Flying Forever

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The albatross can travel great distances with very little energy using a technique known as dynamic soaring.

Albatross courtesy of Alan Tate *www.aabirdpix.com*

Unmanned Aerial Vehicles (UAVs) are used for things like aerial mapping, surveillance, atmospheric observation, communication relays as well as various military applications. Many of these tasks could benefit from the ongoing or even persistent presence of a UAV or one with a practically limitless range.

Aircraft have the ability to harvest solar and wind energy during flight to give them more speed, altitude or electrical energy. By managing these energies and balancing resources against mission objectives, aircraft can benefit from substantially increased performance and the possibility of *persistent flight*.

This project will focus primarily on producing a framework for developing, assessing and deploying small scale fixed wing aircraft capable of managing their own energy resources in balance with their given mission objectives.

Can an aircraft be *truly* autonomous?

Can an aircraft *harness* the weather and use it to its advantage?

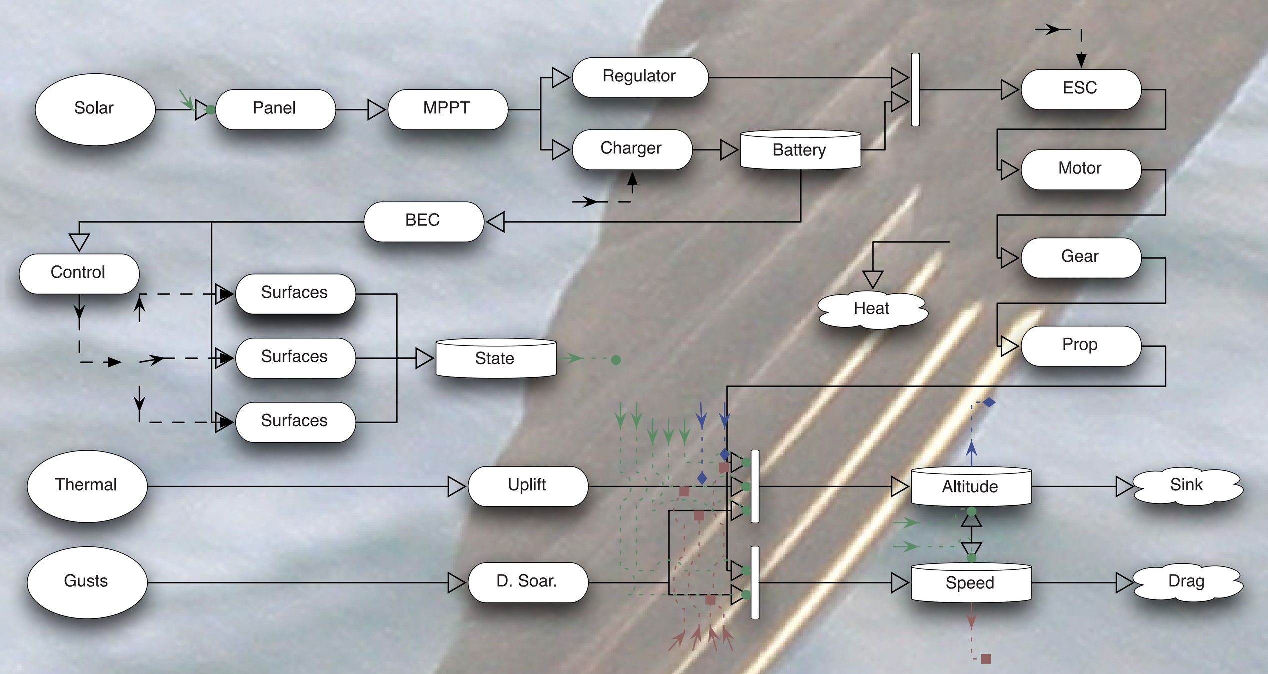
Can we fly *forever*?

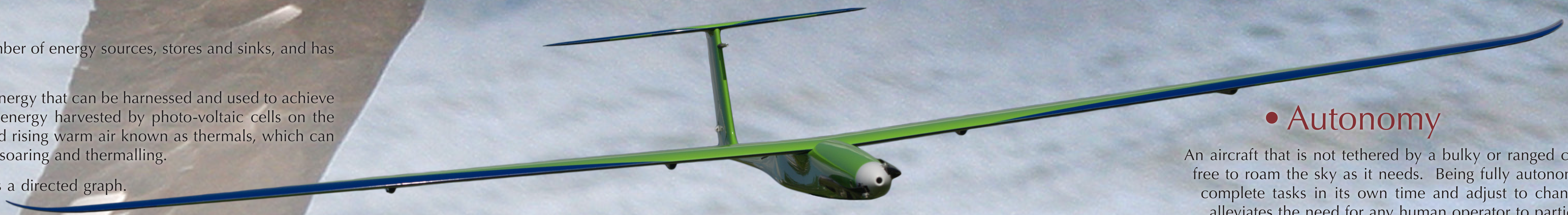
Modelling Energy Flow

Like any physical system, an Aerial Vehicle is comprised of a number of energy sources, stores and sinks, and has methods for transforming this energy over various states.

An energy source is external to the aircraft itself and supplies energy that can be harnessed and used to achieve various goals. This includes the sun which provides electrical energy harvested by photo-voltaic cells on the surface of the aircraft and air movement in the forms of wind and rising warm air known as thermals, which can provide speed and/or altitude via techniques known as dynamic soaring and thermalling.

The energy flow within an aircraft system can be modelled as a directed graph. Each node represents either an energy source, transitional device (like a motor), or an energy sink. The edges of the graph can be annotated with the efficiency of the energy transition.





Experimentation Platform

Experiments are performed on a commercially available airframe, the Alex F5B. The Alex F5B is constructed of and is made of composite materials to provide a very strong and stiff airframe. This airframe provides a very wide speed envelope allowing various techniques to be tested in various conditions. The motor is capable of pulling the aircraft vertically at 100 km/h, however this is only used in short bursts to gain altitude. While gliding, the propeller folds flat against the fuselage to minimise drag.

The current payload is an EagleTree inertial data recorder and transmitter allowing the state of the aircraft to be viewed live on a base-station. The data recorded includes GPS, air-speed, accelerations, barometric altitude, servo positions and current draw from the battery.

Wingspan	1.8 m
Weight	1.78 kg
Drive power	1.6 kW
Speed Envelope	40 - 300 km/h
Materials	Carbon/Kevlar/Glass

- ## Autonomy

An aircraft that is not tethered by a bulky or ranged communications link is free to roam the sky as it needs. Being fully autonomous allows an UAV to complete tasks in its own time and adjust to changing conditions. It also alleviates the need for any human operator to participate in long and tedious tasks.

- ## Efficiency

Understanding the flow of energy through a system allows it to be completely managed and accounted, leading to more efficient system.

- ## Long Endurance

With a low energy consumption, the potential to harvest energy from the environment and efficient use of available resources, UAVs will benefit from improved endurance and the possibility of persistent flight.

- ## Capability

An aircraft platform with an exceptional endurance is capable of flying great distances to remote locations. It can loiter for extended periods of time to provide relay or surveillance over a specific area. It could also cover vast areas while searching or mapping.