**1-14-2010 Update**

**Solar Ray Conceptual Design - IMDL EEL 5666C - Robert Love**

**Summary**

A brief literature review has been performed to continue to evaluate the feasibility of robot sizing and flapping kinematics. The solar ray design had been extensively refined to include drag, torque, Strouhal number and initial power requirements. Much of the main structure has been purchased, however a design change toward the end of the week increased the overall size of the solar ray. Therefore this report contains few of the results of the initial design iteration. Initial efforts to program the board have started. The website has been set up at <http://ornithopters.wordpress.com/robotics/>.

**Initial Sizing and Layout Design**

Substantial adjustments were required to the initial sizing once the PVC was purchased. A single chamber design was made possible with the use of 2” PVC connections. The wing shape was altered substantially based on the available literature, especially that available investigating the Cownose Ray. The current design closely resembles the size of the Cownose Ray which has a wingspan of 0.5m, a chord of 0.15 m, flapping amplitude of 0.11m, flapping frequency of 1Hz and forward velocity of 0.6m/s. Documentation for the final report has been initiated including this material.

**Summary of Essential Calculations**

Calculations of drag, torque required and flapping kinematics were substantially refined this week. Substantial testing will be required to confirm the feasibility producing substantial amounts of thrust with flapping due to the unknown nature of the hydrodynamics involved. However, these calculations performed serve to provide proof that the concept is reasonable, although they rely on the concept that efficient flapping occurs around a Strouhal number of 0.3.

**Electronics**

Feasibility tests with servos, sensors and board on line are the most important to get started. Underwater servos have been ordered and the board from Pridgen-Vermeer Robotics has been received as shown below. While the waterproof servos purchased first do provide fairly high torque output (125 oz-in) and initial calculations suggested they will be sufficient, it is likely the design change will require larger servos to be purchased and waterproofed. Sensor selection continued this week and will most likely consist of: a CdS cell, 2 bump switches, 2 Hawkeye D11s sonar/depth sensors, a pressure sensor, an accelerometer, and a sensor to determine low battery. An onboard camera looking through clear PVC is under consideration, although if that doesn’t work an SLC-137 submersible camera with RCA out may be used to capture video. A working board has been demonstrated.

**Items Purchased (With Sources)**

All items purchased this week are documented below. A design change was made to incorporate threaded ends on both sides of the PVC tubing and to use clear PVC pipe to ensure visibility of the electronics and to clearly identify if leakages were occurring. The additional expense was deemed appropriate for these advantages. These design changes will also necessitate a slightly larger prototype.

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| **Purchases** |
| PVC tubing, connectors, silicone | 50 |
| Nylon Swimwear, thread | 30.25 |
| PV Board  | 128.1 |
| Board Programmer | 22 |
| Battery holders and 9V snaps | 28.03 |
| Batteries 16 2500 mAh batteries, 4 chargers | 60 |
| Servos | 60.93 |
| PVC connectors (threaded) | 16.97 |
| Clear PVC tubing | 49.97 |
| Total Spent | 446.25 |

**Planned Efforts (Upcoming Week)**

Calculations will be redone with the current PVC arrangement in mind. The wing design and power requirements will be refined. Sensor and servo purchases will be finalized.