Northwestern | QUERREY INQBATION LAB

SUMMER SCHOLARS PROJECTS

PROJECT CATEGORY: Engineering & Technology

STARTUP: Rhaeos

WEBSITE: www.rhaeos.com

PROJECT TITLE: Sensor Algorithm Development to Support Children in Need of Brain Surgery

PROJECT DESCRIPTION

Hydrocephalus is a common and costly condition caused by the accumulation of cerebrospinal fluid (CSF) in the brain, with symptoms that include headaches, lethargy, seizures, coma, or death. It particularly afflicts children (occurring in 1 out of every 770 births), but has no cure and will require treatment throughout the child's life. Hydrocephalus is most often treated with the surgical implantation of a catheter, known as a ventricular shunt, which diverts the excess CSF in the brain to a distal absorptive site, such as the abdomen. Shunt related surgeries are the most common neurosurgical procedures performed on pediatric patients. Unfortunately, shunts have extremely high failure rates due to a diverse set of factors including occlusion, mispositioning, or kinking. Non-specific symptoms like headaches and nausea make diagnosing shunt malfunction extremely challenging. An accurate tool for diagnosis would directly improve the lives of patients with implanted shunts as well as reduce the daily worry of their loved ones.

Rhaeos creates wearable medical devices that monitor the flow in surgically implanted CSF shunts for patients with hydrocephalus. Whether fluid is flowing in these shunts is imperative for patient health, and the devices developed at Rhaeos directly measure that fluid flow. In the research and development of flow monitoring devices, Rhaeos uses an in-lab benchtop setup to mimic an implanted shunt underneath skin with flowing fluid. This project would involve characterizing the performance of both existing and prototype flow monitors on a benchtop model under various conditions through both data collection and analysis. The end goal of this project is to provide a complete understanding of the key data-based takeaways of benchtop data to the research and development of Rhaeos sensors as well as a nuanced report of the applicability and limitations of the benchtop model.

JOB EXPECTATIONS:

The student will be responsible for the main data collection and analysis of this project. Additionally, the student will be expected to be a contributing member of the R&D engineering team. This will include: regular lab work on characterizing the benchtop flow model by taking and analyzing data, daily 15 minute standup meeting attendance, weekly 1 hour R&D planning meeting attendance, and weekly 1-on-1 supervisor meeting attendance. Additionally, the student will be expected to make a final report on their findings deliverable to their supervisor, as well as a detailed presentation on their project presented to the R&D team.

DESIRED EXPERIENCE:

Necessary:

- Basic understanding of electronic circuits; completion of ME 233, BME 308, or equivalent
- Demonstrated Matlab proficiency; at a minimum, completion of the Engineering Analysis sequence including Engineering Analysis 4
- Lab experience
- Technical writing experience

Nice to have:

- Understanding of fluid mechanics; ME 241, BME 270, or equivalent
- Understanding of heat conduction and convection in fluid mechanics; BME 378 or equivalent
- Solidworks proficiency

TIME COMMITMENT:

Full-time 40hrs/week for the duration of the program. The student is expected to work during the hours of 9-5, on-site at the Rhaeos office (909 Davis St., Evanston).

TRAINING MENTORING:

The student will be mentored by the company's Chief Technology Officer, Dr. R. Chad Webb, and one of the engineering team's Product Development Engineers, Blake Parsons. Dr. Webb will serve as a development and career mentor, while Blake will serve as the day-to-day mentor and engineering development and coordinator for the student. Blake is a biomedical engineering Northwestern graduate, with multiple years of full-time engineering project work, as well as extensive mechanical design and lab experience. He will mentor the student during planned weekly 1-on-1 meetings, involving both feedback from the mentor and questions from the mentee. The R&D team at Rhaeos maintains a collaborative environment focused both on successful work output and personal engineering development; this environment will extend to the mentee. Other members of the R&D team include graduates of Northwestern's biomedical engineering and mechanical engineering programs, as well as a biomedical engineering PhD graduate from the University of Arizona. Beyond just communicating with the mentor, the student will also be expected to work collaboratively with other engineering team members, resulting in gained experience from multiple knowledgeable full time staff engineers.

Feedback will be given informally regularly during the internship, as well as with two formalized sessions, one occurring halfway through the internship and a written evaluation occurring at the end of the internship, both containing a performance review of the intern's progress and work. The development of the intern will focus on improving problem solving skills in a professional engineering context, solidifying verbal and written technical communication, and emphasizing collaborative engineering work.