Is it possible to create a biodegradable wing using foldable mechanisms to create net-positive lift?

Team 3: BIRB (Biodegradable Inspired Robotic Bird)
Chris Breaux, George Muhn, and Lien White

Current Specifications

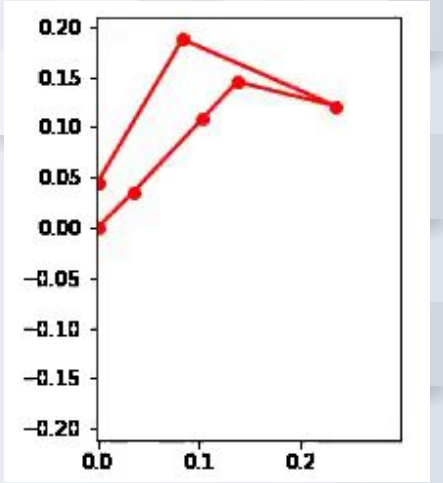
- Bio-Inspiration
- Updated Specifications
  - No new specifications
  - No extreme changes in kinematics, other than switching to a single motor.

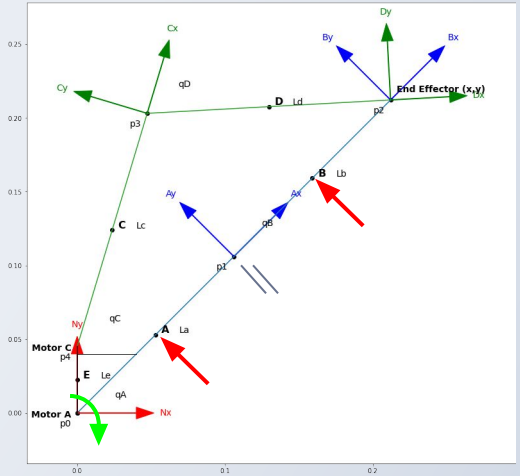
Specifications	
Wing Radius	0.4 m
Chord Length	0.2 m
Flap Frequency	2 Hz
Robot Mass	500g
Flap ROM	45 deg
E.E Force	9.81 N
Power Consumption	23 W

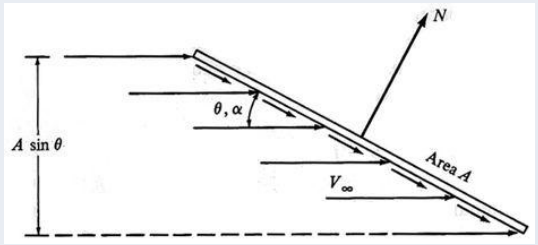
Downward Beat Analysis	
End Effector Force	-9.81 N * Ny
Motor Torque	-0.18Nm
End Effector Velocity	-1.26 m/s * Ny
Motor Velocity	-6.28 rad/s
Total Power Draw	12.32 W

Dynamics

- Valid initial condition
  - Fully extended lower arm
  - 45° lower arm
- Single torque input - lower base joint
- 180° angle limiter - lower passive joint
- Aerodynamic drag
  - Flat plate model
  - Applied at com
- Two compliant links - lower arm
- Joint stiffness and damping
- Time-varying parameters
  - Torque input
  - Angle limiter stiffness
- Fixed to test stand





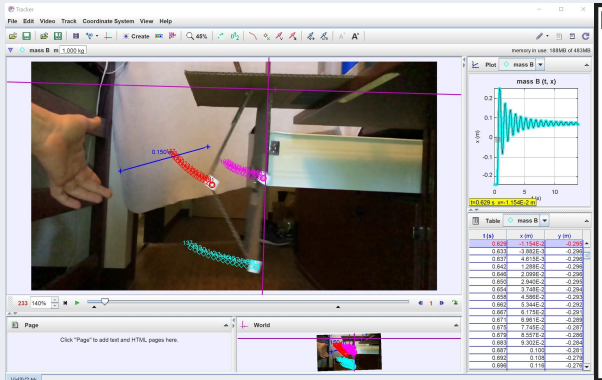


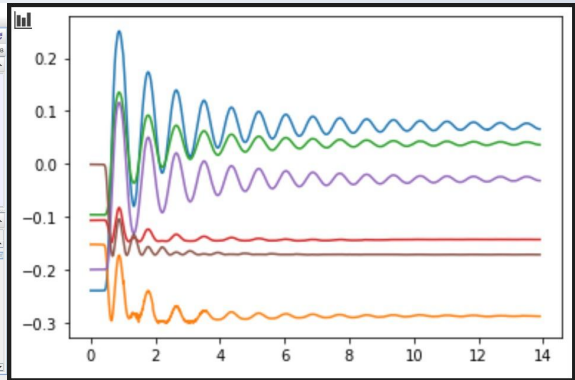
Data Collection

1. Prototyping:
   1.1. Changed lengths and widths of prototype, allowed for better range of motion and a better desired path.
2. Tracker simulation:
   2.1. The tracker set up and video was pretty straight forward. Set up two different ways, first as a wing attached to wall, this had problems as it would run into the wall and produce bad results. Second, as a pendulum to allow for better data collection.
   2.2. Tracker data collection 2+ hour for each point with constant checking for correct template matching.
3. Data Analysis:
   3.1. UNABLE to find b and k values. Despite working code and adjusting the dynamic model to match the tracker sim it still took 24+ hours with multiple adjustments and running multiple types of optimization.
4. Cantilever beam test

E = P*l3/(3**(b*h3/12)) =**17800403.23N/m3**

5. Data Collection integration
   5.1. We ran multiple models and tests in order ro find the best fit b and k models we are also in the process of evaluation the Young's modulus and comparing our calculated number vs a online source





Future Plans

- Continue running optimization to fit values for b and k.
- Validate Young's modulus from cantilever beam test with literature
- Experimentally validate parameters we calculate
- Continue to refine the prototype for better performance and integrate the electronics and actuators.