SUMMER 2022 – SC EPSCOR / INBRE RET PROJECT DESCRIPTION FORM

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Research Subject Area	Marine and freshwater biogeochemistry (Bourbonnais) and robotics and computer science (Rekletis)

A. Briefly describe overall research program at your laboratory:

Bourbonnais is an Assistant Professor investigating nutrient cycling (especially nitrogen) in marine and freshwater environments. She exploits the stable isotope ratios of reactive N pools as a primary tool and tracer to study N transformations in different marine environments.

Rekletis is an Associate Professor working on autonomous marine robotics and he is the lead of the Autonomous Field Robotics Lab (**AFRL**). He works with aerial, surface, and underwater robots with a focus on exploration and environmental monitoring. The key questions addressed in AFRL are localization (where is the robot), mapping (generate representations of the environment), and motion planning (generate trajectories that take a robot to a goal location).

B. Briefly describe specific project(s) for your teacher:

Bourbonnais and Rekletis are currently involved in an NSF-funded EPSCoR project using computational methods and autonomous robotics systems for modeling and predicting harmful cyanobacterial blooms (HCBs). HCBs impact the quality of lake water and can threaten human health through toxins that can damage multiple organ systems. The aims of the project are to use robotic boats, buoys, traditional limnological sampling and camera-equipped drones to collect physical, chemical, and biological data in lakes where HCBs are detected. When combined, the technology will generate large volumes of data on the lakes and development of harmful algae as well as new algorithmic models to assess them. With technology covering the water and air, other teams will collect information on population density in the watersheds together with land use around the lakes and how that might impact bloom formation and development. Local homeowners and students will also form a corps of "citizen scientists" to support the project. One of the final goals of the project is to open the technologies to lake managers and citizens so that monitoring can happen throughout communities. Lakes in New Hampshire, Maine, Rhode Island, and South Carolina will be studied to better understand the spatial distribution of harmful algal blooms in contrasting lake ecosystems.
In South Carolina, moored mini buoys measuring temperature and dissolved oxygen have been deployed at two stations (shallow and deep) in both Lake Murray and Wateree. Depth profiles of temperature, pH, dissolved oxygen, conductivity, total algae/phycocyanin and turbidity will be measured using YSI sensors from March to October during the duration of the project (2020 to 2024). We will also collect samples for dissolved inorganic and organic nutrient concentrations and isotopes, dissolved gases (O_2, N_2, Ar) and

phytoplankton community composition (in collaboration with Dr. James Pinckney, University of South Carolina). Autonomously operating Jetyaks (>2 m) equipped with YSI sensors will be used to gain high spatial resolution surface water measurements (including velocity, GPS, compass, airspeed, and sonar).

The teacher(s) will be directly involved in all aspects of this project, from samples collection in the field to laboratory analysis and data dissemination within the community. The teacher(s) will have the unique opportunity to be introduced to different state-of-the-arts methods for nutrient and stable isotope analysis in the Bourbonnais lab. Participation in AFRL will familiarize the participant(s) with autonomous vehicles and sensors, deployment and data collection methods, and data management.

Information collected through the project could lead to better predictions of when and where the harmful algal blooms will take place. The sampling techniques and the data collected will enable the teacher(s) to augment different Science classes (biology, chemistry, computer science).

C. Will any other people (post docs, grad students, undergraduate students, colleagues, etc.) be involved directly with your teacher?

The teacher(s) will be involved with one Ph.D., two M.Sc, two undergraduates and two visiting high-school students in the Bourbonnais lab and with one Ph.D. student in AFRL over the duration of the project.