Geocentrix Autonomous Glider

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Introduction

Problem definition

Everyday 62 weather balloons are launched and never recovered around Canada

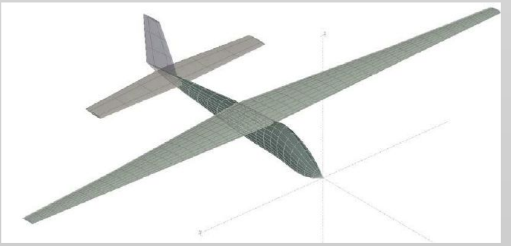
- Causing extra waste
  - Electronics and mechanical components
  - Latex Balloon
- Bad media coverage for Environmental canada
- Create extra cost for Environmental Canada because of the need of buying new electronic components for the weather ballon

Stakeholders

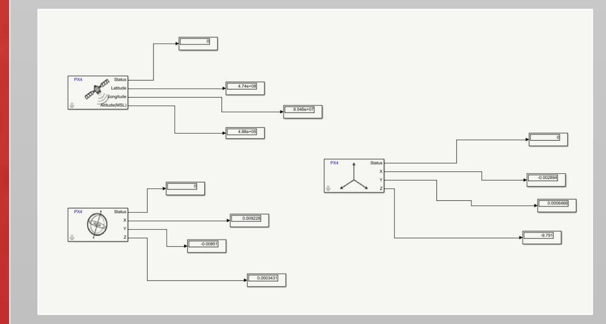
- Environment Canada
- Geocentrix
- General public

Solution

- Autonomous glider that retrieves components and lands in a secondary site

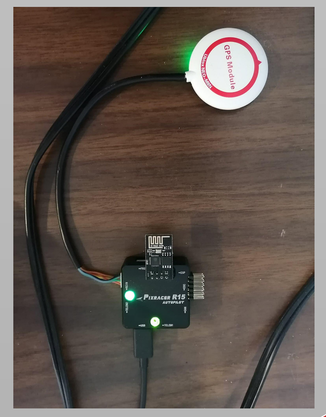


Hardware



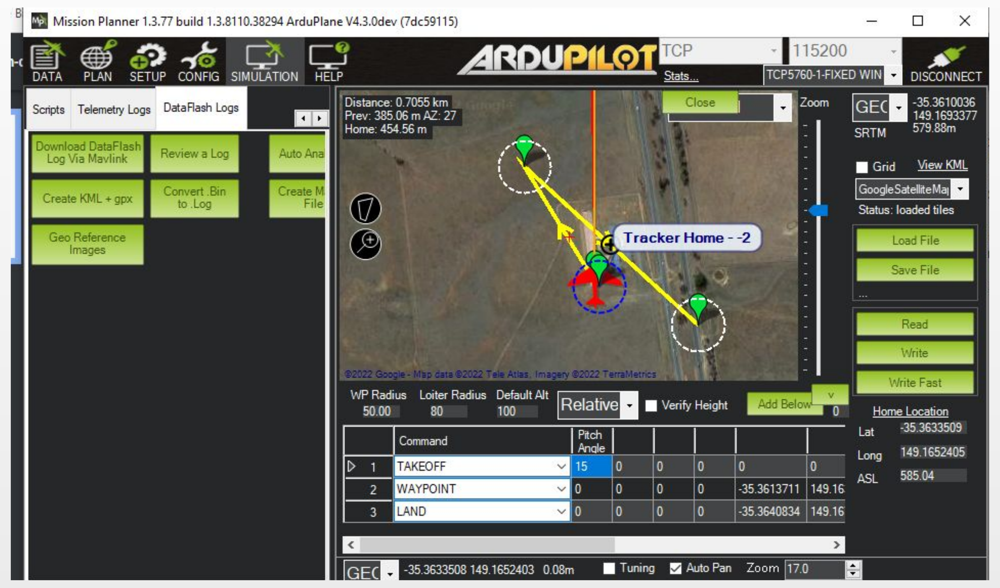
HITL Simulation

- shows GPS, accelerometer, gyroscope values
- simulate the movement of the glider based on sensors



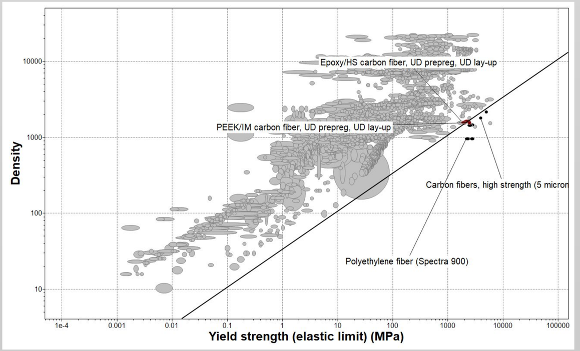
Pixracer R15 controller

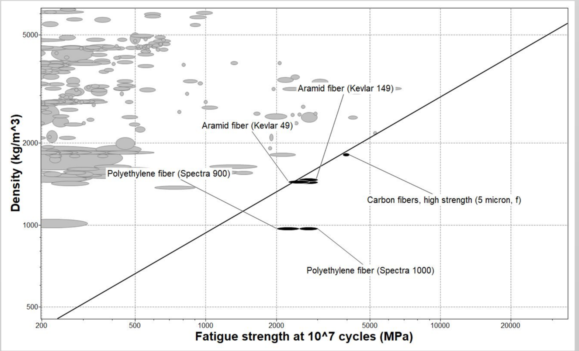
Software (SITL)

