

## **2015-2016 Schob LAUP Mini-Grant Program**

### **PRINCIPAL INVESTIGATOR:**

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### **Co-PRINCIPAL INVESTIGATOR:**

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### **PROJECT TITLE:**

**New Perspectives for the Schob Nature Preserve:** Implementing 3D Modeling and Advanced Mapping Process using a Unmanned Aerial Vehicle (UAV)

### **PROJECT ABSTRACT**

Unmanned aerial vehicles (UAVs: commonly known as drones) have emerged as a new remote sensing method to assist both spatial ecology and environmental sciences. UAVs possess the advantage of being lightweight, cost-effective, versatile sensor choice and easiness of operating to examine study sites. While there are issues to use UAVs such as infringement of privacy, and trespass of air route, technological advancements in the capabilities of UAVs have allowed multiple fields to apply them in various purposes. UAVs have been offering new opportunities to analyze natural and built environments such as land-cover classification, surface temperature assessment, and natural resource monitoring analysis. This proposal is to develop and implement new measurements of 3D modeling with a photogrammetric process and to conduct Normalized Difference Vegetation Index (NDVI) analysis using a UAV at the Schob Nature Preserve. This study will help students improve their knowledge of landscape analysis using an advanced technique.

### **OBJECTIVES OF THE PROJECT**

A wide range of techniques has been used to examine temporal and spatial scale in ecosystems, and remote sensing has been extensively utilized in various disciplines. The techniques of remote sensing have primarily focused on regional and global scaled observations to obtain time-series samples of ecological analyses. However the existing data obtained from satellites or aerial photos do not typically satisfy with measuring local objectives due to several limitations including cloud constraint, difficulty of repeat survey on a designated site, and high cost in case of high resolution images. Utilizing UAVs will improve results of landscape analysis with several advanced measurements. The main purposes of this proposal is 1) to develop a measurement framework using a UAV in landscape architecture studies, 2) to produce 3D modeling and NDVI mapping outputs for the project site using a UAV through an empirical field test, and 3) to provide learning opportunities to graduate and undergraduate students in terms of applying up-to-date technologies in their site inventory and analysis process.

## WORK PLAN

Over the Fall semester of 2015 and Spring semester of 2016, both PI and Co-PI will take UAV videos monthly and develop a measurement framework based on their trial and error learning process. Then each video clip will be analyzed to determine the most appropriate method to produce 3D model of the Schob Nature Preserve. In addition, this research will analyze the quality of green space at the study site using NDVI. This project will progress in four phases which will benefit the experiential learning elements: *Research & Site Analysis*, *Data Collection*, *Data Analysis & Empirical Study*, and *Research Implementation of UAVs*. Graduate students will be involved in all phases of this project, while undergraduate students taking LAND 321 will participate in data collection process during spring 2016. Several tasks in the four phases will be performed during the 2015 fall and 2016 spring semester as following:

### Phase I: Research & Site Analysis

- Task 1 – Site visit & inventory (visiting the Schob Nature Preserve and gathering data with a UAV unit)
- Task 2 – Site analysis (conducting site analysis based on site observation and inventory)
- Task 3 – Research & case study (conducting case study and research focusing on UAV applications)

### Phase II: Data Collection

- Task 4 – Recoding video clips using a UAV unit monthly
- Task 5 – Mid-point presentation (explaining a UAV unit usage with faculty and guest reviewers including the Senior Schob Scholars)

### Phase III: Data Analysis & Empirical Study

- Task 6 – Analysis of data inventory through using a photogrammetric software program
- Task 7 – Filtering scrupulous images to generate a 3D model and NDVI map

### Phase IV: Research Implementation of UAVs

- Task 8 – Developing final package (producing the final measurement framework and results from the empirical study)
- Task 9 – Final presentation (delivering the final package to faculty and guest reviewers including the Senior Schob Scholars)

## SCHEDULE OF ACTIVITIES

Phases	Tasks	2015 Fall		2016 Spring										
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Research & Site Analysis	Task 1	█												
	Task 2	█												
	Task 3	█	█	█										
Data Collection	Task 4	█	█	█	█	█	█	█	█	█	█	█	█	
	Task 5				█									
Data Analysis & Empirical Study	Task 6			█	█	█	█	█	█	█	█	█	█	
	Task 7						█	█	█	█	█	█	█	
Research Implementation of UAVs	Task 8										█	█	█	
	Task 9													█

### STUDENT LEARNING OUTCOMES

This project will expand students' understanding and knowledge in landscape analysis by using advanced technologies including a UAV unit and photogrammetric processing. By participating in this project focusing on developing new measurement framework using a UAV unit, both graduate and undergraduate students will learn how to create a 3D model using data collected by a UAV unit, and how to measure the ecological quality using NDVI analysis. This high-impact learning opportunity will bring a number of pedagogical benefits to students with an empirical research experience with the latest remote sensing technique. In addition, this project will bring diverse opportunities to students for better understanding about landscape analysis process by hands-on learning experience, which will improve the ability to demonstrate problem-solving and critical thinking skills. This project aligns to the Texas A&M University's mission by meeting a number of the Aggie Commit Themes:

1. While participating in this project, students will have an opportunity to enhance *intellectual and practical skills* by learning how to identify and analysis problems to bring solutions for those problems, and how to execute the plan based on in-depth site analysis.
2. All students in this project will have a *high-impact learning opportunity* by being engaged in an advanced data collection process to analyze the site conditions.
3. All students participating in this project will learn how to improve their *communication and analytical skills*, since this project will offer students a unique opportunity to get exposed to challenges dealing with how to improve landscape analysis results using advanced visual communication methods by creating a 3D model and NDVI analysis.
4. Developing a measurement framework with UAVs will bring valuable opportunities to students to learn *process of solving problems with critical thinking*.

### ANTICIPATED DELIVERABLES

The final deliverables of this project will include:

1. A hardcopy and PDF file of the final report
2. Digital files of the final analysis package including a 3D model and a NDVI map for the Schob Nature Preserve
3. Video clips and photos using a UAV unit in the Schob Nature Preserve.

### HOW WILL THE MONEY BE USED

The funds will be used to purchase a software program for one-year license and data collection/field study during the project period.

Items	Costs
Purchasing Photogrammetric Processing Software	\$1,000
Data Collection and Field Study	\$1,200
Printing Costs & Publications	\$500
Contingencies	\$300
<b>Total Requested:</b>	<b>\$3,000</b>

## References

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