UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program
Company Information

Company Name	MEES	**Date Submitted**	*11/12/2020*
Project Title	Water Channel Flow Characterization and Optimization **(UNCC_ME_WATER)**	**Planned Starting Semester**	Spring 21

Funding:

What is the source of funds that will be used to cover all of the direct costs of this project?

The project will require only resources available in the supervising faculty member's lab as a result of prior and current ONR funded research, including hardware components and basic infrastructure.

Is this source of funds already secured? Yes ___x____ No _____

Technical Contact(s)*

	Technical Contact 1	**Technical Contact 2**	**Grader**
Name	Jerry Dahlberg		
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*We would like to have more than one technical contact, so there is a back-up in case of travel, sickness, job re-assignment, etc.

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	**Number**	**Discipline**	**Number**
Mechanical	4	Electrical	
Computer		Systems	
Other ( )			

Project Overview and Requirements:

The UNC Charlotte Water Channel is the nation's fifth largest water channel (by flow rate). The facility recirculating water channel, as seen in Figure 1. The channel has a mezzanine to allow researchers to safely access the top of the channel and overhead crane to assist with the insertion of experimental models. The channel has a 1m^2 by 3 m long test section and a maximum flow velocity of 1 m/sec. The test section of the water channel has a constant cross section and can achieve flow velocities between 0.1 m/sec and 1 m/sec. The closed tunnel design with submerged pump has several advantages over other designs. Experimental variables such as seed density may be assumed to be constant once the channel reaches steady state velocity, which reduces the need and cost of constant particulate addition required in other designs. Additionally, the design minimizes heat being added to the system by the pump since it is submerged. The test section is situated in such a way that the test model or test rigging are lowered from the top and suspended in the flow from a 3D traverse mechanism which allows for controlled movement (±0.1mm):

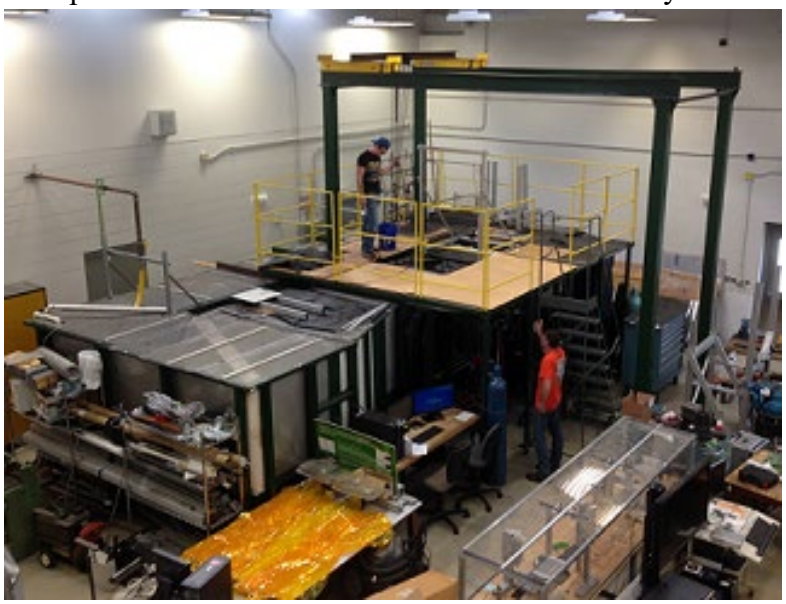

Figure 1: UNCC Weather channel

Flow visualization is conducted using a tomographic PIV system which allows for the creation and representation of 3D flow fields. This system has been the subject of several senior design projects during its construction. The water level can be raised and lowered (or model moved from surface to subsurface by the traverse) to conduct a wide variety of experimental procedures. The

Water Channel has served many research needs and has resulted in several publications and outreach activities. It has been determined that at certain velocities, the flow may not be uniform in the test section due to upstream turbulences and back flow regions. These areas must be addressed before each experiment and temporary fixes are utilized to ensure uniform flow at a specific region in the test section. This procedure is time consuming and costly.

Requirements:
The senior team will be responsible for establishing and executing a test plan that provides data on the water channels flow characteristics at different locations of the channel at different motor frequencies. The team will also model the channel and develop a CFD simulation of the flow in the channel. Following the completion of the experimental data analysis and CFD simulation, the team will make recommendations for channel optimization which will produce a uniform flow field inside the test section for all velocities. If approved, the team may begin implementation of the improvements.

Expected Deliverables/Results:

Deliverables include:
-Test plan for determining flow characteristics.
-Experimental data gathered in the execution of the test plan
-CFD simulation of the flow at a variety of flow velocities.
-Written report detailing the results of the test plan and CFD simulations.
-Written recommendations for methods of optimizing the water channel to produce a uniform flow field at all possible velocities inside the test section.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- familiarity with basic concepts of fluid dynamics