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

Company Name	Department of Mechanical Engineering – Biomedical Concentration	**Date Submitted**	*07/21/2023*
Project Title	Neuromodulation SDP	**Planned Starting Semester**	Fall 2023

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

Neuromodulation is the alteration of neuronal activity through various techniques, such as electrical, magnetic, and optical stimulations. These methods hold the potential to enhance axonal regeneration, and myelination in neurodegenerative diseases, ultimately alleviating symptoms associated with neurological disorders. This project focuses on investigating the effects of one such neuromodulation technique -electrical stimulation (ES)- on peripheral neurons' behavior using a compartmentalized microfluidic system. The primary focus of this study lies in understanding how ES influences axonal growth, regeneration and myelination. Myelination refers to the formation of an insulating sheath around axons providing electrical insulation, enabling saltatory conduction, and supporting axonal function. The current conventional culture system utilizes a single-well culturing platform for both dorsal root ganglion (DRG) neurons, and myelin forming-Schwann cells for the myelination study. However, this approach fails to accurately represent the controlled and physiological microenvironment necessary for studying axonal growth and myelination. To address this limitation, we propose employing the compartmentalized microfluidic system, as depicted in the figure, to replicate the physiological conditions accurately. This approach would allow us to study the specific interaction between myelin-forming Schwann cells and axons of DRG cells in a more realistic setting. Additionally, electrical stimulation will be applied to the culture of DRG's or/and Schwann cells. By observing the effects of electrical stimulation on cellular processes such as axon growth, Schwann cells health and myelination, we aim to gain valuable insights into nerve regeneration under external stimuli like ES. Furthermore, we will induce neuropathic conditions by treating DRGs and/or Schwann cells with chemotherapeutic drugs to assess ES's potential in enhancing neuro-regeneration and myelination. The successful outcome of this project will establish a robust platform for conducting neuromodulation research focused on myelin-related studies.

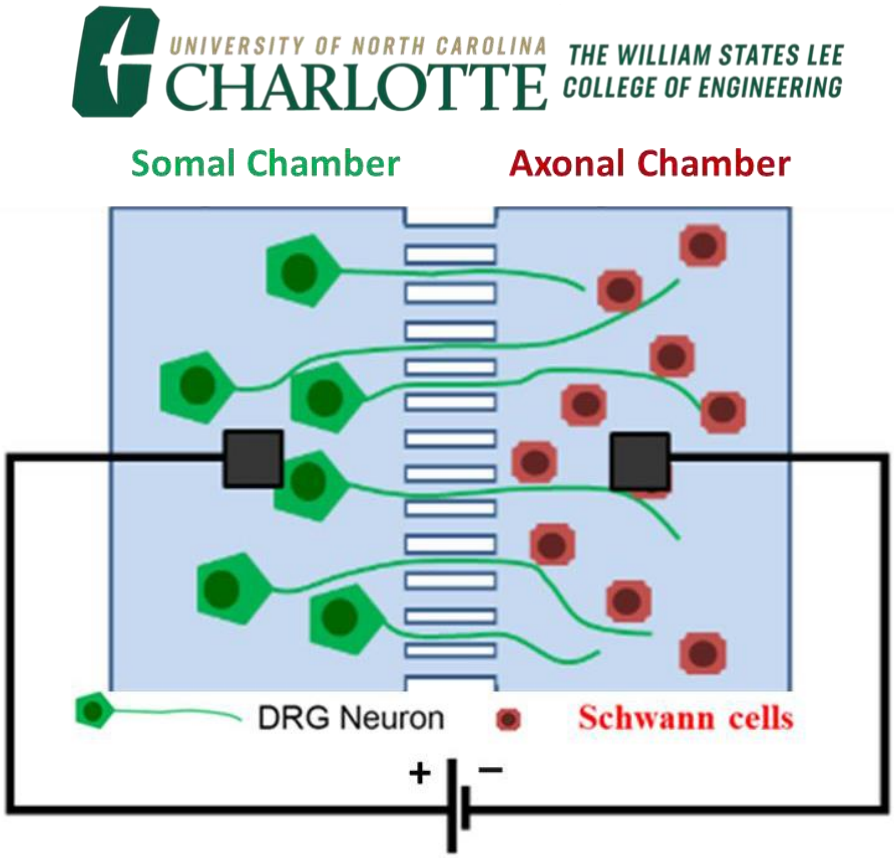

Figure. The *illustration shows the Neuromodulation of DRG neurons and Schwann cells in compartmentalized microfluidic system.*

The project team will work as follows.

- Microfluidic device fabrication
- Neuromodulation using electrical stimulation
- Co-culture of Schwann cell and dorsal root ganglion cells
- Axon growth assessment
- Myelination assessment by immunofluorescence staining approach.
- Florescence microscopy imaging
- Create a disease model for demyelination

Expected Deliverables/Results:

- Development of compartmentalized neuron culture system
- Neuromodulation on DRG's
- Research article

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

- Familiarity or interest in neural engineering