

**Impactful Resilient Infrastructure Science and Engineering  
(IRISE)  
-Project Scope of Work-  
(FY 2024-25 (IRISE Year 7) Annual Work Program)**

**SUMMARY PAGE**

**Project Title:** Improved Collection of Earthwork Quantities Utilizing UAV-Based LiDAR

**Person Submitting Proposal:** Dr. Alessandro Fascetti

**Proposed Funding Period:** 01/01/25 - 12/31/2025

**Project Duration:** 12 months

**Project Cost:** \$26,995

## **Improved Collection of Earthwork Quantities Utilizing UAV-Based LiDAR**

### **Research Problem**

On large earthwork projects, the Pennsylvania Turnpike Commission is facing significant challenges in estimating quantities for earthwork which are based on cross-sections and end-area calculations for volume. Within each 50 ft. interval between adjacent cross-sections, there often exist significant differences in the ground profile that cannot be accounted for by traditional surveying. While actual quantities of earthwork for payment can be adjusted during construction, several agencies are still facing issues in balancing earthwork within large projects. This can lead to increased costs for new or expanded waste areas or hauling of material offsite, or scheduling issues for the permitting of new or resized waste areas. The main challenge lies in the definition of field procedures to accurately reconstruct the 3-dimensional features of the area that are easy to perform

### **Research Objectives**

The overarching objective of the proposed effort is to improve the degree of accuracy for earthwork through the use of Unmanned Aerial Vehicles (UAV) mounting LiDAR and RGB sensors. A set of two workshops will be developed.

### **Project Scope**

The proposed format will consist of a two-part case study on a selected project that will be identified in collaboration with the interested IRISE partners. The specific case study will be selected based on the possibility of hosting the group of attendees, potential flight restrictions, and general layout of the area (to showcase the earthwork volume calculations). The first meeting will be in the form of a workshop, focused on providing understanding of the current state-of-the-art in UAV-based 3-dimensional reconstruction and modeling. The workshop will be geared towards practitioners, contractors, and State agencies personnel, and will be organized and facilitated by the PI. On the second meeting, a field demonstration will be organized by the University of Pittsburgh personnel (the Department of Civil and Environmental Engineering recently acquired high-fidelity industrial-grade UAV-based LiDAR/RGB equipment) and selected industrial partners (such as Phoenix LiDAR systems and AEVEX-Geodetics) to highlight possibilities for the adoption of the new technology in the context of earthwork planning and management.

## **Task Statements**

The objectives of this project will be realized through the completion of the following tasks:

### **Task A: Workshop on UAV applications for LiDAR mapping**

A workshop will be organized at the University of Pittsburgh during the Spring or Summer terms. Attendees will include technical panel representatives and selected members of IRISE partners. Participants to the workshop will be introduced to the current state-of-the-art in aerial LiDAR mapping for large-scale surveying. Best practices in data collection, pre- and post-processing will be discussed, with specific attention devoted to earthwork volume calculations.

### **Task B: Field demonstration and Lunch-and-Learn**

The second task of the project will involve the organization and delivery of a “Field Day” activity, to which selected industrial partners (e.g., AEVEX-Geodetics and Phoenix LiDAR Systems) will be invited to give a hands-on demonstration of currently available solutions for UAV-based earthwork LiDAR mapping. The specific case study will be selected based on the possibility of hosting the group of attendees, potential flight restrictions, and general layout of the area (to showcase the earthwork volume calculations). At the end of the demonstration, a Lunch-and-Learn activity will be hosted, focusing on best practices in processing the acquired data. Based on the chosen site, this activity will be either organized at the University of Pittsburgh or at an IRISE partner organization.

## **Deliverables:**

1. Task A: Workshop instructional material, including PowerPoint slides and associated questionnaire provided to the participants.
2. Task B: Database of acquired data and Lunch-and-Learn instructional material (i.e., PowerPoint slides).

## **Key Personnel:**

### Principal Investigator:

Alessandro Fascetti, Ph.D.

## **Other Personnel:**

### Undergrad Students:

To Be Named Undergraduate Student Researcher

**Proposed Person-Hours by Task:**

<b>Team Member</b>	<b>Task A</b>	<b>Task B</b>	<b>Total</b>
Alessandro Fascetti	140	100	240
Undergraduate Student	35	25	60
<b>TOTAL</b>	<b>175</b>	<b>125</b>	<b>300</b>

**Schedule:**

Calendar Year	2025			
	Q1	Q2	Q3	Q4
Task A: ~6 months				
Task B: ~6 months				

**Budget:** The total project cost is \$26,995

**Acknowledged By:**



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Alessandro Fascetti, Ph.D.  
Principal Investigator