THE UNIVERSITY OF ADELAIDE STUDENT BRANCH OF THE AIAA

CHAIRPERSON'S REPORT 2003

As chairperson of the University of Adelaide Student Branch of the AIAA during 2003, I have been honoured to organise and participate in one of the club's most active periods in recent years in this, the Centenary of Powered Flight.

The ever successful 'Aerospace Careers Night' was conducted and attracted speakers from the Royal Australian Air Force, Aerostructures Australia and the Manager and Director of Apogee Imaging International, Mr John Douglas. The night was valuable in that all present learnt that although the Australian space industry is relatively small, through the right avenues (via satellite imagery and communications), Australia can become a major player in the industry in the near future.

The SpaceFutures Youth Space Conference 2003 was held mid-year in Melbourne and was another event attended by a handful of members of the University of Adelaide AIAA Student Branch. The conference provided a more in-depth perspective of the global space industry and allowed students to make valuable contacts with some of the industry's most experienced people. Having attended myself, I can strongly recommend anyone interested in SpaceFutures 2004 to make the effort and join in.

Unfortunately, the Mars Connection observatory visit to be held at the Douglas residence was cancelled at the last minute due to unfavourable weather conditions. (Better luck in 60,000 years time!)

The culmination of two years planning and hard work saw many AIAA members, through the UAV interest group, compete in the National Aerospace Design, Build and Fly Competition, held as part of global celebrations for the Centenary of Powered Flight. Our team achieved third place in a hotly contested competition, despite being the only team not consisting of students of aeronautical engineering degrees. Well done to all involved!

Lastly, I strongly recommend students upgrade their University of Adelaide AIAA memberships to full AIAA student memberships via the AIAA website. For a small sum of money, members will receive a year's subscription to the AIAA magazine and receive endless offers and courses to attend. Plus, upon completion of the degree, a free year's professional membership! Money well spent. To all the AIAA members in 2004, good luck!

Cowan Ashton-Theunissen

Branch Chairperson 2003

Program for 2003

Week/Semester	Date	Event Title	Time/Venue	Additional Details
Week 2, Sem 1	Thurs 13 Mar	UAV Group Meeting	1pm, S117, Engineering South Building	All welcome.
Week 8, Sem 1	Mon 5 May	Seminar: Determination of Operational Effectiveness of UAVs for Mining Exploration	5:30pm for 6pm, S112, Engineering South Building	Joint presentation: IEEE CAES Chapter, Adelaide University, AIAA Adelaide Section. All welcome.
Week 6, Sem II	Thurs 4 Sept	Seminar: The Future of US Planetary Exploration	5:30pm for 6pm, Flentje LT, Horace Lamb Bldg	AIAA Distinguished Lecturer Randii Wessen, NASA JPL
Week 7, Sem II	Wed 10 Sept	Aerospace Careers Night	6pm, S127	All welcome. $5 non-members
Mid-semester break	2 - 3 Oct	National Aerospace Design, Build and Fly Competition	Marulan Field, NSW	Best wishes to our entry, DUCK!
Week 11, Sem II	Wed 22 Oct	End of Year Drinks	4:30 - 5:30pm, unibar	Members only.
Week 12, Sem II	Wed 29 Oct	Seminar: Model Predictive Control, State Estimation and Coordinated Vehicles Speaker: Professor Bob Bitmead, Mechanical and Aerospace Engineering, UC San Diego.	5:30pm for 6pm, S127, Engineering South Building	Joint presentation: IEEE CAES Chapter, Adelaide University, AIAA Adelaide Section. All welcome.

National Aerospace Design, Build and Fly Competition 2003

To celebrate the Centenary of Powered Flight (1903 – 2003), and as a starting point for the longer-term UAV project, the AIAA Student Branch decided to participate in the Australian National Aerospace Design, Build and Fly Competition 2003.

The competition was held on the 2 – 3 Oct 2003, at Marulan Field, NSW.

