RESEARCH ADMINISTRATION
Bureau of Field Services
Michigan Department of Transportation

Research Spotlight

Taking flight with sensing equipment will deliver benefits across MDOT

Recent strides in technology have opened the doors for using unmanned aerial vehicles (UAVs, sometimes called drones) throughout MDOT. An extensive study on the viability of UAVs instrumented with remote sensors demonstrated a wide range of cost-effective applications. The department has high hopes for this technology, and a follow-up research project is already in the works.

Project Information

REPORT NAME: Evaluating the Use of Unmanned Aerial Vehicles for Transportation Purposes

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COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

MDOT Project Manager

Steven J. Cook, P.E.

Engineer of Operations and Maintenance
Operations Field Services Division
Michigan Department of Transportation
6333 Lansing Road
Lansing, MI 48917
cooks9@michigan.gov
517-636-4094

Problem

In just a few years, the carrying capacity, battery flight time and stability of UAVs have increased, and sensor, storage and transmission hardware has become lighter and more accurate. All of this equipment has continued to become more affordable as well. The prospect of using various UAV platforms in the sky to collect high-resolution visual data, infrared images and LiDAR (Light Detection and Ranging) measurements is becoming a reality. The use of UAVs, specifically for transportation purposes, has the added advantage of efficiently collecting data while keeping traffic moving and taking workers out of harm's way.

A Michigan-made unmanned hexacopter (inset) can gather aerial data quickly, like high-resolution imagery of this construction project on I-96 in Livonia.

A critical first step in UAV deployment, however, is putting new tools like these through their paces in actual practice. Can the varying technologies be wed effectively to collect data that is usable by MDOT practitioners? What barriers—technical, operational and regulatory—must be overcome to realize the promise of instrumented UAVs? A previous MDOT research study conducted by Michigan Technological University sought the answers to these questions and helped chart a path forward for UAV deployment at MDOT.

(continued)

"Taking data collection workers and equipment out of traffic and putting sensors in the air can provide a tremendous safety advantage. Savings on capital and legacy maintenance costs is another benefit."

Steven J. Cook, P.E.
Project Manager

Research

This study of MDOT was among the most comprehensive of its kind, encompassing a wide array of platforms, sensors and field applications.

- **Platforms** included a remote-controlled hexacopter (a helicopter with six rotors), two sizes of quadcopters and a tethered blimp.
- **Sensors** included cameras in the visible spectrum, thermal sensors and LiDAR equipment.
- **Applications** included assessment of highway assets, inspection of confined spaces, traffic monitoring, nondestructive evaluation of bridge elements and infrastructure inspection for asset management through LiDAR sensing.

The researchers integrated combinations of platforms and sensors along with additional equipment as needed, such as onboard storage devices, cellular data transmission and collection systems, and vehicle lighting. A primary research objective was to demonstrate whether the instrumented UAVs could perform comparably to traditional data collection methods.

Results

After extensive study, the instrumented UAVs proved to be viable alternatives to their terrestrial counterparts. For example, the bridge deck characterization included in this research involved collecting aerial images to detect potholes as well as thermal data to detect incipient problems below the riding surface. The data were compared closely to data collected by traditional ground-based means. The UAV data not only met engineering requirements, they allowed researchers to integrate and validate multiple data sets for the same asset.

Other demonstrations proved successful as well. Miniature quadcopters provided streaming visual data in confined spaces that potentially could be harmful to workers. Optical cameras on hexacopters quickly and inexpensively captured construction site conditions. LiDAR-instrumented platforms collected useful data sets for asset inventory and management.

Such research results drew international attention at the 2014 World Congress on Intelligent Transportation Systems held in Detroit. MDOT and the research team showcased a tethered traffic-monitoring blimp with near-live video feeds and demonstrated multi-rotor helicopters for such applications as bridge deck assessment and emergency response video collection.

Value

The external interest in this technology is complemented by support within MDOT and a recognition that UAVs are poised to assist offices across the department. UAVs also offer economic benefits to the state, with a platform manufacturer located in Michigan. The pieces are in place to take next steps toward implementation, and a proposed follow-up MDOT research study should begin soon.

Before the full potential of UAVs can be realized, Federal Aviation Administration rule changes must be adopted. These changes are in progress and are anticipated in 2016 or 2017. Other issues that MDOT will address are the potential for driver distraction by UAVs and privacy concerns from airborne cameras. Further equipment and data integration is needed, along with collaboration among staff in MDOT's data asset management, design, construction, operations and maintenance offices to make sure the data will meet day-to-day operational needs.

The future offers opportunities as well. As technology continues to advance, it may become feasible and cost-effective to equip a platform with multiple sensors—optical cameras, infrared cameras and LiDAR— to collect data sets in a single flight. Many practitioners expect UAVs to become a common tool among transportation and other agencies, and MDOT is positioned to be a leader among DOTs in this area.

Research Administration

Principal Investigator

Colin Brooks
Michigan Technological University
3600 Green Ct., Suite 100
Ann Arbor, MI 48105
cnbrooks@mtu.edu
734-913-6858

Contact Us

PHONE: 517-636-4555
E-MAIL: mdot-research@michigan.gov
WEBSITE: www.michigan.gov/mdotresearch

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