UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	MEES	**Date Submitted**	*05/13/2020*
Project Title	Particle manipulation in viscous streaming flows via reinforcement learning **(UNCC_VISCOUS)**	**Planned Starting Semester**	Fall 2020

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	3	Electrical	2
Computer	1	Systems	
Other ( )			

Project Overview and Requirements:

Aquatic microorganisms use vibrating cilia to propel themselves and to capture and manipulate nearby objects. Engineered systems can exploit analogous fluid dynamics for applications ranging from the contact-free manipulation of biological cells for medical purposes to the "vortex machining" of brittle surfaces. Students participating in this project will develop a laboratory platform for investigating the dynamics of solid particles suspended in a fluid excited by vibrating rods, using a fluid with viscosity greater than that of water to match the Reynolds number of micro-scale aquatic hydrodynamics on a tabletop scale, and will use this platform to validate control strategies rooted in machine learning for manipulating suspended particles based on visual feedback. Project outcomes will be incorporated into a manuscript submitted for presentation at an academic conference in the area of robotics, with project participants listed as co-authors.

Expected Deliverables/Results:

Deliverables include:

- a laboratory platform in which centimeter-scale rods can be driven to vibrate with various

frequencies and amplitudes, along various directions and at various locations, to induce streaming flows in a tabletop bath of viscous fluid according to control commands from a computer connected to one or more motion-tracking cameras
- experimental data validating the use of this platform to develop control policies, based on reinforcement learning, to address a selection of benchmark problems in particle manipulation

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

- familiarity with mechatronics in general and with the Arduino or Raspberry Pi platform in particular
- familiarity with basic concepts of viscous fluid dynamics
- facility with Python or a similar scientific computing language