The design requirements for the competition were to design a blended wing/body radio controlled transport vehicle to carry an emergency package (hereafter referred to as the payload) to the stranded crew of an Antarctic expedition. The blended wing body configuration can include a flying wing, or tailless, or tailed, or canard designs. The payload is represented as 4 x 400g net Dick Smith's Chicken Gravy packets of the dimensions 180 mm x 130 mm x 40 mm. The payload can be arranged in any particular configuration for carriage by the aircraft. The aspect ratio of the aircraft wing must be greater than or equal to a value of 2.0.

The aim was to achieve the highest wing loading and best payload weight-to-take-off weight ratio in a single engined vehicle. These performance parameters would be measured by calculating W/S x Wpl/Wto, with the highest value being declared the winner. The aircraft was to complete three specified flights in a 30-minute period on a single tank of fuel.

Project Inception

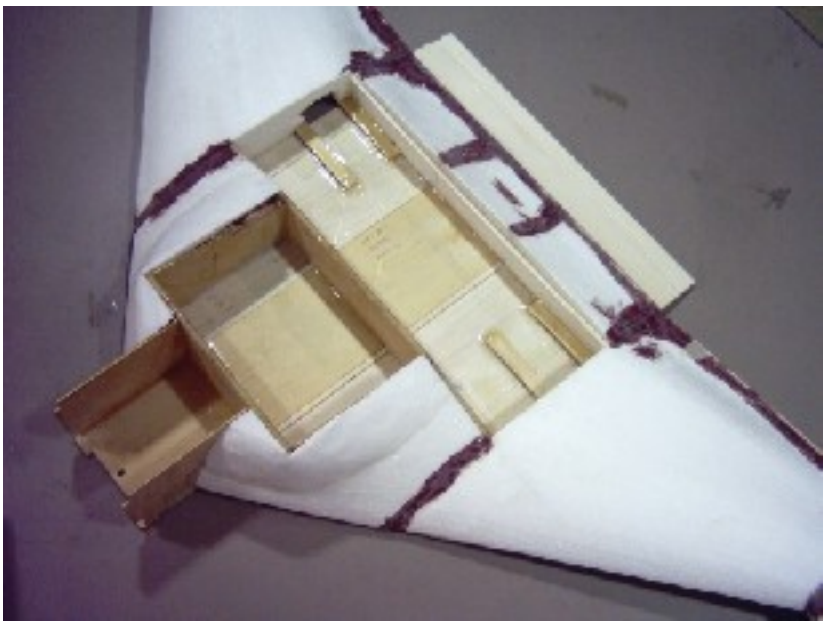
The design process began in March 2003 with two guest lectures. The first was given by Dr Gerald Schneider, AIAA Student Branch Advisor and Aerospace Lecturer, and discussed the basic concepts of aircraft aerodynamics. Mike O'Reilly, owner of Model Flight hobby store, and one of South Australia's most experienced aircraft modellers, gave the second lecture. This led to initial design brainstorming, some preliminary sketches and CAD designs, and experimentation with aircraft dimensions to maximize wing loading. A delta wing design was eventually selected due to its increased controllability over a flying wing, its natural blended wing design, a higher aircraft flight velocity, and the fact that it is a reliable, relatively well-understood design.

While the design was proceeding, six students were also selected as potential pilots for the aircraft, and began flight training on a Trainer F1 aircraft.

Construction

The delta wing aircraft was constructed from foam sections created using a hot wire cutter. These were then glued together to create the desired shape. A chassis was then made out of 3mm and 6mm ply and integrated into the foam structure to strengthen the main load bearing areas. The 485 ml fuel tank was custom-made from brass sheet.

"Micro balloons" were used as a filler material, which was sanded back to produce a smooth finish. The whole aircraft was then fibreglassed, both to strengthen the structure and also to protect it from the aggressive chemicals in the fuel.



Foam delta wing after joining, showing ply structure and payload bay.

Control surfaces were constructed from balsa with a paper and dope covering. Once covered and smoothed, all surfaces were finished with coats of gloss paint. Finally, the undercarriage, radio gear and propulsion system were mounted to produce the finished product, named “DUCK”.

The completed aircraft.

