PROJECT TITLE: USE OF DRONE IN ABC CONSTRUCTION

Quarterly Progress Report
For the period ending November 30, 2017

Submitted by:

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1. Background and Introduction

In recent years, drone technology has entered many industries and applications, greatly impacting and revolutionizing their processes. It is strongly believed that drone technology has also an important role to play in ABC construction, especially when geometry control, inspection, and surveying/mapping are concerned.

The recent researches [1-4] on effectiveness and applications of drones have demonstrated the great potential for drones in inspection of hard to reach bridges, but at the same time pointed to technological limitation of existing drone designs preventing their full implementation. A comprehensive and up-to-date knowledge of drone technology is very essential in addressing these limitations. The current commercially available rotorcraft drones are designed for general-purpose application but successful implementation of such systems in ABC requires certain technical considerations.

The ABC Drone (ABCD) project will provide guidelines to overcome the many challenges of using drones for inspection and construction programs. Aircraft's stability at the inspection site due to gust, wind driven rain, unsteady turbulent flow or induced airflow (from the blades) when flying close to the bridge, aircraft overall efficiency for longer endurance, balancing and fast setup, track control sensor communication, inspection instrumentation setup, software and hardware integration of the data acquisition systems with wireless communication capabilities, tolerability to impact of inappropriate landing are among issues that need to be addressed in application of drones.

2. Problem Statement

One of the main challenges in ABC construction is geometry control at fabrication and construction stages, especially during installation and erection of prefabricated large elements. Also, as it is concerned with the rehabilitation projects, inspection for detection of damages, and survey and mapping of the affected areas necessary for design and construction has required costly operation and traffic interruption that is in contrast with ABC objectives.

This study therefore will include identification of tasks and processes in ABC that can benefit from drone application, and development of preliminary drone systems that would best serve these processes. The study will also provide parameters and hardware/software requirements; identify the existing drone systems that readily are applicable and those that would require adaptation or new designs. An implementation demonstration for conceptual verification will be performed for selective identified process(es) and application(s), and compare them with the current practices.

3. Research Approach and Methods

The overall approach of this project will be organized in three basic stages; search of background information for identification of processes within ABC construction where drone application would be beneficial, and development of appropriate drone systems through determination of

important parameters for applicable drones and necessary hardware and software, and finally verification of the concepts through experimental trials within the scope and budget limitation.

4. Description of Research Project Tasks

The following is a description of tasks carried out to date.

Task 1 – Identification of ABC processes benefiting from drone application

A review of available literature and data is performed to study various processes and operations carried out for an ABC bridge construction, for both new construction and rehabilitation of existing construction. These processes are categorized based on how they would benefit from drone application.

Task 2 – Review of drone technology and its application in construction industry

Available drone technologies are reviewed within construction and other industries, and general applications benefiting the construction industry. Currently, we are at the stage to proceed with the purchase of the drone to be able to start experiments.

5. Expected Results and Specific Deliverables

For the next project period we expect to determine the drone design parameters for application to ABC and assemble and integrate ABCDHardware and software.

6. Schedule

Progress of tasks in this project is shown in the table below.

PHASE	RESEARCH TASK	2017										2018								
		M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
I	Task 1 – Identification of ABC processes benefiting from drone application	■	■	■	■	■														
	Task 2– Review of drone technology and its application in construction industry.	■	■	■	■	■	■	■	■	■	■									
	Task 3 – Determination of drone design parameters for application to ABC.										■	■	■	■	■	■				
	Task 4 – ABCDHardware and software assembling and integration.												■	■	■	■	■			
II	Task 5 – Experimental Concept Verification																■	■	■	
	Task 6 –Final (Draft and Revised) Report submission.																		■	■

7. References

[1] Unmanned Aerial Vehicle Bridge Inspection Demonstration Project, Final Report 2015-40, Office of Bridges and Structures, Minnesota Department of Transportation, July 2015.http://www.dot.state.mn.us/research/TS/2015/201540.pdf

[2] Will Drones Transform Bridge Inspection? Roads and Bridges, September 6, 2016. https://www.roadsbridges.com/will-drones-transform-bridge-inspection

[3] Metni, Najib, and Tarek Hamel. "A UAV for bridge inspection: Visual servoing control law with orientation limits." Automation in construction 17.1 (2007): 3-10.

[4] Murphy, Robin R., et al. "Robot-assisted bridge inspection." Journal of Intelligent & Robotic Systems 64.1 (2011): 77-95.