I. PROBLEM TITLE

Integration of Unmanned Aircraft Systems into DOTs.

II. RESEARCH PROBLEM STATEMENT

Statement of the general problem or need. One or more paragraphs are sufficient.

Unmanned Aircraft Systems (UAS, commonly referred to as drones) offer an innovative means by which to gather data for transportation monitoring, mapping, and decision support. Numerous DOTs in and outside of New England have tested the effectiveness of UAS for a variety of applications including slope and stream monitoring, bridge inspections, right-of-way mapping, accident clearance, and post-disaster damage assessment. In many cases, UAS have been shown to be more cost effective, safer, and generate more data-rich products relative to traditional manual data collection options.1 Although there exist numerous examples and case studies of how UAS can be used to benefit DOTs, there is comparatively little research on how to effectively integrate UAS into state DOT operations. Because they are a relatively new and rapidly evolving technology, DOTs would benefit from clear guidance on available UAS technologies, appropriate application and best practices for UAS deployment and data usage, along with strategies for integrating UAS into DOT operations.

III. RESEARCH OBJECTIVES

A clear and specific statement of the objectives that are to be met by the research necessary to adequately address the research problem described in the Research Problem Statement.

This objective of this research is to produce a guidance document on UAS applications, implementations, integration, and best practices. It should document:

1. Available UAS technologies
2. Legal, privacy, and regulatory considerations around UAS data collection
3. Transportation related UAS applications that have been tested to date and provide guidance on the situations that have yield greatest benefits
4. Benefits and challenges of pairing UAS with traditional methods for data collection
5. Best practices for contracting for UAS services
6. Integrating UAS into current operations, particularly how they should be paired with existing methods
7. The information technology and human resource issues associated with UAS implementation

IV. ESTIMATE OF FUNDING NEEDED
An estimate of the funds necessary to accomplish the objectives stated in III above.

$100,000

V. RESEARCH PERIOD
An estimate of the number of months necessary to complete the project, including preparation of a Draft Final Report and its review by the NETC project Technical Committee (90 days), and the preparation and printing of the Final Report.

18 months

VI. URGENCY AND PAYOFF POTENTIAL
A description of the urgency of the need for this research in relation to the transportation needs of the six New England States and, if possible, the potential for payoff in benefit/cost terms.

Numerous case studies indicate the potential for significant cost savings and safety improvements for DOT personnel and the traveling public. Without guidance on how to implement UAS into their existing operations, along with the organizational changes that may have to be made, DOTs are ill-prepared to harness the true potential of UAS technology. A comprehensive guidance document that provides the New England DOT with concrete recommendations about best practices for UAS deployment, data usage, and strategies for integrating UAS into DOT operations will accelerate the DOTs’ capacity to realize these benefits.

VII. PRELIMINARY LITERATURE SEARCH
To avoid duplicating research already published or in progress, the submitter of the Problem Statement will perform a quick literature search prior to submitting the Problem Statement and attach a summary of the results of the literature search to the Problem Statement. This literature search can be conducted by accessing the Transportation Research Board’s TRID database available at https://trid.trb.org/. The TRID database contains information on completed research as well as research in progress.

Source of preliminary literature search (check as appropriate): X_TRID X_RIP
Other (describe):

Summary of preliminary literature search (how the subject of this Research Problem Statement would differ from or add to, existing Studies):

A growing number of studies document that applicability of UAVs for DOT relevant applications. Many of these cover a single application such as bridge inspection (Hackl et al. 2018; Hawken, Nguyen, and Ivanyi 2017; Khaloo et al. 2018; Wells et al. 2017), traffic incident management (Stevens, Blackstock, 2017), construction site safety inspection (Melo et al. 2017), and concrete crack identification (Kim et al. 2017). While extremely valuable for the documented applications, these reports fail to provide the type
of concise synthesis that would enable DOT decision-makers to understand the potential for broadly integrating UAVs into DOT operations.

A smaller number of studies consider multiple applications in a single report (Brooks et al. 2015; O’Neil-Dunne, 2016; Kamga et al. 2017). These reports provide a valuable overview of UAV technologies and applications do not focus on either the technical proficiencies required to implement UAV data collection programs in-house.

In addition, little information on how UAS should be paired with existing methods as they are integrated into DOT operations or the IT and data management issues associated with UAV implementation could be found in the literature. These two topics are vital to success and on-going UAV integration but DOTs have few resources that cover these topics.

References:


VIII. KEY WORDS TO BE USED FOR ADDITIONAL LITERATURE SEARCH
Provide the key words that can be used to conduct a search of the Transportation Research Board's electronic database (TRID) for completed, related research. To the maximum extent possible key words should be selected from the National Transportation Library’s Transportation Research Thesaurus. The Thesaurus can be found at http://trt.trb.org/trt.asp.

Drone aircraft, UAV, UAS, best practice, and implementation

TWO DOT ENDORSEMENTS ARE REQUIRED

IX. ENDORSEMENT BY THE SPONSORING DOT (To be signed by the DOT representative to the NETC Advisory Committee through whom the Problem Statement is submitted).
By signing the endorsement, the DOT representative is certifying that:
1. The Problem Statement follows the required format
2. The required literature search has been conducted
3. The Problem Statement addresses a transportation issue of relevance to NETC and does not duplicate another Problem Statement being submitted at this time.

Stephen Smith  VTrans  1/16/2018
(Name) (DOT) (Date)

X. ENDORSEMENT BY A DOT SPONSOR TO LEAD THE TAC (To be signed by a DOT lead with technical knowledge and commitment to the research outcome).

