Montana Department of Transportation
Scope of Work

2701 Prospect Avenue
PO Box 201001
Helena, MT 59620-1001
www.mdt.mt.gov

RESEARCH PROGRAMS

Scope of Work		
Date: February 5, 2024	**Champion:** Paul Hilchen	**Technical Panel Members:** Paul Hilchen (Chair), Jack Dartman, Mike Kuni, Ethan Ritzen, Bill Semmens, James Strait, Shane Talley, Nathan Green (USACE), Raja Nagisetty,
Solicitation Number: 24-002	**Sponsor:** Dustin Rouse	
Project Number: 10468-989	**Research Project Manager:** Vaneza Callejas	
Maximum Project Cost: $250,000.00		
Project Title: Classify Wetland and Vegetation Using Multispectral Sensors		View Description
Project URL: https://www.mdt.mt.gov/research/projects/env/wetland-vegetation.aspx		
Project Background: MDT administers multiple wetland mitigation sites that are monitored annually by physical (on-the-ground) inspection and delineation of the wetland boundaries at each site. This research proposes to use Unmanned Aerial Systems (UAS) with a combination of spectral and LiDAR sensors in conjunction with Artificial Intelligence (AI), Machine Learning (ML) or Object Based Image Analysis (OBIA) to determine wetland boundaries. Results will be verified by comparison with the boundaries documented during on-the-ground delineations done at MDT wetland site(s).		View Description
Benefits/Business Case/Impact: Current inspection techniques require a physical field inspections that are time consuming and only effective if the inspector can access the site. UAS would be more efficient from a time perspective but also offer a better visual inspection from an airborne perspective. Experienced wetland field inspectors estimate a UAS inspection method would be 40% more efficient in work hours and likely more accurate based on the airborne inspection techniques. There would be less impacts to the wetland ecosystem by using UAS versus traditional inspection methods.		View Description
Objectives: The research objective is to determine whether Artificial Intelligence (AI), Machine Learning (ML) or Object Based Image Analysis (OBIA) methods can be used in conjunction with multispectral, hyperspectral, Thermal and or RGB imaging along with LiDAR data to detect and identify wetland species and wetland boundaries. The research will evaluate wetland site(s) and the results of the AI generated wetland mapping compared to previously determined plant communities and wetland boundary limits. A) Researching existing spectral sensors and AI, ML, OBIA methodologies that would likely fulfill the project intent. B) Identify the most cost-effective sensor and software combination(s) that will effectively fulfill the project intent. This may include using software MDT already possesses for the data analysis (i.e. ESRI ArcGIS Image Analyst). C) Develop training data for spectral AI / ML algorithms or Rule Set analysis on one or two wetland sites MDT administers for the US Army Corps of Engineers. D) Propose an efficient and effective methodology for wetland assessment.		

Timeliness - Time is of the essence. The proposal must be submitted (original and revised), research conducted, and deliverables submitted as detailed in the proposal and the resulting contract.

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Research will include a guidance document for MDT to follow for implementation of the research results

View Description

Tasks:

Tasks should follow the below outline:

View Description

A: Evaluation of existing research that successfully demonstrates spectral and software methodologies to identify wetland plant species and wetland boundaries.

• Perform literature review of research, and existing data relative to wetland boundary and plant species identification. Research will spend minimal time replicating available data. The Researcher will communicate with other research teams to determine benefits/future actions that are the results of the past research.

B: Evaluate the cost efficiency of sensors and software used to detect wetland attributes. The cost of equipment, software and work hours should be considered.

• Methodologies should employ 'off the shelf' sensors and equipment that are readily obtainable by MDT.
• Data analysis should use off-the-shelf software and analysis methods.

C: Develop methodologies to effectively analyze spectral data (multispectral, hyperspectral, thermal, RGB) using AI, ML or Rule Set analysis to identify wetland plants and wetland boundaries. The methodologies should be at least 80% accurate when compared to ground truth data by traditional inspection methods.

