Cambridge Autonomous Underwater Vehicle

Newsletter - Autumn 2009

CAUV

WELCOME

Welcome to our new quarterly update newsletter. We are moving into a new academic year looking to build on last year's work and grow as a team. We have a strong recruiting plan and hope to particularly expand the business area of the team over the next year. We are also looking to learn the lessons from our previous designs as we build a new vehicle for electronics and software development.

In the last year...

The last year marked not only a special occasion for the university, which entered its 800th year, but also an important step for the CAUV team. At the end of 2008 some key members of the project, including the teams founder Paul Esparon, graduated and moved on from Cambridge. The transition period could have been a testing time but we have come through it well. With the recruitment of many new enthusiastic members we have a team that will carry the project forward for many years into the future.

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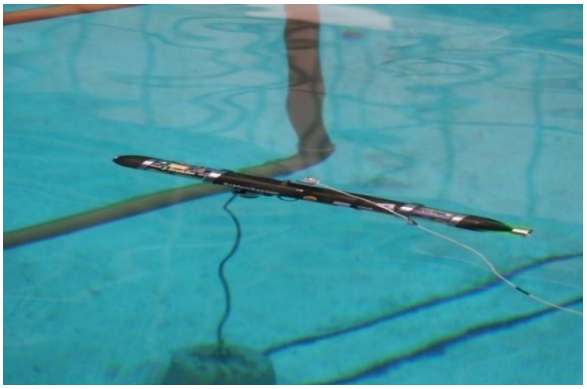
Development of the AUV, christened *Blackghost,* for the SAUC-E competition (Page 2) continued last year. The thin cylindrical chassis is largely unchanged from the previous year. The thruster sections, used to manoeuvre the AUV, were redesigned with some surprisingly powerful thrusters. The internal electronics racks were also redesigned to be more compact and provide a higher packing density. A sonar, kindly donated by Tritech International Ltd, has been fitted to give an acoustic picture to aid location. An inertial measurement unit, subsidised by Xsens, has also been fitted to supplement the existing inertial sensors. Finally, the software has been completely re-written in a distributed style.



Blackghost going through the validation gate

CAUV has been in the media spotlight many times this year, with a featured article in the 'Cool Projects' issue of Linux Journal, an article on the mini-itx.com website, an appearance on the BBC news and numerous appearances in university literature and websites.

Left: Testing Blackghost's thrusters at SAUCE-E '09

MEMBER PROFILE: SIMON CALCUTT

Simon has just returned from a year abroad at MIT to take on the role of CAUV Project Manager for 2010. Whilst in the US he was involved with the MIT solar car, focusing on the power management system, a job he was familiar with from the CAUV 2008 battery module.

SAUC-E 2009

MEMBER PROFILE: JON HANNAH

Jon joins the team as our new Business Manager. He will be focusing on recruitment and further increasing the team's profile.
Additionally, Jon will be using his experience of running Clare May Ball to help manage the project and let other team members focus more on building and testing the AUV.

The SAUC-E challenge requires the competitors to design and build an AUV that must complete an underwater assault course. Obstacles include a series of validation gates, submerged buoys and moving targets. No communication to or from the surface is permitted whilst the AUV is performing a competition run, so all sensor processing and decision making must be done on-board.

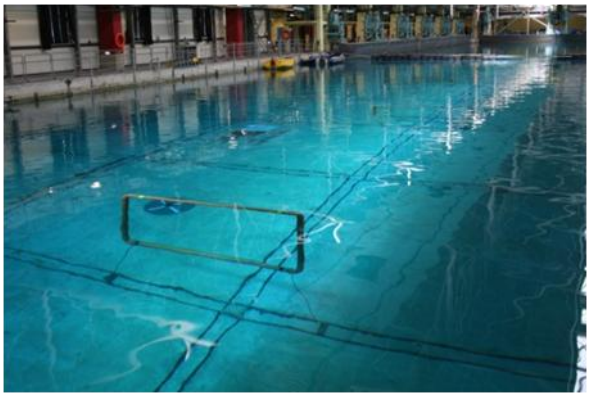
This year was the competitions fourth year and was held in Gosport at QinetiQ's ocean basin. It saw the largest number of entrants so far with some teams travelling from France and Germany to compete.