DOT Technical Endorsement: I agree to chair the NETC Technical Committee if this problem statement is selected.

Stephen Smith  VTRANS  1/16/2018
(Name) (DOT) (Date)

NOTE: To expedite the processing of Research Problem Statements, NETC requires submittal by E-mail (netc@uvm.edu) by January 16, 2018.
NETC LITERATURE SEARCH

RPS Title: Integration of Unmanned Aircraft Systems into DOTs

Summary of Relevance of Literature Search Retrievals to the Problem Statement:
Number of Relevant TRID Transport Retrievals: [High – 17, Medium – 5]
Number of Relevant Internet Retrievals: [High – 1, Medium – 0]
Total Number of Relevant Retrievals: [High – 18, Medium – 5]

- Search Terms Provided by RPS: drone aircraft, UAV, UAS, best practice, implementation
- Additional Search Terms used by Coordinator: DOT

TRID RETRIVALS with HIGH RELEVANCE:

Title: Investigating Unmanned Aerial System (UAS) Application Requirements within a Department of Transportation
Author(s): Gheisari, Masoud; Karan, Ebrahim P; Christmann, Claus H.; Irizarry, Javier; Johnson, Eric N.
Abstract: This paper explores the feasibility of using Unmanned Aerial Systems (UASs) in Georgia Department of Transportation (GDOT) operations. The research team conducted 24 interviews with personnel in four GDOT divisions. Following an interview validation process, a set of UASs design characteristics fulfilling user requirements of each previously identified division were developed. A “House of Quality” viewgraph was chosen to capture the relationships between GDOT tasks and potential UASs aiding those operations. As a result, five reference systems are proposed. This study introduces a variety of UAS applications in traffic management, transportation and construction disciplines related to Department of Transportations (DOTs), such as the ability to get real time, digital photographs/videos of traffic scenes or providing a "bird’s eye view" which was previously only achievable with the assistance of a manned aircraft. The results of this study could lead to further research on design, development, and field-testing of UASs for applications identified as beneficial to DOTs.
Record Type: Publication
Record URL: http://amonline.trb.org/
Supplemental Notes: This paper was sponsored by TRB committee AFB80 Geospatial Data Acquisition Technologies in Design and Construction.
Monograph Title: TRB 94th Annual Meeting Compendium of Papers
Corporate Authors: Transportation Research Board
500 Fifth Street, NW
Washington, DC 20001 United States
Pagination: 15p
Conference: Transportation Research Board 94th Annual Meeting
Location: Washington DC, United States
Date: 2015-01-11 to 2015-01-15
Title: Information on the fly: UAV use looking more appealing for DOTs across the U.S.

Author(s): Wilson, Bill

Abstract: While merely part of a hobby trend just a couple of years ago, unmanned aerial vehicles (UAVs) are on the verge of transitioning into the business world, as the benefits of capturing images of varying degrees from a couple of hundred feet off the ground are beginning to be explored by state departments of transportation (DOTs). In Michigan, North Carolina and Ohio, platforms are already being built around the potential of UAVs by the DOTs. Issues of safety, public perception, regulation surveying and data collection are addressed.
Availability: Find a library where document is available
Order URL: http://worldcat.org/oclc/11660022
Files: TRIS
Created Date: 10/27/2015 10:39 AM

Title: Taking Off: State Unmanned Aircraft Systems Policies
Author(s): Essex, Amanda
Abstract: This report looks at State laws and legislative action in the U.S. related to Unmanned Aircraft Systems (UAS). It begins with an overview federal action related to UAS including proposed rulemaking, test sites, categories of operation, registration, enforcement, and public education. State legislative action explored includes privacy, hobbyists, insurance, commercial use, governmental use, hunting/fishing, security concerns, and criminal penalties for misuse. The report also looks at State-requested studies and convened task forces on the use of UAS.
Record Type: Publication
Record URL: http://www.ncsl.org/Portals/1/Documents/transportation/TAKING_OFF-STATE_%20UNMANNED_%20AIRCRAFT SYSTEMS_%20POLICIES_%20%28004%29.pdf; /common/images/covers/large/1420190.png
Corporate Authors:
National Conference of State Legislatures
Washington, DC United States
ISBN: 9781580248587
Pagination: 32p
Publication Date: 2016-00-00
Language: English
Media Type: Digital/other
Features: Figures; Photos; References
Subject Areas: Aviation; Law; Policy
Keywords: Drone aircraft; Insurance; Law enforcement; Laws and legislation; Privacy; Security; States
Accession Number: 01622514
Availability: Find a library where document is available
Order URL: http://worldcat.org/isbn/9781580248587
Files: TRIS
Created Date: 8/17/2016 10:33 AM

