SPRING 2016

Flapping Wings

THE ORNITHOPTER SOCIETY NEWSLETTER

Payload-Lifting Ornithopter Contest!

Begins: March 1, 2016
Contest Director: Patrick Deshaye

PURPOSE

To promote the development of substantial, practical and useful flapping-wing aircraft.

RULE

1) More than 2/3 of any and all horizontal surface areas (including any required for stability and control) must be devoted to the flapping wings.
2) The flapping motion of the wings must simulate that of some flying creature, such as a bird, bat or insect. No more than four such flapping wings are permitted in the airframe design.
3) No sources of propulsion other than the powered flapping surfaces themselves are allowed on the aircraft in flight or at launch.
4) A removable, inert payload in the form of a 16 lb. bowling ball must be included on the aircraft at all times during the contest flight. Neither the weight of any fuels, human pilots, avionic or robotic apparatus, nor any other functional items or material will be considered as acceptable payload in this connection; pets or animals are prohibited onboard.
5) Contest flights must be made outdoors under safe conditions. The aircraft must rise from level ground under its own propulsive action and remain airborne for no less than three minutes from liftoff and thence complete a landing with both aircraft and all onboard payload intact.
6) No restrictions apply with regard to the overall size, power sources, fuels, structural materials, airframe design, etc. save those stipulated above, but the contest flight may not be assisted by any extraneous device or subterfuge. Determination of acceptability for entries in any doubtful or ambiguous situations is left solely to the discretion of the contest director.

ENTRIES

1) There is no entry fee, nor any restriction on who may enter this contest. Entries must be submitted to the contest director via email at the address provided below.
2) Entries may be submitted at any time after the date of this announcement. There is no deadline. The winner will be determined by the earliest entry to satisfy the rule as determined by the contest director.
3) Entries must include:
   A) A simplified plan drawing or diagram of the flying model or aircraft, to include overall airframe dimensions and materials, plus some general description of powerplant and operation.
   B) An electronic motion picture or video recording of the entire contest flight, from liftoff to landing.
   C) Current contact information for two witnesses to the contest flight in addition to the contestant who will confirm compliance with all contest stipulations regarding design, duration of flight, payload weight, etc.

PRIZES

A prize purse has been established with a US$500.00 contribution from the contest director. Additional contributions to the contest prize purse are welcome. A bronze trophy commemorating the contest will also be provided to the winner.

SUBMISSIONS and FURTHER INFORMATION

patrick@ornithopter.org

FireWing

from Air Hogs, $49.99

Product Review by Don Cook

The FireWing from Air Hogs is a cool little toy. It provides a quick and easy leap from rubber bands to RC, right out of the box. And it's impressive! [The FireWing is based very closely on the Avitron, a similar but pricier model that was designed by the grandson of Tim Bird inventor Guy de Ruymbeke.]

First the good stuff: The bird and the controller work great. The cost is less than 50 bucks. Easy to fly, and a lot of fun. With only speed and direction control, it is very simple to operate. And, on a grass field it crashed without damage.

Operation is mostly simple. The controller takes four AA batteries, and the bird hooks up to the controller to charge its internal lithium-polymer cell. The charging instructions are clear. However, the plug and socket didn't quite line up, and so had to be encouraged a bit.

The FireWing comes with a two-channel, 2.4 GHz radio system. Press the throttle lever forward to make it go. Like-wise, move the steering lever side to side for steering. The direction lever pressed to the left causes extra tension on the right wing membrane, which results in a left turn. And vice-versa.

Your choice of venue will determine the bird's tail setting: up for slow indoors, down for fast outdoors.

The drive mechanism is not entirely visible, but it appears to be a plastic crank sliding in a slot that translates into an up and down motion. This slider is connected only to the left wing. The right wing is geared in unison to the left. The wings consist of a plastic membrane glued onto solid carbon spars. The flapping amplitude is about 60 degrees.

At first, the bird took a dive to the left, so trim weights (were added per the instructions. It took about four pieces on the right wing tip to achieve straight flight. You'll soon learn that the launch speed has to be nearly equal to cruise speed. The bird doesn't have the strength to quickly gain speed from a slow launch. Once at flight speed, the throttle can be adjusted.