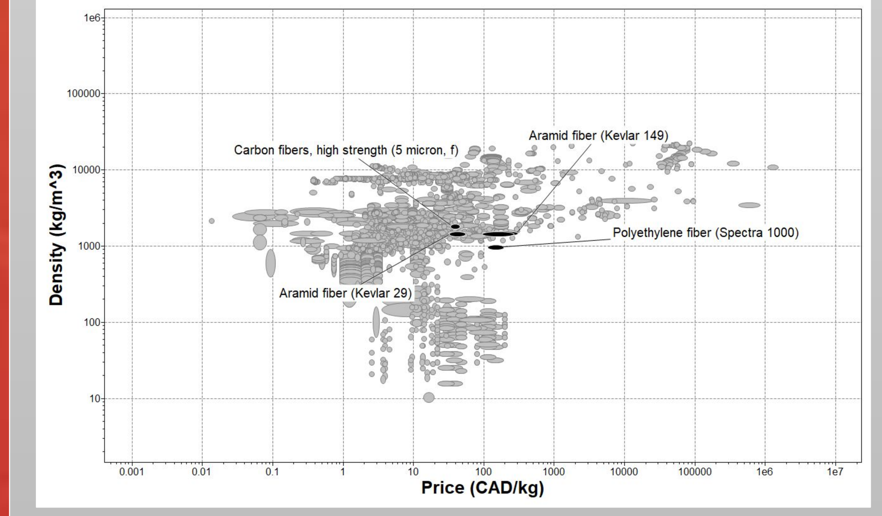


- Used Ardupilot Open source software
- SITL simulation enabled us to test our flight code based on ardupilot to control a computer modeled glider in a simulated world
- We would be able to see the behaviour of the flight code when tested in a different scenarios

Material Selection







Final choice:

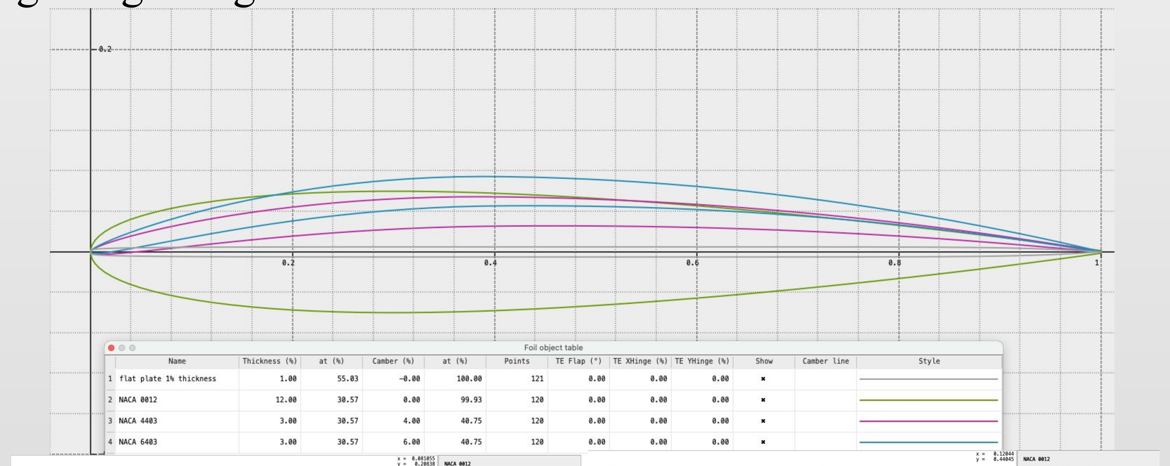
Carbon Fiber

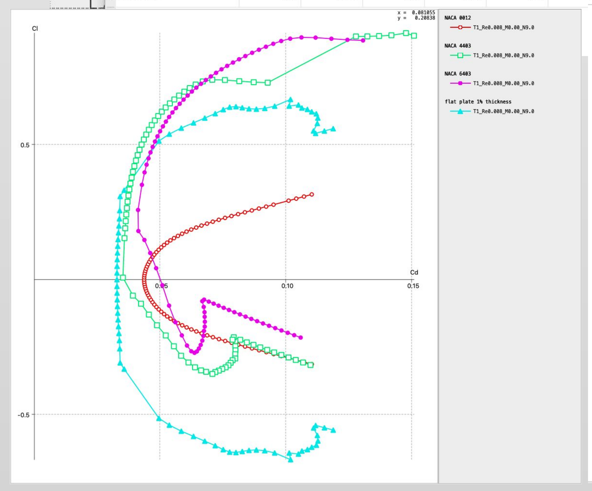
- Used Ansys Granta CES Material Selector
- Screened for materials that work between -30 deg C to 30 deg C
- Screened for non-brittle failure materials
- Graphs show best balance for low density, high yield strength, high fatigue strength, and price