Title: Field Test Based Guidelines Development for the Integration of Unmanned Aerial Systems (UASs) in GDOT Operations
Author(s): N/A
Abstract: The objective of this research project is to determine the technological feasibility, advantages, limitations, and legal/social implications of Unmanned Aerial Systems (UAS) use for applicable Georgia Department of Transportation (GDOT) operations.
Record Type: Project
Language: English
Contract Numbers: GDOT RP 16-09
Status: Active
Funding Amount: $346658
Sponsor Organizations:
Georgia Department of Transportation
One Georgia Center
600 West Peachtree Street, NW
Atlanta, GA 30308 United States
Managing Organizations:
Georgia Department of Transportation
One Georgia Center
600 West Peachtree Street, NW
Atlanta, GA 30308 United States
Project Managers:
Bui, Binh
(404) 608-4798
bbui@dot.ga.gov
Performing Organizations:
Georgia Institute of Technology
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Atlanta, Georgia 30332 United States
Principal Investigators:
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Georgia Institute of Technology
javier.irizarrry@coa.gatech.edu
Johnson, Eric N
Georgia Institute of Technology, Atlanta
Notice Date: --
Start Date: 2016-04-19
Expected Completion Date: 2018-07-19
Actual Completion Date: --
Subject Areas: Aviation; Data and Information Technology
Keywords: Drone aircraft; Feasibility analysis; Field tests; Georgia Department of Transportation; Legal factors; Social factors; Technological innovations
Accession Number: 01599095
Source Agency: Georgia Department of Transportation
One Georgia Center
600 West Peachtree Street, NW
Atlanta, GA 30308 United States
Files: RiP; STATEDOT
Created Date: 5/18/2016 11:05 AM

Title: A Study of How Unmanned Aircraft Systems Can Support the Kansas Department of Transportation’s Efforts to Improve Efficiency, Safety, and Cost Reduction
Author(s): McGuire, Melissa; Rys, Malgorzata; Rys, Andrew
Abstract: Regulations for using Unmanned Aircraft Systems (UAS) are not yet standardized by the Federal Aviation Administration (FAA). This creates tedious obstacles for those who wish to utilize the technology. The goal of this research is to provide a justified recommendation to the Kansas Department of Transportation (KDOT) on whether or not it is beneficial to implement UAS into routine operations, as well as advice on specific UAS equipment that best fits the needs of KDOT. This report includes a literature review which lists the commercial companies currently using UASs after gaining a Certificate of Authorization (COA) exemption and research done by other DOTs. Potential applications of and concerns about UAS usage are also included in the literature review. Please note that in the literature review, the term UAS and unmanned aerial vehicles (UAV) are used interchangeably since the terms vary within each source. A survey was created and sent to all state Department of Transportation offices. A SWOT (Strengths, Weaknesses, Opportunities, and Threats/Challenges) Analysis was carried out looking at different areas of interest for KDOT. Based on the literature review, survey responses, and SWOT analysis, the use of a UAS for KDOT’s operations will improve safety, efficiency, and possibly reduce costs. Out of the nine areas considered for implementing UAS, seven could realize benefits in safety, efficiency, and a possible cost savings. The recommended UAS applications are in bridge inspection, radio tower inspection, surveying, road mapping, high-mast light tower inspection, stockpile measurement, and aerial photography. While UAS cannot replace many of the current activities that KDOT performs, it could greatly enhance them both from a safety and technical point of view.

Record Type: Publication


Edition: Final Report

Corporate Authors: Kansas State University Transportation Center
Department of Electrical and Computer Engineering
Manhattan, KS United States
Kansas Department of Transportation
Bureau of Research, 2300 SW Van Buren Street
Topeka, KS 66611-1195 United States

Pagination: 105p

Publication Date: 2016-08-00

Language: English

Media Type: Digital/other


Features: Appendices; Figures; Maps; References; Tables

Subject Areas: Planning and Forecasting; Transportation (General); Vehicles and Equipment

Keywords: Benefits; Costs; Drone aircraft; Kansas Department of Transportation; Literature reviews; Recommendations; State departments of transportation; Surveys

Accession Number: 01608653

Abstract: The Next Generation Air Transportation System (NextGen) Air Transportation Program (NGAT) at North Carolina State University (NCSU) collaborated with the North Carolina Department of Transportation (NCDOT) departments (Location and Surveys, Photogrammetry, Aviation, etc.) to analyze the potential role of small Unmanned Aerial Systems (UAS) in transportation environments such as structural inspections, small area surveys, rockslide assessments, and other situations. This project provided insight into UAS integration as an additional tool for situational assessment and surveying during inspection activities, especially for smaller areas and difficult to reach places. Multiple aircraft were used for data capture. Data sets captured included orthophotos, digital elevation models (DEMs), traffic videos, thermal imagery, and flight logs.

Record Type: Publication

Record URL:
/common/images/covers/large/1485829.png;
https://rosap.ntl.bts.gov/view/dot/32892

Edition: Final Report

Corporate Authors:
North Carolina State University, Raleigh
Institute for Transportation Research and Education
Raleigh, NC 27695-7908 United States
North Carolina Department of Transportation
Research and Analysis Group, 1 South Wilmington Street
Raleigh, NC 27601 United States
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591 United States
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590 United States

Pagination: 120p

Publication Date: 2016-10-31

Language: English

Media Type: Digital/other

Period Covered: 8/16/2014-7/31/2016
Abstract: Performance and current state of conditions of civil infrastructure can be determined using close range photogrammetry (CRP) techniques via high-resolution digital cameras mounted on unmanned airborne vehicles (UAVs). This proposed research describes how appropriate use of unmanned aerial systems (UASs) with their UAVs can be integrated with CRPs to help in infrastructure performance assessment. A UAS covers all of the work that a UAV does and makes that work possible through a ground-based controller, a system of communications connecting the UAVs and the controller, and the personnel and guidelines that keep their use functional and safe. Foundational work first covers selection and acquisition of UAS-CRP technologies as well as development of specific guidelines for operation of UAVs. The acquired UAS-CRP will then be studied in infrastructure investigations related to pavements performance and railway track assessments. All these tasks, if proven effective will increase safety with less boots on the ground, reduce survey costs, increase readiness, and help with ease of use and accuracy for transportation infrastructure condition assessment. The final outcome of the research will present a framework and guidelines on how UAS-CRPs technology can be used to effectively perform pavement and railway track assessments.
Title: The State of the Practice of Unmanned Aircraft Systems in State Departments of Transportation