Design Features

The design includes a number of features from the original design as well as some modifications implemented after the test campaign. As per the competition requirements, the final result was a blended wing aircraft with as small a plan area as possible. To accommodate the payload dimensions efficiently, a low wing design with dihedral was adopted, as opposed to a high wing design. The tricycle undercarriage raised the aircraft high off the ground and had large wheels to accommodate the rough competition airstrip.

During taxi, a steerable nose wheel was used to allow lateral control. Wing-tips were included in the design to allow lateral stability at low speeds when the nose wheel was off the ground, such as at take-off, however, they proved to be insufficient, so dual tail booms with large vertical tail fins were added for low speed lateral control. During flight, control was provided by ailerons mounted on the trailing edge of each wing and a rudder mounted on the left rear tail fin. A large elevator was also added between the tail booms to improve vertical control.

Finally, a rear ballast was added, and the propulsion system was moved back into the airframe to balance the nose-heavy design.

Design Specifications

Wingspan	1.3 m
Length	0.705 m
Aspect ratio (actual)	4.7
Aspect ratio (competition calculation)	3.0
Area (actual)	0.3695 m^2
Area (competition calculation)	0.5742 m^2
Weight (empty)	2.9 kg
Weight (loaded)	5.0 kg
Take-off distance	~ 50 m

The Competition

Five members of the AIAA Student Branch travelled to NSW to represent the Branch and participate in the competition.

The University of Adelaide competition participants with DUCK.

In total, four teams took part in the competition at Marulan Field, NSW: the University of Adelaide, the University of Sydney, Royal Melbourne Institute of Technology, and Australian Defense Force Academy. Our team from the University of Adelaide was the only team to consist entirely of students who were not studying aerospace engineering! Showing the magnitude of the challenge presented by this competition was the fact that original entrants to the competition had totalled 8 teams, from 5 universities around the country. However, by the start of the competition these figures had been revised down to 4 teams, with one university not participating due to testing failures in their aircraft.

The evening preceding the competition, aircraft were judged, with each aircraft being assessed on presentation, build quality and other appearance-related items. Teams were also judged on a seminar presentation, poster, and team shirt. The University of Adelaide was very pleased to receive an award for best team shirt!

Scrutineering was carried out concurrently, with measurements of each aircraft's size and weight taken to determine each aircraft's performance scale - a measure of wing loading and takeoff weight which was used to determine which aircraft had the 'best' performance. Adelaide scored very well, with the smallest area, however we came third in takeoff weight.

On the morning of the competition, wind at the airfield was a less than ideal 10 – 15 knots, coming from the east and progressively swinging to the south, causing a cross-wind on the runway. The flight segment was set up so that each team would fly unladen, then with payload, then again unladen. Each flight was be separated by a break allowing for the other teams to fly that segment. Lots were drawn for flying order, and Adelaide was scheduled to fly second, however, a crack in the tail plane was found just prior to starting the aircraft, so we were delayed and went to make immediate repairs. During this time, the other teams flew, and Adelaide returned and made its first successful flight with no load.

The pilot for all flights (for all teams) was Mr Jeremy Randle from University of Sydney, who was the most experienced pilot available, and deemed most likely to achieve successful flights given the less than ideal weather conditions. Due to Adelaide's delay, the flight with full load was now scheduled to occur after all the other competitors had completed their flights. With promising take-

off run, DUCK took to the air again. However, the strong cross wind and insufficient airspeed combined with an excessively high rate of climb took its toll, leading to stall on the left wing, and resulting in a slow descent to the left that the pilot could not correct. This resulted in heavy contact with the ground, and the break-up of the aircraft (with loud cries from the crowd).

After such a promising run, DUCK came its end, scattered on the side of the runway. It was an unfortunate end, but not without some sense of satisfaction, as DUCK had been airborne, and had done so with the highest wing loading. However, being close was not quite good enough. The University of Adelaide was awarded third place, closely behind RMIT, with the University of Sydney taking first place honours.

Though saddened by the loss of our aircraft, it was satisfying to know that it had flown, and carried the payload aloft!

Sponsors

The AIAA Student Branch extends its sincere thanks to the sponsors who made our participation in this competition possible:

AIAA Evolution of Flight Campaign
Model Flight
JR Radio
Holdfast Model Aero Club
Thunder Tiger engines