*New this year !* (if applicable), mark this Yes,  checkbox to request consideration of your USS proposal for a Western Center Social Impact and Justice Research Award.

## USS Project Title: Swarm Robot Sensor Characterization for Simulation

Mentor 1 First Name: **Peter** Mentor 1 Last Name: **Jamieson**

Mentor 1 Email: **jamiespa@miamioh.edu**

Mentor 1 Administrative Unit Full Name: **Electrical and Computer Engineering**

Mentor 2 First Name: **Bryan** Mentor 2 Last Name: **Van Scoy**

Mentor 2 Email: **bvanscoy@miamioh.edu**

Mentor 2 Administrative Unit Full Name: **Electrical and Computer Engineering**

## Mentor Certification Statement

I, thementor, certify that I have also discussed and jointly prepared this application with the student, including the description of the proposed project(s) and the plan of supervision. I agree to:

* + Abide by the program award conditions if granted to us.
  + Oversee the spending of the $200 project allowance.
  + Serve as the instructor of record for the independent study under course number for which the undergraduate student will enroll in for zero credit hour to conduct the USS independent research project.
  + Ensure that the project complies with university policies and federal research regulations.
  + I agree to assume responsibility for submission of IRB or IACUC protocols and inventions disclosures, if applicable.

Undergrad First Name: **Tra Yen Nhu** Undergrad Last Name: **Phan**  
Undergrad Email: **phant2@miamioh.edu**

Expected Grad Year: **2023** Phone: **9492338733**

Student Major 1: **Computer Engineering** Student Major 2: **N/A**

**Major 1 College**

Arts & Science  Creative Arts  Education Health & Society

Engineering and Computing  Farmer School  Liberal Arts & Applied Science

**Major 2 College**

Arts & Science  Creative Arts  Education Health & Society

Engineering and Computing  Farmer School  Liberal Arts & Applied Science

## Student Certification Statement

## I have read the USS Program Guidelines and I agree to abide by all USS program conditions.

* + I will have earned at least 60 credit hours by end of spring semester, and \*I plan to continue as a full time undergraduate at Miami University for at least one additional semester after the award period.
  + If selected for a USS award, during that 9 weeks that I conduct the summer research project, I will:
  + Devote 100% effort (as determined by the administrative unit of the USS mentor)
  + NOT accept any employment, nor any internship (volunteer or paid), unless cleared with my mentor.
  + I acknowledge I must obtain written permission from my USS mentor and from the ORU coordinator to register for any other Miami academic courses for credit as stipulated in the program guidelines.
  + Participate in several ORU workshops to promote communication of project outcomes to non-technical/public audiences. Workshops will be held in late spring, summer and early fall.
  + Submit a brief report outlining the accomplishments of my project, plans of communication of the outcomes to a public/non-technical audience, and outcomes for diversity, equity and inclusion.

By submitting this application, both the student and the mentor agree to abide by the program requirements and all Miami University policies including COVID-19 requirements

**Project Purpose**

Robots interact with the physical world through sensing and actuation. In the development stages, however, it is often useful to have a simulation that accurately describes the behavior of the robot. In this project, the student will characterize and model a sensor, which can then be used in a simulation that accurately demonstrates the behavior of the robot. From the project, the student is expected to have a better understanding of the properties of the sensor and of various models that can be used to represent it. The project is also expected to enhance some of the student’s critical skills, such as researching, analytical analysis and modeling, etc.

**Project Goal:**

There are three goals for this project:

1. The student will design a robot to sense its surrounding environment. Some expected functionalities of the robot are to locate objects around it, to avoid collision to the walls, etc. The student will need to determine the sensors and other equipment needed for the robot to acquire those functionalities.
2. Once the robot design works, the student will characterize a distance sensor, such as an infrared distance sensor. The characterization will be based on experimental measurements and will describe the probability that the robot detects an object, depending on the position and orientation of the object in relation to the robot, the size of the object, the object’s materials, lighting conditions, etc.
3. Using the measurements and an existing software simulator, the student will then introduce the sensor model to the simulator. The student will compare the simulations to the experimental measurements on the actual robot to characterize the effectiveness and accuracy of the model. Some simulators that can be considered to use in the project are Gazebo, Webots, V-REP, etc.

**Expected Outcomes**

The student is expected to achieve the three goals mentioned above. For a successful project, they should have a working robot that can sense its environment, a model of the sensor, and a simulation that more accurately reflects the behavior of the robot when using the model than without.

**Expected Educational Benefits**

This research experience will be a hand-on experience on how to design a robot with specific functionalities, such as detecting objects, changing directions to avoid collision, etc. Additionally, the student will have a chance to use and improve their programming skills while creating the simulation for the design. The project also helps to enhance analytical skills by conducting a characterization on a sensor and coming up with a programmable model of that sensor. These are critical skills for a researcher and engineer.

The deliverables for this work are:

● Code and design files that will be hosted on an open repository – Github

● A report describing the work. This report will be created after the nine weeks research has been

completed and is a post USS activity and may be used towards a general technical elective in the

department’s curriculum.

● A poster presentation at the Undergraduate Research Fair at Miami to present their work to the

larger Miami community

Preliminary preparation:

● Faculty and student will meet bi-weekly over the spring term to prepare for the summer project

● Student is expected to do a minimum of 1hour/week of work in the spring term towards the

project.

During the USS:

● Student will spend weekdays working in the departmental research labs each weekday during the

USS nine weeks to work on the project. This time will, mostly, be spent in EGB 267 or other lab space

● Meet at the start of each day in an agile design environment to discuss the to-dos and dones of

the project

● Each week, the student and faculty members will meet with other students in the faculty member’s research group to discuss their work. This may include small presentations. Depending on the state of research in the deparment, this might be forgone

● Github will be used as a platform for sharing of information. This will allow quick questions to be

asked and interesting results to be shared – students will submit code as they develop it learning

software engineering practices

Presentation of Ideas:

● Student will create a research forum poster to illustrate the progress of the research and what

else can be done (i.e further research topics).

● The poster will convey the general topic, what the methods/procedures followed during the

research portion of the USS, as well as results and other relevant data.

● Poster shall be formatted in an easy to follow “flow” style with the left side (looking at poster)

being the main topic and idea and the lower right side being the results.

● A short academic paper might be created to disseminate the methodology of characterization to modeilng in the simulator