Author(s): Plotnikov, Michael; Ni, Daiheng; Collura, John

Abstract: This paper presents the results of a study conducted by a team of researchers at the University of Massachusetts Transportation Center on the current state of the practice of applications of small unmanned aircraft systems (UAS) in State Departments of Transportation (DOTs). As a part of the study, a nationwide survey was conducted to identify and understand how State DOTs have considered and implemented UAS related policies, procedures, and applications in their day to day activities and operations. Similar studies by other research groups were also reviewed and analyzed to determine what State DOTs have done in the area of UAS applications. Based on the results of the nationwide State DOT survey coupled with the
review of survey results reported in other studies, it is concluded that the majority of State DOT current and planned UAS activities fall into the following categories: asset management, construction, disaster management, environmental monitoring, infrastructure inspection, surveillance, and traffic operations. The paper also presents recommendations to the MassDOT pertaining to the: a) development of UAS related internal policies and standard operating procedures; and b) design of a UAS pilot program including field based applications for the Divisions of Highways, Mass Transit, and Aeronautics. It is expected that results in this paper will be of interest to the State DOTs as well as UAS stakeholder groups including Federal Aviation Administration, University Transportation Centers, and industry partners as State DOTs move forward to develop departmental policies, operating procedures, and action plans regarding the use of small UASs.

Record Type: Publication
Record URL: http://amonline.trb.org/
Supplemental Notes: This paper was sponsored by TRB committee AV060 Standing Committee on Airfield and Airspace Capacity and Delay.
Corporate Authors: Transportation Research Board
500 Fifth Street, NW
Washington, DC 20001 United States
Pagination: 16p
Conference: Transportation Research Board 97th Annual Meeting
Location: Washington DC, United States
Date: 2018-01-07 to 2018-01-11
Publication Date: 2018-00-00
Language: English
Media Type: Digital/other
Features: Figures; References; Tables
Subject Areas: Aviation; Operations and Traffic Management; Policy; Vehicles and Equipment
Keywords: Drone aircraft; State departments of transportation; United States
Accession Number: 01658583
Report/Paper Numbers: 18-03694
Files: TRIS; TRB; ATRI
Created Date: 1/8/2018 10:55 AM

Title: Unmanned Aircraft System Bridge Inspection Demonstration Project Phase II
Author(s): Wells, Jennifer; Lovelace, Barritt
Abstract: An Unmanned Aircraft System (UAS) is defined by the Federal Aviation Administration (FAA) as an aircraft operated without the possibility of direct human intervention from within the aircraft. Unmanned aircraft are familiarly referred to as drones, and the names can be used interchangeably. The UAS is controlled either autonomously or with the use of a remote control by a pilot from the ground. These UASs offer a wide range of imaging technologies which include photographic stills, video, and infrared sensors that can be viewed live and later processed to assist with inspections. Bridge inspections often pose logistical challenges to efficiently and effectively inspect a wide variety of structure types; therefore, inspection by UAS
is a solution that can be safe and cost-effective. The Minnesota Department of Transportation (MnDOT) and Collins Engineers have been researching the use of UASs as a tool for bridge inspections in a multi-phase project. This phase of the study research identified potential applications of UAS technology to aid in bridge inspections and is a continuation of a previous study by the MnDOT.

Record Type: Publication
Edition: Final Report
Corporate Authors: Collins Engineers, Inc.
1599 Selby Ave.
Suite 206
St. Paul, MN 55104 United States
Minnesota Department of Transportation
Research Services and Library
395 John Ireland Boulevard
St Paul, MN 55155 United States
Pagination: 174p
Publication Date: 2017-06-00
Language: English
Media Type: Digital/other
Features: Appendices; Figures; Photos; References; Tables
Subject Areas: Aviation; Bridges and other structures; Maintenance and Preservation; Planning and Forecasting
Keywords: Bridges; Drone aircraft; Inspection
Accession Number: 01642723
Report/Paper Numbers: MN/RC 2017-18
Files: NTL; TRIS; ATRI; STATEDOT
Created Date: 7/20/2017 8:26 AM

Title: Demonstration of Unmanned Aircraft Systems Use for Traffic Incident Management (UAS-TIM)
Author(s): Stevens Jr, Charles  R.; Blackstock, Tiffany
Abstract: Texas freeways experience considerable traffic congestion—sometimes from high traffic volumes and others from minor or major traffic incidents. Whether from minor (e.g., crashes, stalls, and road debris) or major (e.g., vehicle rollovers, chemical spills, flooding, and hurricane evacuations) incidents, freeway systems can come to a complete standstill, which results in significant economic impacts for Texas drivers and businesses. Quick response and clearance of traffic incidents through traffic incident management (TIM) practices is a proven method of restoring roadway capacity and increasing mobility on urban freeways.
Transportation agencies and emergency responders are continually seeking new technologies and systems (especially for major incidents) that can improve response times, monitoring, and
clearance. One such system/technology under consideration is unmanned aircraft systems (UAS). Commonly referred to as drones in military applications, public and civil UAS could prove to be a flexible and useful tool for transportation agencies and emergency responders.

