Creating Connections: Bed bugs to UAV Swarms

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Abstract

Modern aerospace systems need a new approach for swarm consensus that is distributed, operates with local knowledge, and uses simple agents. The overarching goal of our research is to advance our understanding of bed bug behavior and use this understanding to improve performance of aerospace swarms. The first step is to understand individual bed bug response to stimuli (CO2, heat, light) and individual neural characteristics, before considering group dynamics. The objective of this proposal to establish a collaboration between biologists and engineers at ERAU to design and implement a test platform to enable new data collection for bed bug movement. This collaboration begins by examining individual bed bug response to CO2 concentration. Our central hypothesis is that if we record bed bug response to CO2 exposure, then we will be able to improve our understanding of collective decision making because the bed bugs coordinate their response to environmental conditions. We will test the central hypothesis and accomplish the overall objective of this proposal with four aims. The research will involve five undergraduate students from the three campuses and result in five outcomes (including two conference publications).

Research Question

Can an enhanced understanding of bed bug behavior be used to improve aerospace swarm performance?

Purpose

- Establish a collaboration between Embry-Riddle's engineers and biologists
- Develop a test platform for new data collection for bed bug movement.

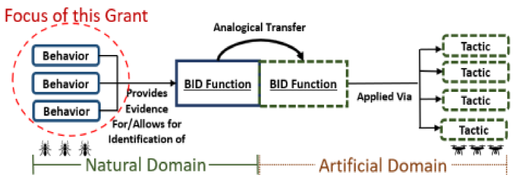


Figure 1: Shows the current state of the project along its outlined plan.

Hypothesis

If we record bed bug response to CO_2 exposure, then we will be able to improve our understanding of collective decision making because the bed bugs coordinate their response to environmental conditions.

Test Bed

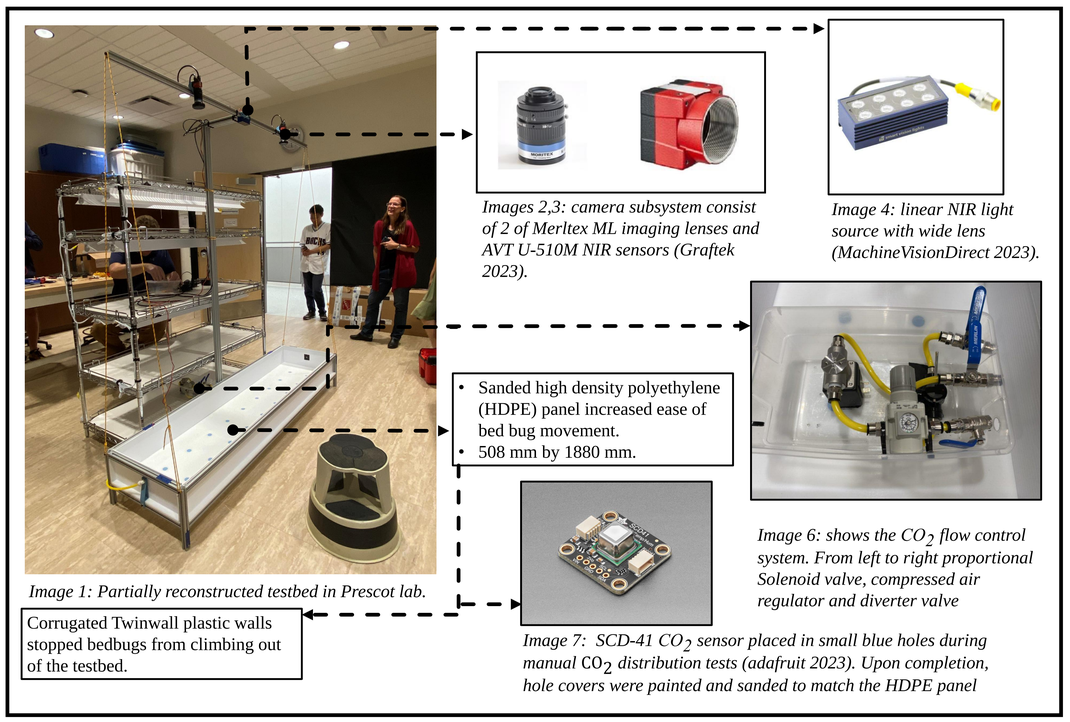


Figure 2: Shows the whole testbed as it was reconstructed at the Prescot campus. Also describes the main components of the testbed.

