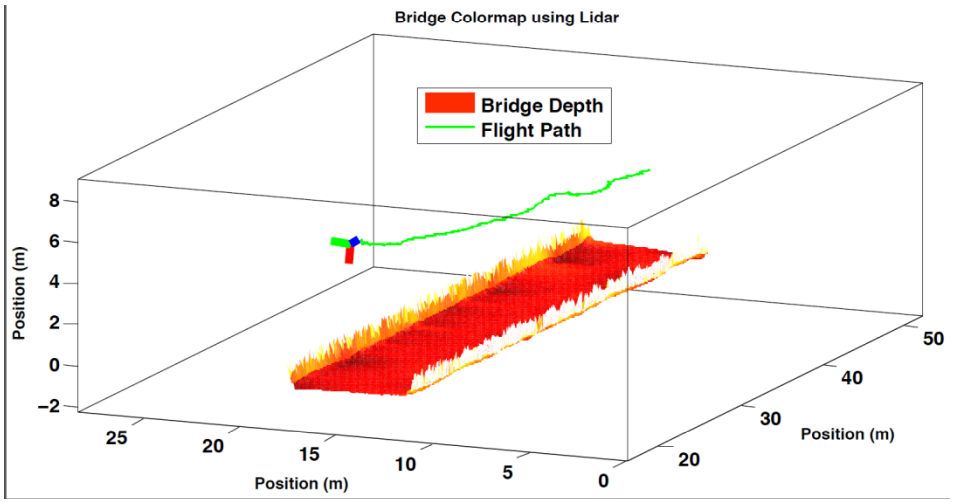
- Detection of subsurface condition
- Infrared imagery automatically detects delamination (left, green polygons)



LiDAR Scanning for Asset Management

- Goals:
  - Measurement of transportation infrastructure w/ 10cm resolution and 3D models
  - Automated detection of transportation infrastructure (roads, bridges, signs, guardrail, lighting, etc.)

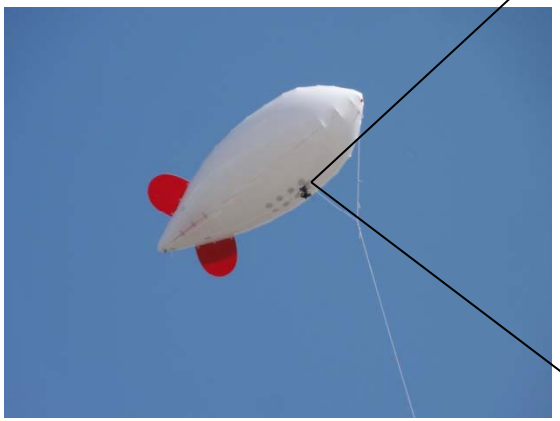




UAS Demonstration – TIM Crash Reconstruction

Another Option for Aerial Monitoring of Traffic Operations

- Blimps
  - Long flight time – up to several days
  - Tethered, lower FAA requirements for flight operations, can operate at night (max 500 ft. line of sight & 5 miles from airports)
  - Relatively large open area required for launch and recovery
  - Gimbal (gyro) device to stabilize visual display
  - Transmit video feed for live viewing



US-23 and Plymouth Road, Ann Arbor,

Proposed MDOT UAS Phase II Research (January 2016 to July 2018) Objectives/Deliverables

1. Develop, deploy, and implement near-time data collection communication backhaul and data storage capabilities proof of concept for the most viable UAV platforms and sensing capabilities
2. Develop, deploy, and implement (via pilot projects) UAV data uses, analysis, and processing systems delivered from on board sensors for two (2) to three (3) specific business functions/activities identified by MDOT
3. Demonstrate, deploy and implement (via pilot projects) data quality protocols to ensure data collected is accurate and within tolerance requirements when compared to current data collection systems at MDOT for the same two (2) to three (3) specific business functions/activities identified by MDOT
4. Provide device/sensory training, deployment/implementation plan, including a user/operation guidance document
5. Determine the return on investment (benefit/cost analysis)
6. Secure an FAA COA


Thank you!
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