Title: Sea Turtle Robot Locomotion in Complex Environment

Faculty: Yasemin Ozkan-Aydin, yozkanay@nd.edu - Electrical Engineering

Description: Terrestrial animals demonstrate a unique performance in using multiple propulsion elements (limbs and trunk) to generate thrust in a variety of environments [1, 2]. Inspired by biology, several terrestrial robot models that use animal locomotion techniques to solve real-world locomotion problems were developed [3–9]. However, when systems have joint limits, their ability to locomote depends on how effectively they can change their interaction with the environments during a gait cycle (a pattern of limb actions that an animal uses repetitively during locomotion). In this project, we will study the locomotion dynamics of sea turtles using a robotic model that consists of back and front flippers controlled by servo motors. Sea turtles have developed the ability to move quickly in the water, climb up onto beaches and rocks, and dig nesting holes in the sand. Their evolved flippers can help them move in different directions and speeds. However, how they synchronize their flippers to move in various challenging environments has not been studied extensively.

To study sea turtle locomotion, first, we will develop a low-cost, 3D-printed sea turtle robot with flexible flippers that propels itself around the world, similar to the capabilities of natural systems. In particular, we will focus on how the passive and active stiffness of flippers facilitates the robot's stability in a variety of environments, including a granular substrate and rough terrain where the system is intermittently in contact with the ground. The outcomes of this research will greatly advance the design of innovative robots, especially soft robots, that can navigate through the real world.

The expected involvement: The first expectation from an REU student is to build a 3D printed-legged robot under the guidance of the PI. Using an Arduino-based controller, the student will learn how to program different gaits that allow the robot to walk on various terrains. The student will then design flexible flippers with different geometries. actuation and sensing mechanisms and test them on the robot. The student will test the performance of the robot through laboratory experiments. At the end of the program, the student will write a short research paper in a conference paper format.

Preferred Expertise: Electrical or Mechanical Engineering students with experience in Arduino programming and CAD design (such as Solidworks) are welcome.