Results

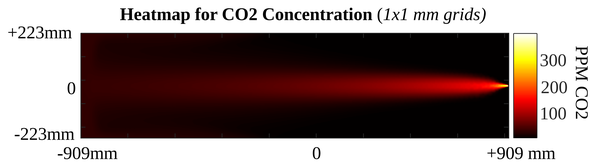


Figure 3: The single injection CO2 distribution

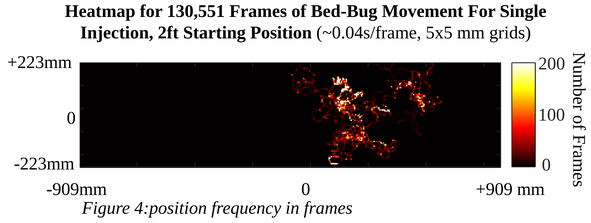


Figure 4:position frequency in frames

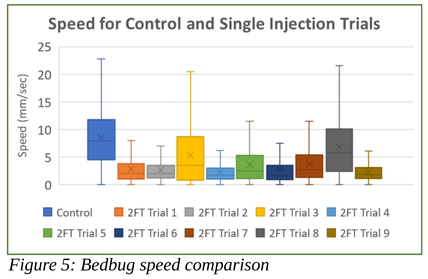


Figure 5: Bedbug speed comparison

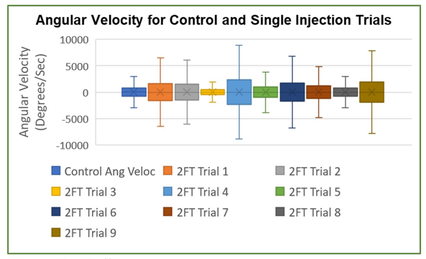
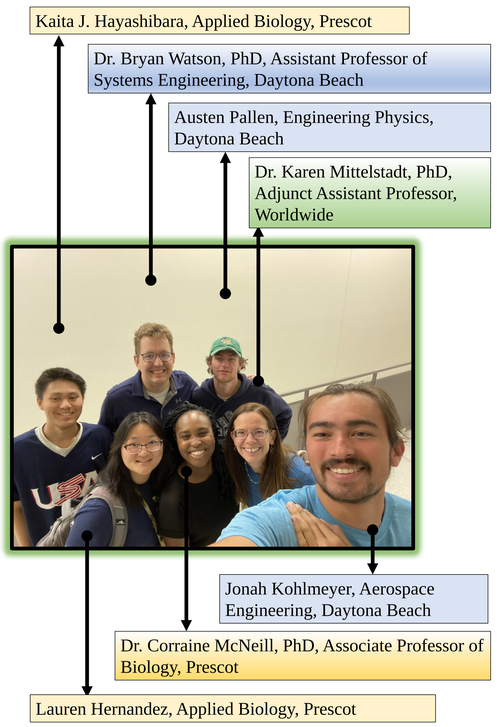


Figure 6: Bedbug turning activity comparison

Collaboration



- Missing from photo: Marysa McCartney, Dr. Fan Yang

Conclusion

- New test bed fully integrated into Biology lab at Prescot campus
- Single Injection CO2 Modeling completed
- Computer vision parameters adapted for specific video conditions
- Data collection still ongoing
- Behavior not effected by CO2 concentration

Future Work

- Complete data collection
- Single source test for three other Bed bug conditions
- Single source test with increased CO_2 concentration
- Choice test (two sources)

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Biologically Inspired Design-for-Resilience Lab