AEROSPACE ENGINEERING AND ENGINEERING MECHANICS
COLLEGE OF ENGINEERING AND APPLIED SCIENCE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 03/01/2024

PROJECT TITLE: <u>Experimenting new control designs for source seeking on robots or UAVs</u>

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Project Description

Our research has led to new kinds/designs of control systems based on what is called "extremum seeking control." This kind of control systems allow for real-time optimization, enabling bodies (such as robots and UAVs) to reach their optimized objectives in real-time with few information compared to most kind of other controls. Hence, we tested our design on robots trying to seek light source in real-time without GPS information! This demonstrates a significant potential for our methods. We are conducting many other tests using the new control design; we are planning to do so with robots, UAVs, and perhaps Imitated designs of birds.

See our YouTube channel and check out some of our experiments:

https://www.youtube.com/@mdcl9697/videos

Particularly, make sure to check out these three videos:

https://www.youtube.com/watch?v=nYKkCMsxnRY
https://www.youtube.com/watch?v=TLom8YMZojg
https://www.youtube.com/watch?v=DTd_5bJpxVk

Recently, we were able to show that these very simple control techniques (extremum seeking control) can actually explain how some biological organisms may be conducting their dynamic optimization. We published results on that in very top journals and were highlighted in the news by the society of industrial and applied mathematics (SIAM) for solving the decades-long mystery of Albatross and soaring birds flight method. UC summarized these highlights in their news as well in an easily accessible way:

https://www.uc.edu/news/articles/2022/12/uc-aerospace-engineers-explainhow-

albatrosses-harness-ocean-winds-to-sail-energy-free.html

We need help in multiple domains, so the person joining from the UPRISE group will help with one or more of the following: (i) running simulations to test codes made for implementing the new controls, (ii) help in assembling robots/UAVs/sensors or simulation of bio-inspired phenomena, and (iii) helping in running the experiments in the testing room with motion capturing and data collection. In addition, the student will have the opportunity to learn a lot about coding (via MATLAB), robotic operating systems, control systems and sensors.