Landing was as simple as releasing the spring loaded “go” lever, but slow flapping approaches are prettier. After about 6 learning trials and 10 real flights the last one ended abruptly and the bird fell to the ground. The charge was spent. But crashing on the outfield grass from an altitude of about 25 feet was no problem. The foam body protects the delicate mechanism inside. The FireWing does come with an extra set of wings in case you need it.
I wouldn’t be able to say this model can fly, right out of the box. In fact, the box itself was a problem. Since Air Hogs has provided an in-store demo, the ornithopter is already wired to a pushbutton on the outside of the box. You must carefully unravel the button, the temporary wire, the bird, and the box. Be very careful and go slow when you undo the packaging. Once you extricate the bird and the controller, you can dispose of the box, the button, and the temporary wire. Also be wary of the tape stickers in the box. They'll grab anything, including the bird's delicate wings. After that, everything else went fine. But they do have a hotline if you have trouble.

So, here's a chance to take a break from your rubber band models, and experience RC, cheap and simple. You'll like it!

Specifications:
Wingspan: 13 inches (33 cm)
Weight: 1/3 ounce (8.8 grams)

Tensioned Membrane Wings

by Nathan Chronister

Some readers have asked me to talk about the tensioned wing system I have been using on some of my ornithopters. This is a simple but unique innovation that I started working with several years ago.

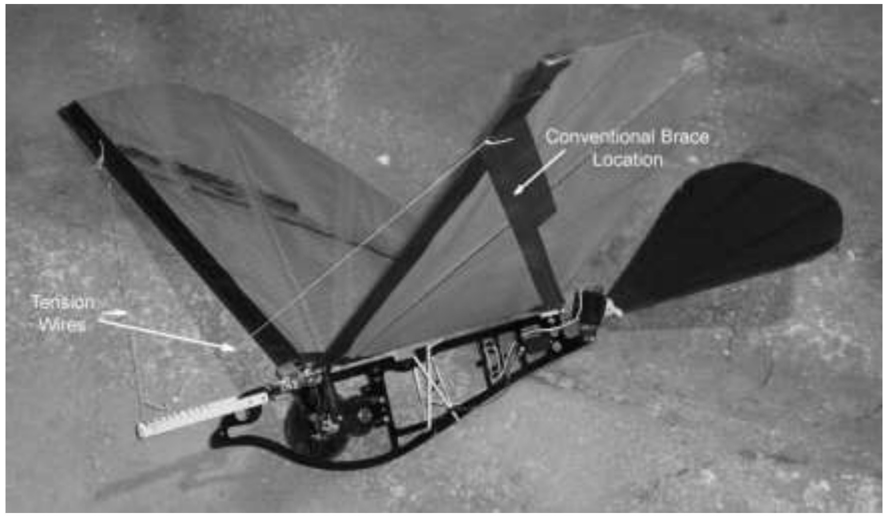
Back in 2008, I built a life-size, but very light weight, RC eagle that was requested by a client for an indoor flying demonstration. Originally I used some bracing wires on that model, because of its extreme light weight. It had a multitude of thin kevlar lines to stiffen all parts of the structure. That model never flew. However, I wondered if the wing tensioning cord, in particular, might have broader application.

My next experiment was to add bracing wires to an already proven design. I had a Kinkade Park Hawk at the time. I modified it by fastening a comb-like tensioning device onto the head. I removed the carbon wing braces from their sleeves. I tied a 100 lb kevlar cord, left over from my rocketry experiments, onto the wings and then hooked it onto the comb, drawing it tight. When I flew the model, it went right up into a stupendous climb, performing visibly better than the original wing.

The cord basically replaces the carbon bracing rods. It does the same job of keeping the wing membrane tight so it isn't too floppy. Despite this similarity, the cord-tensioned wing has major advantages.