D: When an accurate and efficient method has been developed the primary investigator shall prepare a draft implementation guidance document that will outline the procedure for using software to analyze wetland areas for MDT's review and edit and a final report of their findings.

E. Coordination with MDT's Aquatic Mitigation Unit and the monitoring site consulting firm will be required. This will include on-site visits and meetings.

F. Quarterly meetings with the Technical Panel.

Acceptance:

The researcher will submit an economic analysis of optimal methods determined in Task B.

View Description

If the economic analysis indicates that a cost-effective method is feasible, the research team will prioritize data collection at the MDT wetland sites.

Cooperators, Stakeholders, Partners:

MDT Engineering
MDT GIS
MDT Environmental
United States Army Corps of Engineers (USACE)
MDT DEQ SBECP

View Description

Researcher will provide the expertise to evaluate technologies and methods, which will be presented to Technical Panel.

Researcher will provide initial interim report identifying and evaluating data analysis methods with preliminary financial analysis for technologies.

Researcher or their appointee will conduct data collection at MDT wetland sites for

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Communications:	analysis. Researcher will provide business plan and financial assessment of selected methodologies. Researcher will develop a draft implementation guidance document for review and ultimate acceptance by MDT. Researcher will write a final report of their findings for MDT.	View Description
Data Requirements:	MDT will provide researcher with a list of MDT available UAS, software and MDT wetland sites for the data analysis.	View Description
IT:	Research project will involve IT. The level of IT involvement is unknown at this point. Ideally, the research will identify methodologies that utilize existing software platforms and equipment.	View Description
Intellectual Property:	Unknown at this point.	View Description
MDT and Technical Panel Involvement:	MDT Technical Panel will be involved in decision points within project. Researcher will present the following: Interim Report identifying and evaluating wetland analysis methods with preliminary financial analysis. Technical Panel will determine whether to proceed. MDT wetland sites will be determined by the Technical Panel with input from MDT's on-board wetland site monitoring consulting firm, and the researcher. MDT Technical Panel will review and determine whether to proceed with recommended sites. Business plan and financial assessment of selected methodologies. Implementation of wetland boundary and wetland plant identification method(s). MDT Technical Panel will review and edit the draft guidance document and approve the final report for compliance with acceptance criteria.	View Description
Deliverables:	Deliverables will include an economic analysis of possible wetland assessment methodologies. Once the most cost-effective method is identified the method will be used to analyze MDT wetland sites. The final report will determine the method's effectiveness. An implementation guidance document will be developed for MDT acceptance.	View Description
Risks:	An economically viable spectral inspection method won't be determined. The initial financial feasibility review will minimize financial risk of research. Potentially a method won't be found at an economically acceptable cost.	View Description
Implementation:	Guidance that includes a list of feasible technologies for MDT to implement.	View Description

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Performance Measures:	A study that clearly defines financial viability of wetland rapid assessment methods for MDT. Expertise necessary to evaluate technologies and methods that serve the project intent. Expertise necessary to develop a guidance document for MDT implementation. Expertise necessary to develop a final report detailing the benefits and promote the method wetland assessment method.	View Description

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Scope of Work Background and Description

Title: Back

The title should briefly and immediately convey to the reader what the proposed study is about. It does not have to capture every element, nuance, and expected task of the research problem. It is like the title of a book --it should attract your attention, quickly convey the subject, draw you in, and make you want to read what's inside. A good title is like a good sound bite --people will remember it.

Hint: Look at every word in your title and ask yourself if it's necessary.

Background: Back

This section sets the stage for the research. It describes the issue, and indicates why we care and why we are seeking to fund the research in the first place.

Benefits/Business Case/ Impact: Back

Address urgency, timeliness, and importance of the research. Identify if the research is required for any federal or state initiative or compliance. This section must include a description of how this research will help to meet MDT's mission (i.e., serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality and/or sensitivity to the environment). It should also indicate the expected outcomes, such as cost savings, improvements in safety, user benefits, and process improvements.