Record Type: Publication
Record URL: https://static.tti.tamu.edu/tti.tamu.edu/documents/PRC-17-69-F.pdf;
/common/images/covers/large/1492061.png

Corporate Authors:
Texas A&M Transportation Institute

Pagination: 73p
Publication Date: 2017-12-00
Language: English
Media Type: Digital/other
Features: Appendices; Figures; Photos; References; Tables
Subject Areas: Aviation; Highways; Operations and Traffic Management; Security and Emergencies
Keywords: Drone aircraft; Emergency response time; Incident management; Intelligent transportation systems; Texas; Traffic congestion; Traffic flow; Traffic incidents; Traffic surveillance

Accession Number: 01655169
Report/Paper Numbers: PRC 17-69 F
Files: TRIS
Created Date: 12/15/2017 1:45 PM

Title: Unmanned Aerial Systems for Transportation Decision Support
Author(s): N/A

Abstract: Commercial remotely sensed datasets have tremendous value for a broad range of transportation-related activities, but their full potential is often constrained by inadequate temporal resolution, poor spatial resolution, and high acquisition costs. Unmanned Aerial Systems (UAS) have the potential to overcome these limitations, radically changing the way remote sensing data are used for transportation planning, operations, maintenance, and program development. Contemporary off the shelf UAS are inexpensive to purchase, easy to operate with proper training, rapidly deployable, and provide data with spatial resolutions that cannot be matched by traditional airborne and space-borne platforms. This supplemental funding will be used to expand the operational capacity of the UAS portion of this project, addressing the needs of state transportation agencies. This project will apply proven UAS acquisition and analytical capabilities in four categorical areas that have been determined to be of high interest by stakeholders: 1) geomorphic assessment, 2) construction management and phasing, 3) resource allocation during disaster response, and 4) cost decision support. The project team will marry this with a robust outreach and training program that will improve the abilities of state and local transportation planners to integrate UAS data and products into their decision-making and management operations. The activities in all four areas will develop operational solutions with quantifiable results that improve decision making, reduce costs, increase life safety, and provide a measurable impact on existing decision processes, models and resource tasking.
Record Type: Project
Record URL: http://www.uvm.edu/trc/rapid-exploitation-of-commercial-remotely-sensed-imagery-for-disaster-response-recovery/unmanned-aerial-systems-for-transportation-decision-support/
Language: English
Contract Numbers: OASRTRS -14 -H-UVM
Status: Active
Funding Amount: 468126
Sponsor Organizations:
Office of the Assistant Secretary for Research and Technology
University Transportation Centers Program
Department of Transportation
Washington, DC 20590 United States
Project Managers:
Singh, Caesar
(202) 366-3252
Caesar.singh@dot.gov
Performing Organizations:
University of Vermont, Burlington
85 South Waterman Building
Burlington, VT 05405 United States
Principal Investigators:
O'Neil-Dunne, Jarlath
Notice Date: --
Start Date: 2014-09-29
Expected Completion Date: 2016-07-29
Actual Completion Date: --
USDOT Program:
Unmanned Aircraft Systems Research
Subject Areas: Administration and Management; Construction; Data and Information Technology; Finance; Planning and Forecasting; Research; Transportation (General); Vehicles and Equipment
Keywords: Construction management; Costs; Decision support systems; Disasters and emergency operations; Drone aircraft; Geomorphology; Remote sensing; Resource allocation; State departments of transportation; Transportation operations; Transportation planning
Accession Number: 01593654
Source Agency: UVM Transportation Center
University of Vermont
210 Colchester Avenue
Burlington, VT 05405 United States
Files: UTC; RiP
Created Date: 3/15/2016 1:15 PM
Title: Applicability of Unmanned Aerial System (UAS) for Safety Inspection on Construction Sites
Author(s): Melo, Roseneia Rodrigues; Costa, Dayana Bastos; Álvares, Juliana Sampaio; Irizarry, Javier

Abstract: The use of technologies on jobsites is one of the recent challenges for construction management. To exemplify this, studies report the use of Unmanned Aerial Vehicles/Systems (UAV/UAS) for transportation and jobsite monitoring, and these potential features have caught the attention of the construction industry. However, studies are still required to orient the development of operational procedures for using this technology effectively, mainly for on-site safety monitoring. This study aims to assess the applicability of UAV for safety inspection on construction sites, focusing on the identification of the requirement that can be inspected and the non-compliances with the safety requirements established. This study was based on two case studies, conducted by a protocol developed for data collection, processing and analysis of the visual assets (photos and video recording) gathered from the UAS flights on jobsites. The results show that the visual assets collected by UAV can improve the safety inspection on jobsites by means of a better visualization of working conditions. This fact was pointed out by the analysis of the visual assets which provided detailed information about the compliance of safety items according to the safety regulations. The main contribution of this research is the development of a set of procedures and guidelines for collecting, processing and analyzing safety requirements from UAS visual assets on jobsite in order to identify the potential to incorporate this technology into the project’s safety management routine.