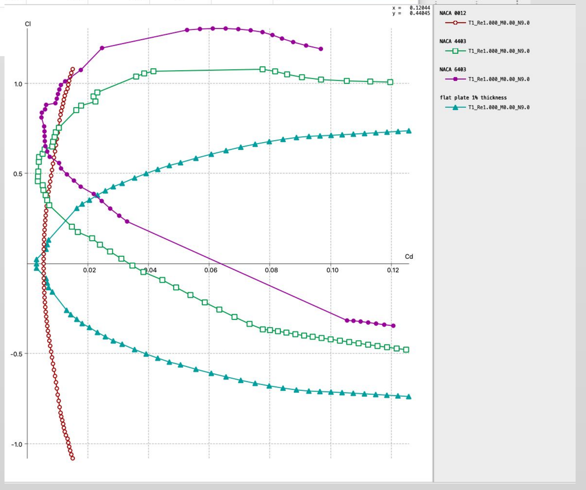
Mechanical

Foil Analysis

Using XFLR5 and Flow5 software we ran a foil analysis on 4 different foils over a wide range of Reynolds numbers with a focus on lower Reynolds numbers to ensure the foil would function at high altitudes. Running simulations on the NACA 0012 as a baseline, a 1% thickness flat plate, the 4% camber NACA 4403, and the 6% cambre NACA 6403, we were able to distinguish the characteristics that made an ideal foil choice for gliding at high altitudes

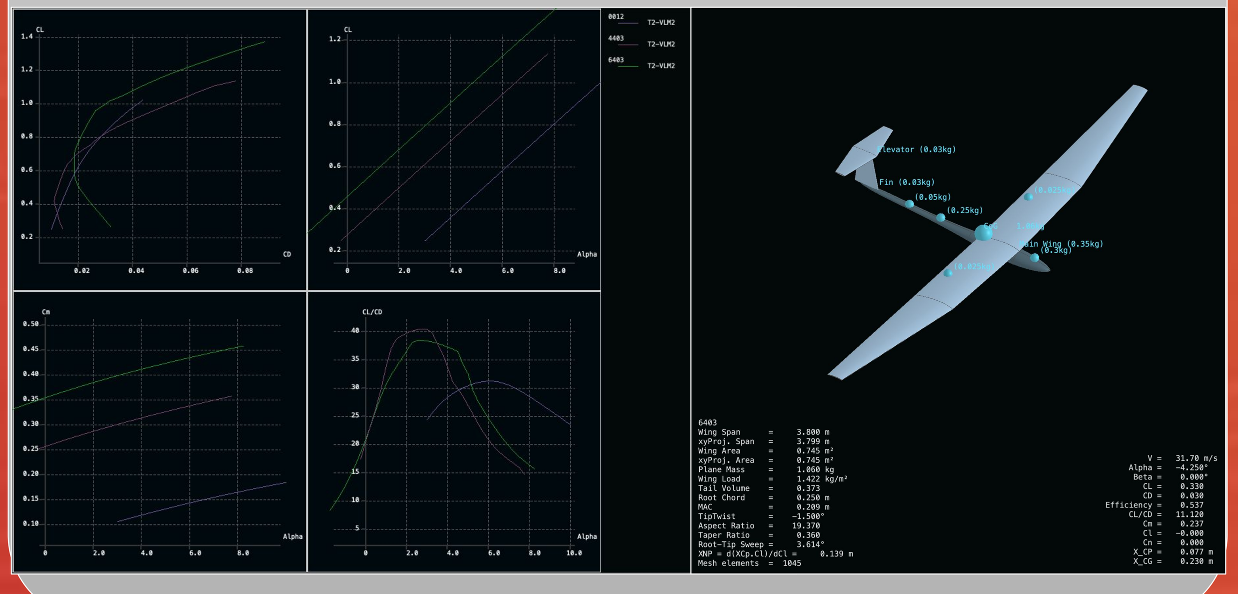






Plane Analysis

We then designed three gliders with the same dimensions and mass locations. Each glider had a different foil for the main wing. The three foils we used were the NACA 0012 as a baseline, the NACA 4403 and the NACA 6403 as they performed best in our foil analysis. Using the data we collected from our foil analysis we then simulated the three gliders at low air density. The simulation calculated the minimum velocity that would be required at different angles of attack to generate a lift equal to that of the force of gravity acting on the glider. From there we could compare the velocities as well as the lift and drag coefficients generated.



Conclusions

Impact of the project

- The autonomous glider can eliminate the cost of spending $2.5 million a year in weather hardware
  - Money saved can be spent in further research for Environmental Canada
- Reduction of 7920 kg of electronic waste per year
- Improvement of public image of Environment Canada
- Less waste of energy and resources to produce new electronic components for the ballon
- Components of the balloon that can not be re-used, such as the ballon, can be re-used

Next steps

- Add further hardware such as radio and wifi module
- Integrate mechanical and electronic/ software design
- Manufacture and test the physical prototype

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