It's no secret that the CAUV team had high hopes for the 2009 competition. We were better prepared than in any previous year and had completed some successful pool tests before we arrived. The first couple of days of testing at the competition went well and the software was continually improving.

On the second afternoon we started to suffer some problems with our original, custom built thrusters. Fortunately we had considered this and had spare thrusters with us but they weren't ready to be used. After some hard work we managed to get them working but this then caused us problems with leaks. We worked through the problems and were making more progress but the problems had cost us pool testing time. By the time we reached our qualification runs the AUV was almost fully working again but the lack of pool testing had restricted our software development. Ultimately this meant that the AUV didn't perform as well as we would have liked and fell short of the points required for a top result.

Following the competition we are redesigning our hull and connector system to make it more robust. We are currently discussing the best design to pursue and hope to be able to reveal some sketches of the new hull soon.

The CAUV team at the SAUC-E 2009 competition

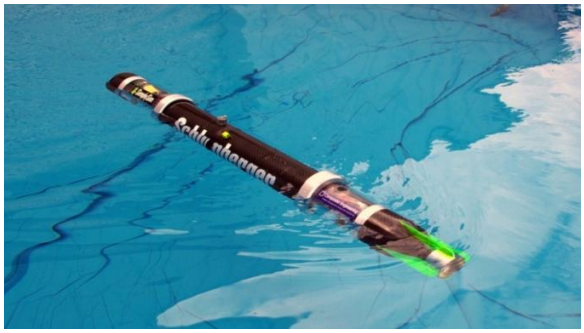


SAUC-E 2009 competition arena and validation gate

BLACKGHOST

Our current vehicle, named Blackghost, is the second AUV that the team has built in three years. Construction of the design was started in October 2007 and it was completed for the 2008 SAUC-E competition in July. Over the past year the vehicle has undergone a number of improvements, including new thrusters, a new battery module and a new software architecture.

The design of Blackghost is heavily influenced by our long term arctic goal of being deployable through a bore hole. This has driven the torpedo shape of the hull which is 10cm in diameter and 1.2m long. It is controlled using a 100W main motor and rear propeller to drive it forwards and four internal vector thrusters for manoeuvring. They are arranged in two sets with one vertical and one horizontal thruster at the front and back. This design makes the AUV very manoeuvrable and the internal thrusters don't require any extruding parts that would make bore-hole deployment difficult. The original design contained extremely compact, custom built, rim driven thrusters which were based on a brushless motor design. They were designed to be extremely compact and waterproof without the need for a lip seal. Unfortunately after a year of use their performance started to degrade so they were replaced by commercial thrusters at the SAUC-E competition this year.



Blackghost in a small tank for ballasting at SAUC-E '08

The computer that provides most of the processing power is a very small form factor PICO-itx. This a motherboard with a 1GHz processor and provides 1GB of ram within a footprint measuring 100x72 mm. Extra processing power is provided by two 16-bit PIC microcontrollers built into our custom inertial navigation unit. The first uses data from accelerometers, gyros and pressure sensors to provide an estimate of the AUV's current position. The second PIC is used to control the motors and implement our low level control loops and autopilots. To aid navigation the AUV also uses a Xsens MTi which uses a 3D compass and gyros to calculate the AUV's orientation and turn rates.

THE FUTURE

We have developed a 5 year plan to reach our ultimate goal of arctic deployment:

- Year 1: Building a new hull for software and electronics development.
- Years 2 & 3: Developing a prototype vehicle equipped to deal with the extremes of the arctic and entering the US AUV competition, AUVSI.
- Year 4: Construction and testing of the final mission-ready vehicle.
- Year 5: Expedition to the arctic for scientific research.