Record Type: Publication
Record URL: http://dx.doi.org/10.1016/j.ssci.2017.06.008; http://www.sciencedirect.com/science/article/pii/S0925753516303861
Supplemental Notes: Abstract reprinted with permission of Elsevier.
Serial: Safety Science
Publisher: Elsevier
ISSN: 0925-7535
URL: http://www.sciencedirect.com/science/journal/09257535
Volume: 98
Pagination: pp 174-185
Publication Date: 2017-10-00
Language: English
Media Type: Web
Features: References
Subject Areas: Aviation; Construction; Safety and Human Factors
Keywords: Case studies; Construction management; Construction safety; Drone aircraft; Inspection; Regulations; Safety factors; Technological innovations
Accession Number: 01643178
Availability:
Find a library where document is available
Order URL: http://worldcat.org/issn/09257535
Files: TRIS
Created Date: 7/12/2017 4:08 PM
Concrete Crack Identification Using a UAV Incorporating Hybrid Image Processing

Author(s): Kim, Hyunjun; Lee, Junhwa; Ahn, Eunjong; Cho, Soojin; Shin, Myoungsu; Sim, Sung-Han

Abstract: Crack assessment is an essential process in the maintenance of concrete structures. In general, concrete cracks are inspected by manual visual observation of the surface, which is intrinsically subjective as it depends on the experience of inspectors. Further, it is time-consuming, expensive, and often unsafe when inaccessible structural members are to be assessed. Unmanned aerial vehicle (UAV) technologies combined with digital image processing have recently been applied to crack assessment to overcome the drawbacks of manual visual inspection. However, identification of crack information in terms of width and length has not been fully explored in the UAV-based applications, because of the absence of distance measurement and tailored image processing. This paper presents a crack identification strategy that combines hybrid image processing with UAV technology. Equipped with a camera, an ultrasonic displacement sensor, and a WiFi module, the system provides the image of cracks and the associated working distance from a target structure on demand. The obtained information is subsequently processed by hybrid image binarization to estimate the crack width accurately while minimizing the loss of the crack length information. The proposed system has shown to successfully measure cracks thicker than 0.1 mm with the maximum length estimation error of 7.3%.
Author(s): Khaloo, Ali; Lattanzi, David; Cunningham, Keith; Dell’Andrea, Rodney; Riley, Mark

Abstract: Unmanned aerial vehicles (UAV) are now a viable option for augmenting bridge inspections. Utilizing an integrated combination of a UAV and computer vision can decrease costs, expedite inspections and facilitate bridge access. Any such inspection must consider the design of the UAV, the choice of cameras, data acquisition, geometrical resolution, safety regulations and pilot protocols. The Placer River Trail Bridge in Alaska recently served as a test bed for a UAV inspection methodology that integrates these considerations. The end goal was to produce a three-dimensional (3D) model of the bridge using UAV-captured images and a hierarchical Dense Structure-from-Motion algorithm. To maximize the quality of the model and its benefits to inspectors, this goal guided UAV design and mission planning. The resulting inspection methodology integrates UAV design, data capture and data analysis together to provide an optimized 3D model. This model provides inspection documentation while enabling the monitoring of defects. The developed methodology is presented herein, as well as analyses of the 3D models. The results are compared against models generated through laser scanning. The findings demonstrate that the UAV inspection methodology provided superior 3D models with the accuracy to resolve defects and support the needs of infrastructure managers.

Record Type: Publication

Record URL: http://dx.doi.org/10.1080/15732479.2017.1330891

Supplemental Notes: Abstract reprinted with permission of Taylor & Francis.

Serial: Structure and Infrastructure Engineering

Publisher: Taylor & Francis

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Volume: 14

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Publication Date: 2018-01-00

Language: English

Media Type: Web

Features: Figures; References

Subject Areas: Aviation; Bridges and other structures; Highways; Maintenance and Preservation; Vehicles and Equipment

Keywords: Accuracy; Alaska; Bridges; Computer vision; Defects; Drone aircraft; Inspection; Laser radar; Mathematical models; Methodology; Photogrammetry; Placer River Trail Bridge

Accession Number: 01650867

Availability:

Find a library where document is available

Order URL: http://worldcat.org/issn/15732479

Files: TRIS

Created Date: 10/28/2017 3:00 PM
Title: Exploring Applications for Unmanned Aerial Systems (UAS) and Unmanned Ground Systems (UGS) in Enhanced Incident Management, Bridge Inspection, and Other Transportation-related Operations

Author(s): Kamga, Camille; Sapphire, Joah; Cui, Yu; Moghimidarzi, Bahman; Khryashchev, Denis

Abstract: Unmanned aircraft systems (UAS) and unmanned ground systems (UGS) have the potential to change the way we perform some of transportation-related operations. Nowadays, opportunity arises to leverage various innovative technological capabilities to explore their use and value in real world operating environments. Specifically, exploring the capabilities of UAS, also called drones, and UGS in specific transportation areas appears to have significant potential. This report summarizes the literature review, performed by students from three schools within the University Transportation Research Center Consortium, documenting applications and demonstrations of UAS and UGS technologies and potential deployment opportunities for New York State Department Transportation (NYSDOT) in the near future. Specifically, NYSDOT would like to assess the existing capabilities of these systems for responding to highway incidents including field surveying, accident information collection and reconstruction and other related requirements to clearing a highway incident. As part of this effort, NYSDOT would also like to explore other transportation applications for these devices such as bridge inspection, traffic monitoring, road construction and maintenance worker safety.

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Corporate Authors: University Transportation Research Center
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Washington, DC United States

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Subject Areas: Aviation; Data and Information Technology; Highways; Operations and Traffic Management; Safety and Human Factors; Vehicles and Equipment

Keywords: Aerial surveying; Bridges; Data collection; Drone aircraft; Evaluation and assessment; Highway safety; Incident management; Inspection; Literature reviews; Mobile
Title: Bridge condition inspections using unmanned aerial vehicles: a trial project

Author(s): Hawken, R.; Nguyen, T.; Ivanyi, J.

