Evaluating the Use of Unmanned Aerial Vehicles for Transportation Purposes – Crash Scene Reconstruction Technologies

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MTRI’s UAV Background

- Unmanned aerial vehicles (UAVs) have been incorporated into a variety of studies at MTRI including:
  - Transportation: Unpaved road condition assessments, bridge condition assessments, traffic monitoring, confined spaced inspections, forested road detection, utility inspections.
  - Environmental: Invasive species monitoring, water quality assessments.

- MTRI has experience in using quadcopters, hexacopters, mini-, small-, and blimp / aerostat UAVs.

- MTRI has worked with local, state, and federal agencies in the use of UAVs for data collection and assessment:
  - Michigan Department of Transportation
  - United States Department of Transportation
  - USDA Forest Service
  - Utility companies
  - Class I Railroad
  - Pipeline service company
Transportation Studies

Unpaved Road Condition

Bridge Condition

Confined Space Monitoring

Construction Monitoring

Utility Inspection

Traffic Condition
Environmental Studies

Eurasian Watermilfoil

Phragmites

Forested Roads and Wetlands

Lake Erie Algal Blooms
FAA Rules and Regulations

- Rules History (brief timeline)
  - 1981 FAA issues Advisory Circular on Model Aircraft Operating Standards guidelines
  - 2006 First COAs issued (Certificate of Authorization)
    - Focused on public agencies obtaining permission to fly
  - 2012 FAA Modernization and Reform Act dictated what FAA can and cannot regulate with respect to UAVs
  - Dec. 2013 5-year FAA UAV integration RoadMap
  - Feb 2015 New proposed rules for small UAS (under 55lbs), comment period closed April 2015, now under review by FAA – to be issued in 2016 or 2017.
  - Nov 2015 – Registration of all UAVs over 0.55 lbs recommended by FAA multi-stakeholder committee
Section 333 Requirements

- Private pilot or sport pilot certificate
- Exemption from airworthiness certificate
- Small UAVs (under 55 lbs.)
- Generally under 400 feet in altitude
- Aircraft remains in line of sight
- Notification of towered airports if operating within 5 miles of the airport
- Blanket authorizations have been given to some applicants to fly under 200 feet anywhere in certain states
FAA – Section 333 Exemption

- FAA Modernization and Reform Act of 2012 – granting authority to Sec. of Transportation to waive airworthiness certificate requirement still allowing safe operations of UAVs in national airspace.

- Multiple petitions have been granted for accident investigation
  - O’Hern Traffic Accident Consultants, Inc. (10/29/15)
    - “Aerial inspections, site surveys as part of a forensic analysis, assisting law enforcement with search and rescue operations, and with the execution of search warrants”
  - Kineticorp (10/13/15)
    - “Aerial data collection for accident analysis”
  - Sydor Aerial Photography LLC (6/29/15)
    - “Flights over accident scenes for the purpose of accurately documenting details of fatal and nonfatal transportation related accidents”
  - [https://www.faa.gov/uas/legislative_programs/section_333/](https://www.faa.gov/uas/legislative_programs/section_333/)
  - [https://www.faa.gov/uas/legislative_programs/section_333/333_authorizations/](https://www.faa.gov/uas/legislative_programs/section_333/333_authorizations/) (searchable online database of exemptions)
Michigan State Police Demonstration

- Demonstration at MTRI using small DJI Phantom 2 quadcopter and GoPro-Hero 3.

- Highlighted rapid collection of aerial imagery of a crash scene investigation using low-cost (~$1,000), commercial off the shelf technologies.

- Imagery outputs provide a good overview of crash scene, but due to the lower resolution of GoPro imagery, should not be used to make measurements.

- Measurements were collected by MSP officer for use by crash scene investigators in tandem with aerial imagery.

- Next year, MSP purchased their own system ($150k Aeryon Scout), UAV person
Southeast Oakland County Crash Investigation Team (SOCCIT) Demonstration

- Demonstrations at the Bloomfield Township Police Department using a Bergen Hexacopter (flights up to 20 minutes; $5,400) and Nikon D800 digital camera ($3,800 with lens).

- A mock traffic incident was set up, with tire marks left by police cruiser, and crash scene markers placed by crash scene investigators from local police.

- Due to the high resolution, 36 megapixel images, quantitative measurements could be made using the UAV collected aerial imagery.
Southeast Oakland County Crash Investigation Team (SOCCIT) Demonstration
Each crash scene marker was about 20x20 pixels per flat rectangular area, with a pixel equal to 1/11 inch (0.0875 inches) or 2.2 mm.

“By using known distances and an approximated drag factor for the road surface, with 15-20 minutes of work, I was able to estimate the speed of the vehicle at 28 mph through imagery captured by the UAV. In training environments, we will test skids at 30 mph, so everything seems to be in line with reality.”

– St. Clair County Officer, Crash scene investigation team
Multiple demonstrations at the ITS World Congress in Detroit, Michigan at both Cobo Hall and Belle Isle.

Mock emergency scenario involved a tracker trailer – passenger vehicle incident, with leaking fluid (soapy water) and a reported fatality in the passenger vehicle.

Working closely with MDOT and the Michigan State Police, MTRI flew the Bergen hexacopter / Nikon D800 to collect high resolution imagery. Additionally, the MTRI traffic monitoring blimp was flown to collect and transmit near real-time video to command center.
Intelligent Transportation System World Congress Emergency Response Day

Images, video available to Incident Command Center
Nighttime Possibility

- Local police training in nighttime photography for crash investigation.
- Mock scene practical activity included flying a DJI Phantom 2 Vision quadcopter over previously wrecked vehicles.
- Aerial imagery would prove useful for quick imaging of entire traffic incident. However, due to nighttime conditions, external lighting is needed for the UAV to collect useful imagery.
- Also demonstrated new low-cost thermal add-ons for cell phones (<$300)
- Night-time data collections with UAV currently very limited under FAA rules
Conclusions

- UAV technology can be implemented and be useful – daytime is currently more practical to implement.

- UAVs can be implemented into crash scene investigations to provide both qualitative and quantitative information concerning the incident.
  - Lower resolution imagery can quickly provide an overview
  - High resolution imagery can provide measurements concerning how fast vehicles were moving at the time of impact can be calculated.
  - Can potentially reduce time spent measuring data (increase safety, reduce traffic impact)