



GAANN- GOSTARS Fellowship Project.

Adviser: Cheng Zhu, Ph.D., P.E.

Title: Bio-mediated Soil Improvement Technique for the Protection of Coastal Roadways

Description: Sand erosion under natural environment changes or human activities is a major concern to many coastal zones, imposing significant risk for the integrity of coastal infrastructure. This research aims to develop novel bio-mediated techniques to improve the soil strength and reduce its susceptibility to erosion. Laboratory scale experiments will be designed and carried out to optimize the developed technique and validate its effectiveness in soil improvement under natural environmental conditions. The detailed breakdown of research tasks includes the following:

- Task 1: Investigate the applicability of the bio-mediated cementation methods on coastal soils
- Task 2: Test the mechanical and hydraulic behaviors of bio-cemented soils
- Task 3: Develop and examine the effectiveness of bio-cementation method in reducing soil erosion

Impact on GAANN: This project will directly address the existing soil erosion issue faced by many coastal regions and protect coastal infrastructure including roadways. Coastal zones are the area of transition between the terrestrial and marine components on Earth's surface. Those areas contain diverse natural resources in close relation to the livelihoods of a very large proportion of the human population. However, many coastal zones are continually degraded under the dynamic interaction between oceans and lands. Global climate change has triggered the more frequent occurrence of extreme weather events and the gradual sea-level increase, increasing the potential of inducing more significant geotechnical failures.

Impact on GOSTAR: This project will allow the graduate student to learn novel geotechnical techniques and develop skills in the area of costal geotechnics and infrastructure resilience. Graduate student will also have the chance to publish in top-ranking journals and present in prestigious conferences. Working in this area will provide numerous opportunities to the graduate student to work in either industry or academia.

Tentative Plan											
Semester	1	2	3	4	5	6	7	8	9		
Task	of the cement	te the appe bio-med ation met oastal soil	iated hods on	Test the mechanical and hydraulic behaviors of biocemented soils			Develop and examine the effectiveness of biocementation method in reducing soil erosion				
Outcome	Develop a bio-mediated technique that can reinforce coastal soils			Quantify the effectiveness of bio-mediated soil reinforcement			Validate the in-situ applicability of the bio- mediated technique				
Deliverable		Publish in a refereed onference proceeding and journal			Publish in a refereed conference proceeding and journal			Publish in a refereed conference proceedings and journal			
Graduation									Summer 2025		





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Title: UAV-Based Assessment of Geotechnical Infrastructure under Climate Influences

Description: This project aims to integrate unmanned aerial vehicle (UAV) and novel image processing techniques to perform reliable assessment of geotechnical infrastructure for the improved understanding of soil-atmosphere interactions. UAV-based photogrammetry will be conducted to generate the high-resolution 3D elevation model of levees and slopes in New Jersey. Novel image data processing techniques will be developed to support the fast and reliable generation of the 3D model. These models will be used to evaluate the stability and resilience of geotechnical infrastructure under extreme weather events such as flooding and drought. The detailed breakdown of research tasks includes the following:

Task 1: Identify surveying site locations and carry out multiple UAV-based site surveying

Task 2: Analyze survey results and develop data processing algorithms to generate 3D models

Task 3: Establish and validate infrastructure assessment system based on 3D models

Impact on GAANN: A large amount of the geotechnical infrastructure in developed countries is old and constructed using historic construction methods, but play a critical role in ensuring the safety of transportation. Maintaining such pervasive infrastructure requires high costs, and even higher in the event of failure. This project will directly focus on the timely and accurate assessment of geotechnical infrastructure and provide quantitative analysis of the infrastructure performance. The valuable information obtained from this project will serve the national need in infrastructure rehabilitation.

Impact on GOSTAR: This project will allow the graduate student to learn novel site surveying techniques and develop skills in the area of infrastructure asset assessment and management. Graduate student will also have the chance to publish in top-ranking journals and present in prestigious conferences. Working in this area will provide numerous opportunities to the graduate student to work in either industry or academia.

Tentative Plan

Semester	1	2	3	4	5	6	7	8	9
Task	Identify surveying site locations			Analyze survey results and			Establish and validate		
	and carry out multiple UAV-			develop data processing			infrastructure assessment system		
	based site surveying			algorithms to generate 3D			based on 3D models		
				models					
Outcome	Establish the procedure for			Develop a data processing			Develop a standardized system for		
	airborne site surveying			algorithm for 3D model			infrastructure assessment		
				generation					
Deliverable	Publish in a refereed conference			Publish in a refereed conference			Publish in a refereed conference		
	proceeding and journal			proce	eeding and jo	ournal	proceeding and journal		
Graduation									Summer
									2025