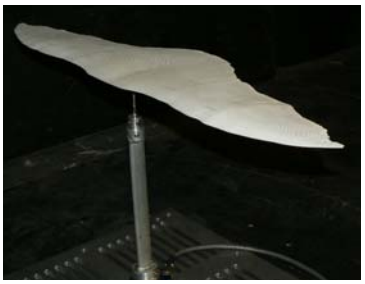
New MAE 4900/Masters of Engineering Project - Bat Wing Morphing Aircraft Design

Pteropus giganteus, a megachiropteran bat of the 'flying fox' family

Brief description:

Research at the Lab of Intelligent Machine Systems has so far been able to model and test aerodynamics of a rigid bat-like wing structure. For the next phase of this project, an active bat-wing aerial vehicle will need to be developed and tested. This project will require research on bio-inspired flight, greater understanding of bat wing morphology through study of physical specimens in conjunction with the Cornell Lab of Ornithology or the Syracuse Zoo, and development of a bat-like wing skeleton with flexible wing membranes employing existing shape change actuators. This project will require research on actual bat morphological change in flight, as well as fabrication of a man-made skeletal wing structure and assistance with wind tunnel testing.

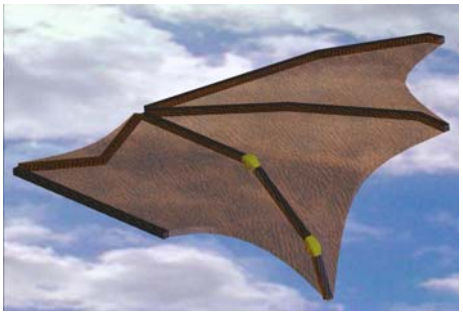
Overview:



Rigid bat wing test setup in wind tunnel

Being the only flying mammal, bats have evolved with unique flight devices affording them high maneuverability and efficiency despite their low flight speeds. By selecting bats of different ecological niches, passive wing shapes have already been demonstrated through computational analysis as capable of attaining very different aerodynamic performance characteristics. We have studied the aerodynamics of these wing shapes through computation and experiment for rigid wings that use thin airfoils rather than the final skeleton and membrane construction for 'morphed' and 'unmorphed' wing shapes.

The next phase of the research requires the transition to a skeletal wing shape. In the first phase of the project, a greater understanding of bat wing shape changes will be gained through photographic study of live bats, potentially with the help of the Syracuse Zoo and/or making use of a high speed camera while in flight at the Cornell Lab of Ornithology.



Morphing bat wing concept

In the next phase, a skeleton with embedded actuators and an aerodynamic membrane will be designed and constructed based on these findings, to test performance of various wing shapes in the low speed wind tunnel facility in Upson Hall. Morphing actuators are currently under development, and will be embedded to create a complete morphing vehicle. If possible, an analytical study of the three-dimensional wing shape in FLUENT will provide further insight into expected performance.

Skills sought:

- Aerodynamics or mechanical design background
- Computational fluid dynamics experience (optional)
- Computer Aided Drawing experience
- Photography experience
- Experiment development
- Appreciation for biology and aviation

- **Project duration:** 1-2 semesters
- **Hourly commitment:** 10-20 hours per week, taken for credit
- **Start date:** Monday, September 1

For more information or to apply, contact Professor Ephrahim Garcia at eg84@cornell.edu or Justin Manzo at jem54@cornell.edu