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"Monarch Butterflies Migrate up to 4,500 km Across North America every Year to Escape the Cold Winter"

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Summary

Monarch butterflies migrate up to 4,500 km across North America every year to escape the cold winter. During migration, they can fly at altitudes of 1,300 m where the ambient pressure and density reduce to about 70% and 75% of the sea-level values, respectively. Their overwintering sites are all located in the high mountains in Central Mexico at 3,000 m. Moreover, the air density is about 70% of that at the sea level. The effects of density on the flight performance of butterfly and how these butterflies fly at the high-altitudes are unknown. In this project, we will measure freely-flying butterfly flight using high-resolution motion-tracking camera. Implications of flight dynamics and flapping wing aerodynamics will be discussed. The density and pressure inside the vacuum chamber will be adjusted to simulate a high-altitude environment. Experimental methods will be improved to enhance the accuracy and resolution of the measurements. Female and minority students are encouraged to apply.

Student Prerequisites

None.

Student duties

The student will be expected to work closely with a graduate student to perform following duties:

- Measuring the morphological parameters (wing area, span, etc.) of the butterflies before the testing
- Acquiring motion-capture data involving calibration of the cameras, placement of markers on the butterfly wings, operating the motion-capture system, operating the motion-capture system in the PRC vacuum chamber
- Postprocessing the data from the experiments
- Assessing the accuracy of the measured data

Main benefits to the students are

- Unique opportunity to operate a state-of-the-art motion tracking system and PRC vacuum chamber
- Working with live butterflies
- Opportunity to contribute to a journal or conference paper, depending on the progress

Experimental data are expect in June/July, which will be postprocessed and analyzed at the end of the summer semester.

Mentor Supervision and Interaction

A graduate (PhD) student will provide a daily supervision to the student. In addition, the student is expected to update the mentor with a weekly progress update report and during a bi-weekly update meetings. The followings are the specifics.

- Weekly progress update report
 - Written together with the graduate student
 - To discuss the results, any issues, and plans for the following week
 - Evaluation: the mentor will provide feedback to all reports. The mentor will assess the writing, scientific progress, and quality of the analysis. Suggestions will be provided
- Bi-weekly progress update meetings
 - Together with the graduate student.
 - To discuss the results and any issues in person.
 - Frequency of the meeting will increased as needed.
 - Evaluation: the mentor will provide detailed instruction for the on-going work and offer suggestions for improvement.