Flight Simulation of a Hawk

"flightagain"

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Abstract

This project is an attempt to create a simplified simulation of a hawk taking flight, soaring, and landing within VPython. The project started in October 2015 with little knowledge in how to use VPython.

1 Backstory

As a child, I have always observed the dozens of birds that existed within the wetlands beyond my backyard. Red tailed hawks were the most eye catching due to it's bright red tail and easy visibility in the day light (whereas owls were hard to see in the dark). Animal Planet (before the channel went to shows that aren't really educational) supplied me with many documentaries as to how birds worked and clips for me to observe with intense attention. I have seen red tailed hawks take off from trees about 15 yards away from me. Years later, the observed and learned knowledge is now serving a purpose through this project.

2 Background

The following subsections contain a general compilation of observation through my years.

2.1 Differences in Bird Mechanics and Human Mechanics

Most animals can move each individual limb on their own, but choose to synchronize movements to optimize the energy they spend. Humans (like most land animals) move in opposite movement; their left leg will move forward with their right arm and vice versa. Contrary to humans, birds are

more lateral. Their wings will move together as whole with a few feathers at the ends of their wings able to move individually. Legs move together in flight and on land movement; birds of prey often can use a leg independently to help in the feeding process. The tail works in conjunction with the wings, often spreading and narrowing with their wings. Contrary to the wings, the tail often works more in horizontal plane than any other plane.

2.2 Take Off

The most fundamental part of take off is the movement of the legs. While the wings and tail prep for flight, the hawk will coil its body toward the perch to build up energy in the legs. With the release of that energy by extending the legs fully, the wings flap with maximum surface area as the tail spreads wide to catch as much lift as physically possible. By the time the wings stroke down for a second time, the legs retract into the body to create a more aerodynamic shape. With a few more wing strokes, the bird is in air and needs very little energy to stay a float on the premise that the hawk uses maximum wing surface area.

2.3 Soaring

In order to maximize wing surface area, hawks do minimize the amount of wing strokes it takes. When changing directions, the hawk simply leans to one side or another for larger movements or uses its end feathers for more subtle movements. The slight shifting of feathers allow for the hawk to make turns without too much movement of the body. The tail is narrower compared to take off, but is still spread rather wide. The tail helps in changing the hawks location in the sky by allowing more or less air to go through. This negates the need to fold in the wings to drop any small distance.

2.4 Diving

When diving, the Hawk tucks its wings in without tucking them in all the way. Often creating a "w" like shape, the tail narrows to a point to allow for maximum vertical drop in the minimal amount of time.

2.5 Landing

After losing vertical height, the bird will snap its wings and tail feathers open to create as much drag as possible. Often flapping in the last moments

to slow them to a near hover, the bird will extend their legs to reach for the perch. The wings do not fully close all the way upon landing and the tail is often spread wide to help with balance.

3 Methods

Creation of this simulation will be done between my Windows personal laptop, the macs within the classroom, and possibly linux EWS computers. The simulation will be done via VPython. No computer components have been created at the day of October 26, 2015.

4 Timeline

This is a tentative schedule for the completion of this project.

- October 30, 2015 - Completion of the seminar
- November 6, 2015 - Completion of main frames for the hawk
- November 13, 2015 - Completion of a component on VPython
- November 20, 2015 - Completion of the hawk framework
- November 27, 2015 - The beginnings of the animation
- December 4, 2015 - Completion of simulation