CBBG Center for Bio-mediated & Bio-inspired Geotechnics

Testing the Vertical Penetration Capability of a Self-Burrowing Robot in Granular Media

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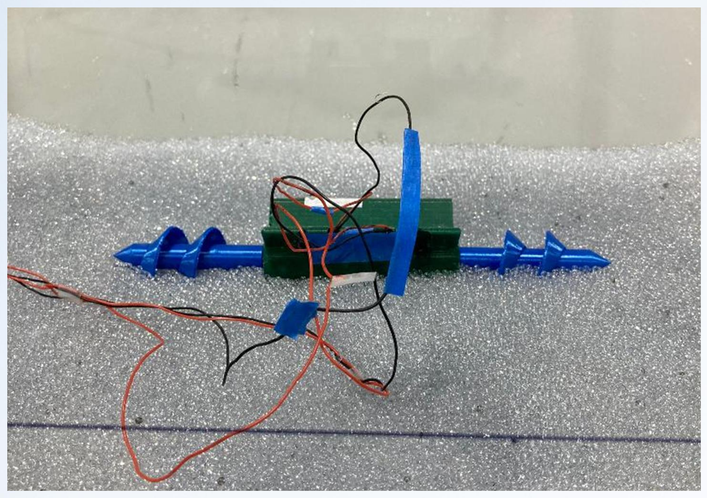
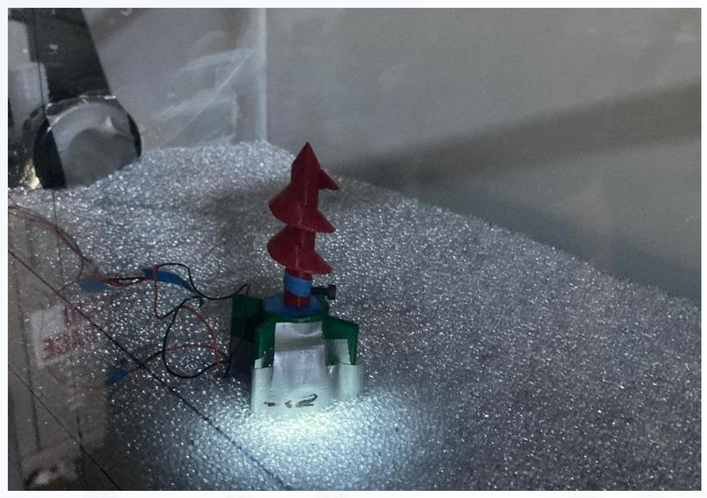
Research Background

- CBBG Researchers have created a two auger, self-burrowing robot to study the mechanics of self burrowing.
- Prior research achieved horizontal burrowing through a simulated soil. This stage of research begins experimenting with the robot's ability to vertically penetrate granular media.



Research Objectives

- Determine if the robot can vertically penetrate the granular media.
- Determine how far downward the robot can penetrate.
- Determine the effects of changing the initial embedment depth and increasing the auger speed.

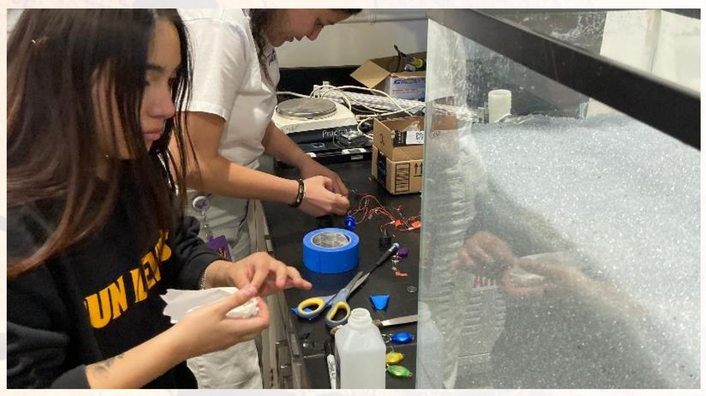


Research Conclusions

- When fully embedded under the surface before starting, the robot did not move.
- When starting partially embedded the robot did penetrate, but only about 5 cm before the thrust force of the auger was overcome by the resistant contact force of the media, causing it to stop.
- Increasing the auger's RPM did increase the speed of penetration, but not the depth.
- Future trials will examine the effect of changing the size and shape of the augers.
- Stronger motors may be needed.

Lesson Description

- The development of a self-burrowing robot is an inherently difficult and interesting engineering problem, ideally suited for a problem-based learning activity to introduce students to the engineering process.
- High school students observe demonstrations of the robot's motion, describe and explain it using Newtons laws, identify obstacles and then develop their own ideas for how to overcome them.
- Students propose their own design changes and improvements to help plan the next stage of experiments.



Lesson Objectives

- Students will apply the abstract concepts of forces and Newtons laws of motion to real engineering problems.
- Students gain an understanding of the process of engineering by engaging them directly in engineering design process.
- Compare and contrast locomotion in fluids and solids.

Lesson Outcomes

- The robot prototype served as an excellent example to introduce and engage students in the Engineering Design Process.
- Students never surprise or impress more than when given a chance to be creative. They produced a wide range of interesting and novel ideas.
- In addition to teaching the Engineering Design Process, students were introduced to some basic robotics, 3D printing and CAD.

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