Quarterly Progress and Performance Indicators Report:
Project Number and Title: 1.12, Improved UAV-Based Structural Inspection Techniques and Technologies for Northeast Bridges
Research Area:
PI: *Eric Landis, University of Maine*
Co-PI(s): *Alex Friess, Ali Shirazi, University of Maine*
Reporting Period: *1/1/22 – 3/31/22*
Submission Date: *3/31/22*

Overview:

*Provide **BRIEF** highlights of activities performed during the reporting period.*
- Continued development AI-based tools for rapid condition assessment using different types of imaging.
- Engaged with technical champion on data fusion needs.

Meeting the Overarching Goals of the Project:

How did the previous items help you achieve the project goals and objects? Please give one bullet point for each bullet point listed above.
- Advancement in this field requires some more mundane aspects be automated. The uniqueness of each structure prohibits routine automation, and as such, algorithms for rapid data analysis must carry a high level of sophistication.
- Mission optimization will be central to improving both inspection productivity and assessment reliability.

Accomplishments:

List any accomplishments achieved under the project goals in bullet point form…
- Published refereed journal paper (attached)

Task, Milestone, and Budget Progress:

Complete the following tables to document the work toward each task and budget…

Table 1: Task Progress			
Task Number: Title	**Start Date**	**End Date**	**% Complete**
Task 1: *Review of Current Regional Practice*	10/1/20	12/31/20 / 3/31/21	100%
Task 2: *Survey of Commercially Available UAVs appropriate for Applications*	10/1/20	12/31/20 / 4/30/21	100%

Task 3: *Prototype Development*	10/1/20	5/31/21	100%
Task 4: *Image array packages*	1/1/21	9/30/22	50%
Task 5: *Adv. Data interp.*	1/1/21	9/30/22	60%
Task 6: *Laboratory trials*	3/1/21	9/30/22	0%
Task 7: *Field trials*	6/1/21	9/30/22	0%
Task 8: *Field validation*	TBD	TBD	0%
Overall Project:	10/1/20	9/30/22	60%

Table 2: Milestone Progress			
Milestone #: Description	**Corresponding Deliverable**	**Start Date**	**End Date**
Milestone 1: Survey of Commercial UAVs	UAV purchase	10/1/20	(Delayed to 5/31/22)
Milestone 2: Custom UAV prototype development	Prototype UAV	10/1/20	5/31/21
Milestone 3: Custom UAV prototype development		9/1/21	In progress
Milestone 4: Optimized sensor array packages		1/1/21	In progress
Milestone 5: AI-based data interpretation		1/1/21	In progress
Milestone 6: Laboratory trials		Delayed	
Milestone 7: Field trials		Delayed	

Table 3: Budget Progress		
Project Budget	**Spend – Project to Date**	**% Project to Date (include the date)**
$566,743	$94,221	16.62% as of 2/28/2022

Is your Research Project Applied or Advanced?

☐ **Applied** (*The systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.*)

☒ **Advanced** (*An intermediate research effort between basic research and applied research. This study bridges basic (study to understand fundamental aspects of phenomena without specific applications in mind) and applied research and includes transformative change rather than incremental advances. The investigation into the use of basic research results to an area of application without a specific problem to resolve.*)

Education and Workforce Development:

Answer the following questions (N/A if there is nothing to report):

1. Did you provide any workforce development or training opportunities to transportation professionals (already in the field)? If so, what was the training? When was it offered? How many people attended? (i.e. The research team provided an in the field training for the SAR technology for 3 maintenance crew members of the MassDOT on 3/31/2021. The members learned how to use the technology and interrupt the data.)
N/A

2. Did you hold meetings with any transportation industry organizations or DOTs? If so, what was the meeting's purpose? When was it offered? How many people attended? (i.e. The research team held a meeting with MaineDOT to update them on the progress of the research findings and how the findings can be implemented on 3/31/2021. 15 DOT maintenance members were present at the meeting.)
N/A

3. Did you host/participant in any K-12 education outreach activities? If so, what was the activity? What was the target age/grade level of the participants? How many students/teachers attended? When was the activity held? (i.e. 25 8th graders and 2 teachers visited the concrete lab and created small concrete trinkets like Legos on 3/31/2021. They learned about the different types of fibers that can be used in the concrete.)
N/A

Technology Transfer:

Complete all of the tables below and provide additional information where requested. Please provide ALL requested information as this is one of the most important sections for reporting to the USDOT.

Use the table below to complete information about conference sessions, workshops, webinars, seminars, or other events you led/attended where you shared findings as a result of the work you conducted on this project:

Table 4: Presentations at Conferences, Workshops, Seminars, and Other Events					
Type	**Title**	**Citation**	**Event & Intended Audience**	**Location**	**Date(s)**
N/A					

Use the table below to report any publications, technical reports, peer-reviewed articles, newspaper articles referencing your work, graduate papers, dissertations, etc. written as a result of the work you conducted on this project. Please list only completed items and exclude work in progress.