Abstract: VicRoads manages a significant number of structures where access for inspection is difficult due to height, length and the obstacle being crossed; for example deep water. In order to gain access for close-up visual inspection of these structures, the normal procedure has been to use an underbridge access unit or a boat, both of which are potentially hazardous, time-consuming and costly. In order to address some of the limitations of conventional bridge inspection methods, an Unmanned Aerial Vehicle (UAV) was used to inspect a bridge in VicRoads North Eastern Region in 2015. Building on this trial, a series of three trial UAV inspections was conducted in June 2016 in order to further investigate and develop the accuracy, effectiveness and safety of UAV inspections. This paper describes the trial inspections and their methodologies using different UAV equipment on four bridges located in VicRoads North Eastern Region. Evaluation of the results of the trial UAV inspections suggests that using UAVs for bridge inspections is a safe, compliant and cost-effective methodology that can be used to conduct visual inspections and as an aid to more detailed investigations. There are still some limitations such as difficulty in identifying defects and operating in more extreme weather conditions such as strong winds.

Record Type: Publication

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Monograph Title: Bridges: connecting communities: Austroads Bridge Conference, 2-6 April 2017, Melbourne, Victoria

Pagination: 10p

Conference: Austroads Bridge Conference, 10th, 2017, Melbourne, Victoria, Australia

Publication Date: 2017-04-00

Language: English

Subject Areas: Aviation; Bridges and other structures; I24: Design of Bridges and Retaining Walls; I61: Equipment and Maintenance Methods

Keywords: Aerial photography; Australia; Automatic; Bridge inspection; Bridges; Condition surveys; Drone; Drone aircraft; Drone radar; Evaluation; Evaluation; Evaluation (assessment); Field test; Field tests; Inspection; Structural health monitoring; Victoria; Visual assessment
Title: Evaluating the Use of Unmanned Aerial Vehicles for Transportation Purposes

Author(s): Brooks, Colin; Dobson, Richard J; Banach, David M; Dean, David; Oommen, Thomas; Wolf, Rudiger Escobar; Havens, Timothy C; Ahlborn, Theresa M; Hart, Ben

Abstract: Advances in unmanned aerial vehicle (UAV) technology have enabled these tools to become easier to use and afford. In a budget-limited environment, these flexible remote sensing technologies can help address transportation agency needs in operations, maintenance, and asset management while increasing safety and decreasing cost. This project tested and evaluated five main UAV platforms with a combination of optical, thermal, and light detection and ranging (LiDAR) sensors to assess critical transportation infrastructure and issues such as bridges, confined spaces, traffic flow, and roadway assets. A State of the Practice report was completed, and a series of lab testing were accomplished to ensure practicality and safe operations. Field demonstrations were completed at bridges, pump stations, and conferences. The project team gave a series of technical demonstrations at the Intelligent Transportation Systems World Congress in Detroit in September, 2014, enabling outreach to a wide domestic and international audience who gained understanding of the advanced research that Michigan Department of Transportation (MDOT) is funding. These demonstrations showed that UAV technologies provide many advantages to helping MDOT cost-effectively assess, manage, and maintain its resources, providing benefit to staff and the traveling public.

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Supplemental Notes: Appendix includes the 2013 report, "State of the Practice for Remote Sensing of Transportation Infrastructure Using Unmanned Aerial Vehicles (UAV)".

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Corporate Authors: Michigan Technological University
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Office of Research and Best Practices, 425 West Ottawa, P.O. Box 30050
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Subject Areas: Bridges and other structures; Highways; Maintenance and Preservation; Vehicles and Equipment; I61: Equipment and Maintenance Methods

Keywords: Asset management; Condition surveys; Data collection; Drone aircraft; Evaluation; Laboratory tests; Laser radar; Remote sensing; State of the practice; Traffic surveillance
TRID RETRIVALS with MEDIUM RELEVANCE:

Title: Rules for operating unmanned aircraft in the US National Airspace System
Author(s): Gunn, Bill
Abstract: Congress mandated UAS integration into the NAS in the 2012 Reauthorization Act. Here’s where we are today and what will likely be the path for tomorrow.
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Serial: Professional Pilot
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Keywords: Aeronautics; Air traffic rules; Drone aircraft; Laws and legislation; United States
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Title: The Need for a Comprehensive Unmanned Aircraft Management System
Author(s): Plotnikov, Michael; Collura, John; Brody, Richard, S.
Abstract: Unmanned Aircraft System (UAS) operations in the U.S. began with various military applications, and these provided the basis for wider civilian UAS applications. However, the introduction of civilian UAS requires a totally new approach because it raises questions that were not applicable to the majority of military UAS applications. At this point in time, there is a need to establish a comprehensive UAS Management System to help address the challenges associated with civilian-oriented UAS registration, pilot training and licensing, operations, inspections, standards testing, traffic management and control, and fleet management. The
lack of such a comprehensive management system impedes wider UAS proliferation, which, in turn, reduces the ability for domestic manufacturers and potential UAS customers to contribute to the potential multi-billion-dollar civilian UAS market. This ultimately limits U.S. competitiveness in the global UAS technology arena. The objective of this paper is three-fold: 1) to describe a framework to assist with the development of a comprehensive UAS Management System; 2) to present a concept of operations and system architecture to aid in the identification of UAS Management System modules, data elements, and roles and responsibilities; and 3) to provide an illustrative example of a UAS agricultural application, as rural areas are expected to serve host to simplified preliminary builds of selected modules of UAS Management System. This paper will be of interest to the FAA, State DOTs, industry partners, and other UAS stakeholders as they move forward to develop strategies and action plans to integrate UAS into the National Air Space.