Most importantly, the cord doesn't interfere with the aerodynamics of the wing. As Patrick Deshaye pointed out in his first edition of the *Ornithopter Design Manual*, the membrane wing should be allowed to conform to the surface of a cone. Any battens on the wing should radiate outward from the apex of that cone, which is the front, inside corner of the wing. This gives the wing a nice, cambered airfoil shape. The bracing rod used by Spencer and Kinkade tended to interfere with that cross section. The cord-tensioned wing has a better cross-section and more efficient flight.

The tensioning cord is also *lighter* than the carbon rods, and it allows the wing tension to be *adjusted*. Less tension is good for slow flight. However it comes with a pitch-down tendency that must be compensated. More tension is good for high speed flight.



Modified Park Hawk with tensioning comb and kevlar lines.

Crossbow achieves efficiency with cord-tensioned wings and sailplane-like body.

The cord-tensioned wing became the basis for the new Crossbow RC ornithopter kit, available from Bird-Kit.com, and I also use it in some of my servo-powered, robotic ornithopters. In newer models, I replaced the showy rooster comb with a more easily concealed tensioning device. There are many ways to adjust the tension on the cord.

New Research Grants Program

The Ornithopter Society is back. One of our goals in restarting this organization was to offer more solid benefits for members — instead of just a newsletter. The new *Research Grants Program* of the Ornithopter Society does just that. The society will now offer small grant awards to facilitate projects in key areas of flapping flight research. This will benefit the award recipients, and it will also benefit every member of the society, because it will help provide us with key information that we can all use to build better ornithopters.

The newsletter itself may seem anachronistic. When Patrick first started it, there was no other way to find out what was going on in the world of ornithopters. Now, we can easily stay current using the internet.The society though has a bigger role. The internet provides a lot of information, but the quality and accuracy vary. Making sense of it all is a big job. The Ornithopter Society uniquely can provide a single resource that provides an accurate and comprehensive introduction to ornithopters, both for the general public and those wishing to build ornithopters. We also have the role of documenting the history of ornithopters and making this information available for all who wish to know.

One aspect of the grant program is that it will help university students who want to get involved with ornithopters. For example, I have been in contact with many students in India who would like to complete an ornithopter research project in fulfillment of their graduation requirements, but they don't have what they need to get started. They might not have the financial resources to buy the needed equipment. They might not have access to proper materials, or they might not have enough guidance. The Ornithopter Society can make it possible for these enthusiastic individuals to get a project underway.

It might cost only a few hundred dollars for materials, to do some really significant new work that we can all benefit from. The modest costs can easily be covered by membership dues, and other contributions. If you have extra items that you would like to donate, such as RC gear, motors, or building materials, let me know what you have. Once you are matched with a grant recipient, you will be able to send the items to that person directly.

There will be some requirements for grant recipients. They will need to join the Ornithopter Society. They will also be required to write a full report on the sponsored research, which will be published in *Flapping Wings*, ensuring that all society members can benefit from the project. There will also be an application form that will help ensure the applicant is competent to complete the project and has a worthwhile proposal from which others can benefit. We will not fund any student who simply wants to build an ornithopter. Although I expect students will benefit from this program, I do not want to limit it to just students at this time. Hobbyists or individuals can also apply.

I am volunteering my time to provide technical assistance to ensure the success of these projects. Currently I don't have anyone to help decide which projects should be funded. If you would like to get involved in either of these roles, please let me know.

Nathan Chronister
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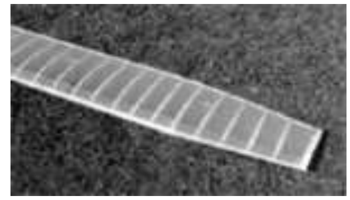
Example Projects



Francis Reynolds envisioned an efficient, airfoiled wing that could actively twist to provide the correct angle of attack for the upstroke and downstroke. What's more, the amount of twist could be adjusted for steering and different flight speeds. Reynolds' half-built ornithopter is in my basement. Let's see this amazing project brought to completion.

Flapping Rate Measurement: Develop a smartphone app that uses the phone camera to measure the flapping rate of

Flapping Wings

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