Objectives: Back

Describe in very brief terms the expected product(s) of the research. The objective should be short, concise, and accurate. Don't put details in the objective related to how the study will be done unless some new or innovative research methodology is the key element of the research. The details will be in the research plan and reflected in the final product. If your objective is “to produce a new fuel-efficient vehicle,” say so. Don't say that the objective is “to produce a new fuel-efficient vehicle, including the design, construction, testing, and installation of all necessary components including body, frame, power train, tires, wheels, seats, mirrors, and other appurtenances to be determined through a survey of user needs, performance measures, and financial constraints.” If those things need to be done to accomplish the objective, put them in task statements.

Hint: Go back and read the advice above on titling your research statement. A very reasonable objective statement is “…to develop (insert your title).

Tasks: Back

If you have identified specific tasks that absolutely have to be part of the project work plan, include them in the SOW. However, don't let your own biases determine the research plan. Focus your attention on providing a full and accurate description of the final product(s). To the extent possible, give the proposing research team the flexibility to describe a research plan that they feel will accomplish the project objectives.

Hint: The more detail you include in the task statements, the less opportunity a researcher has to show initiative and innovation, and the more every proposal will come in looking the same. Don't be prescriptive.

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Acceptance: Back

As appropriate and only as required, establish milestones or management control points in the sequence of events where actions for review, approval, acceptance, or rejection are required.

Collaborators, Partners, and Stakeholders: Back

Identify individuals and/or organizations that need to be brought into the fold to create buy-in and acceptance of the results; review results; and/or participate in communications, decisions, and/or deployment. Specify the relationship and roles.

Communications: Back

Identify any communication needs, including technology/knowledge transfer, marketing, and training. Consider such factors as the target audience, end users, communication methods, events, responsible person/area, required approvals, and efforts needed for full implementation. Timing for communications should also be considered.

Data Requirements: Back

Identify available data that may be helpful in conducting the research. Include the limits of the data, such as fields and date ranges. Identify the format, such as Excel spreadsheet or hardcopy documents. Indicate what MDT can provide to the consultant and how.

IT: Back

Identify if the project involves software, hardware, data management, or technology devices, including maintenance, that may require coordination with ISD and/or SITSD.

Intellectual Property: Back

Describe any potential intellectual property issues.

MDT and Technical Panel Involvement: Back

As much as is known at this point, identify all MDT and consultant participation needed for the project, as well as the nature and extent of this participation. For example, MDT will provide gravel samples, traffic control, core samples to the consultant. The consultant may need to provide the time frame and required quantities. Another example may be that the consultant is required to visit MDT to review project hardcopy files or the consultant is required to provide specific equipment for use during the project.

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Deliverables: Back

It is critical to identify deliverables needed to implement the results of the research. Final reports, while required, cannot typically be implemented. Determine the products that will facilitate implementation. To achieve a significant impact, products must be well specified, well matched to the needs of the users, implemented in a deliberate and adaptive manner, and supported by a hospitable environment and learning processes.

Risks: Back

Identify risks to budget, resources, schedule, and scope. Identify potential mitigation measures, forewarning indicators, and contingencies. Determine impact and probability. Rate risks as high, medium, and low. Develop a plan to mitigate risks.

Implementation: Back

As much as is possible at this point, describe how the results will be implemented, who will implement the results, and any barriers to implementation and how these barriers might be reduce or eliminated. Define/describe successful implementation and activities necessary for successful implementation. Describe the criteria for judging the progress and consequences of implementation.

Performance Measures: Back

The research to be conducted should include both qualitative and quantitative performance measures if at all possible. Performance measures include such improvements as cost and time savings; improved process, safety, environmental considerations, efficiency, quality, and service; and user benefits. As much as possible, these benefits need to be quantified. This is an indication of the value of the research. Consideration needs to be given to the data that will need to be collected to report performance measures. The proposal must describe how performance measures will be quantified.

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