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Keywords: Agriculture; Airspace (Aeronautics); Civil aircraft; Drone aircraft; Rural areas
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Title: Concept of Operations and Policy Implications for Unmanned Aircraft Systems Use for Traffic Incident Management (UAS-TIM)
Author(s): Stevens Jr., Charles R.
Abstract: Transportation agencies and emergency responders are continually seeking new technologies and systems (especially for major incidents) that can improve incident response, monitoring, and clearance. One such system/technology under consideration is unmanned
aircraft systems (UAS). Commonly referred to as drones in military applications, public and civil
UAS could prove to be a flexible and useful tool for transportation agencies and emergency
responders. To better understand the policy implications, the Texas A&M Transportation
Institute developed a concept of operations (ConOps), an early step in the systems engineering
process, with a focus on using UAS as an intelligent transportation systems tool to enhance
traffic incident management (TIM) and provide quick and accurate information from the scene
of a traffic incident: UAS-TIM. The ConOps provides a roadmap for the validation of UAS
abilities to enhance monitoring, situational awareness, and safety when compared to
traditional fixed-location cameras and expensive helicopters. This document discusses: current
uses of UAS in transportation; perceived needs for UAS-TIM; the development of ConOps
components including goals, functions, key concepts, and operational scenarios; potential UAS-
TIM system architecture impacts; potential policy concerns; and next steps.

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Title: Drone/Unmannned Aircraft System (UAS)
Author(s): N/A
Abstract: FAA Advisory Circular 107-2 provides guidance on the regulation of UAS in the NAS,
however, AC 107-2 does not provide, nor is it intended to provide, a legal interpretation of the
regulations. Rather, this advisory is provided as best practice methods for developing
operational programs scaled to specific small unmanned aircraft (UA), associated system equipment, and operations in combination with agency’s operational details and local laws in New Jersey. Some of the laws local impacting the implementation of these guidance in New Jersey are privacy laws and motor vehicle laws. The research team will conduct an extensive review of the literature. This literature review will focus on several aspects including: UAS Operations, applicable NJ State/Local laws, UAS Regulations, Risk Management and Safety Procedures, review of current NJDOT Aeronautical policies and regulations, and survey of public airports. The research team will resolve regulatory issues in the use of UAS by NJDOT by drafting: statewide drone regulation to insert into Title 6, Chapter 16.55, best practices for proposing state legislation, internal DOT UAS Operations Manual, internal forms for Divisions requesting support, internal forms to track/record FAA compliance, and internal training/qualifications forms. The proposers will also create a FAA compliant SMS tool for Risk Assessment of UAS Operations and a detailed PowerPoint based training module for engineers/consultants involved in UAS Operations.

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Title: Wheels up, wheels spinning: As drone technology takes off, solutions are needed

Author(s): McConnell, Alicia

Abstract: Otherwise known as unmanned aerial systems (UAS) or unmanned aerial vehicles (UAV), drones have expanded beyond recreational use into commercial applications. As with any emerging technology, there are growing pains and practical limitations which need to be addressed. In the realm of bridge inspections, UAS technology has the potential to make a huge impact, as this article addresses. The Federal Aviation Administration (FAA) has made adjustments to its regulations in order to ensure safe and proper commercial operation of small UAS (Part 107 Regulations). With these adjustments in place, the Wisconsin Department of Transportation (WisDOT) has investigated the capabilities and limitations of using UAS for bridge inspections and has established a pilot project aimed at (1) making bridge inspections safer; (2) making the inspection process more efficient; and (3) improving the quality of the inspection reports.

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INTERNET RETRIVALS with HIGH RELEVANCE:

Title: Use of Unmanned Aerial Vehicle Photogrammetry to Obtain Topographical Information to Improve Bridge Risk Assessment
Author(s): Hackl, Jürgen; Adey, Bryan T.; Woźniak, Michał; Schümperlin, Oliver
Abstract: Bridges, as all objects in road networks, are built to provide a specified level of service over a specified time period. This level of service ensures that acceptable levels of health, safety, and prosperity of society are guaranteed. The level of service, required from the transportation infrastructure, changes over time, as does the ability of infrastructure to provide it. The extent of maintenance is influenced by gradual deterioration, such as that caused by chloride-induced corrosion of concrete, and sudden deterioration such as that caused by the occurrence of scour resulting from extreme floods. To ensure that infrastructure provides the required service levels, its performance needs to be monitored. Determining how monitoring is to be done is a trade-off between accuracy and cost. Ideally, one will have access to accurate but inexpensive monitoring techniques. This paper contains the results of an investigation into the use of an unmanned aerial vehicle and modern photogrammetric technology to obtain topographical information to apply in bridge risk assessment. The unmanned aerial vehicle was used to take georeferenced images. With the images and photogrammetric technology, a three-dimensional (3D) mesh of the terrain was generated. This mesh was then converted to a computational mesh, which could be used to run computational fluid dynamic simulations during a bridge risk assessment. The investigated bridge was a single span concrete bridge in the Canton of Grisons, Switzerland. The hydraulic events, predicted by the developed model, correspond with historical observations, indicating that the topographical information collected is sufficiently accurate to be used to simulate complex flow situations, which can be used in bridge risk assessments.

INTERNET RETRIVALS with MEDIUM RELEVANCE:
None.