Table 5: Submitted/Accepted Publications, Technical Reports, Theses, Dissertations, Papers, and Reports				
Type	**Title**	**Citation**	**Date**	**Status**
Journal	Impact of UAV hardware options on bridge inspection mission capabilities	Ameli Z, Aremanda Y, Friess WA, Landis EN. Impact of UAV Hardware Options on Bridge Inspection Mission Capabilities. *Drones*. 2022 Feb 28;6(3):64.	2/28/2022	published

Answer the following questions (N/A if there is nothing to report):

1. Did you deploy any technology during the reporting period through pilot or demonstration studies as a result of this work? If so, what was the technology? When was it deployed?
   N/A
2. Was any technology adopted by industry or transportation agencies as a result of this work? If so, what was the technology? When was is adopted? Who adopted the technology?
   N/A

3. Did findings from this research project result in changing industry or transportation agency practices, decision making, or policies? If so, what was the change? When was the change implemented? Who adopted the change?
   N/A

4. Were any licenses granted to industry as a result of findings from this work? If so, when? To whom was the license granted?

N/A

5. Were any patent applications submitted as a result of findings from this research? If so, please provide a copy of the patent application with your report.
N/A

6. Based on project results, were any industrial contracts awarded for additional research and development activities? If so, when? How much was awarded? Who awarded the contract?
N/A

Describe any additional activities involving the dissemination of research results not listed above under the following headings:

Outputs:
- Journal publication (listed in Table 5)

Outcomes:
- Nothing yet to report

Impacts:
- Nothing yet to report

Participants and Collaborators:

Use the table below to list individuals (compensated or not) who have worked on the project other than students.

Table 6: Active Principal Investigators, faculty, administrators, and Management Team Members				
Individual Name & Title	**Dates involved**	**Email Address**	**Department**	**Role in Research**
Eric Landis	10/1/20 -	landis@maine.edu	CIE	PI
Alex Friess	10/1/20 -	Wilhelm.friess@maine.edu	MEE	Co-PI, Capstone Design Leader
Ali Shirazi	10/1/20 -	shirazi@maine.edu	CIE	Co-PI, Data science, AI

*Use the table below to list **all** students who have participated in the project during the reporting period. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.) **ALL FIELDS ARE REQUIRED.***

Table 7: Student Participants during the reporting period								
Student Name	**Start Date**	**End Date**	**Advisor**	**Email Address**	**Level**	**Major**	**Funding Source**	**Role in research**
Zahra Ameli	12/1/20		Eric Landis		PhD	Civil Eng.	TIDC	Inspection techniques, data processing
Yugandhar Aremanda	1/1/21		Alex Friess		PhD	Mech Eng.	Univ. TA	Drone hardware optimization

Use the table below to list any students who worked on this project and graduated or received a certificate during this reporting period. Include information about the student's accepted employment during the reporting period (i.e. the student is now working at MaineDOT) or if they are continuing their students through an advanced degree (list the degree and where they are attending).

Table 8: Students who Graduated During the Reporting Period			
Student Name	**Degree/Certificate Earned**	**Graduation/Certification Date**	**Did the student enter the transportation field or continue another degree at your university?**
N/A			

Use the table below to list any students that participated in Industrial Internships during the reporting period:

Table 9: Industrial Internships			
Student Name	**Degree/Certificate Earned**	**Graduation/Certification Date**	**Did the student enter the transportation field or continue another degree at your university?**
N/A			

*Use the table below to list **organizations** that have been involved as partners on this project and their contribution to the project during the reporting period.*

Table 10: Research Project Collaborators during the reporting period						
		Contribution to the Project				
Organization	**Location**	**Financial Support**	**In-Kind Support**	**Facilities**	**Collaborative Research**	**Personnel Exchanges**
VHB	Augusta, ME (and others)		x		x	

*Use the table below to list **individuals** that have been involved as partners on this project and their contribution to the project during the reporting period. (**List your technical champion(s) in this table.** This also includes collaborations within the lead or partner universities who are not already listed as PIs; especially interdepartmental or interdisciplinary collaborations.)*

Table 11: Other Collaborators				
Collaborator Name and Title	**Contact Information**	**Organization and Department**	**Date(s) Involved**	**Contribution to Research**
Dale Peabody, Director, Research & Innovation		Maine DOT	10/1/20 - Current	Technical champion

Use the following table to list any transportation related course that were taught or led by researchers associated with this research project during the reporting period:

Table 12: Course List						
Course Code	**Course Title**	**Level**	**University**	**Professor**	**Semester**	**# of Students**
CIE 110	Materials	Undergrad	UMaine	Landis	Fall 2021	126

Changes:

We continue to struggle with a variety of pressures, both internal and external. Laboratory trials are postponed for now due to overbooking of ASCC lab. We are redirecting much of the lab trials to field trials, which will start as soon as it is practical to get outside.

Planned Activities:

Focus on IR/optical data fusion algorithms. Start field trials in a big way.