LED Strobes

the challenges of getting high power at a fast recharge rate

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- Introduction
  - CSIRO has for many years assisted the fishing industry by providing biomass estimations using techniques that combine acoustics with photographic and video imagery. We call this our AOS – Acoustic Optical System.
  - An important part of understanding the relationship between the acoustic reflectance of a fish is to know its length.
  - We use stereo cameras to take “pairs” of images which we process via 3rd party software. This gives us the fish length and inclination for a fish and we relate this to a corresponding target strength from multiple echosounders.

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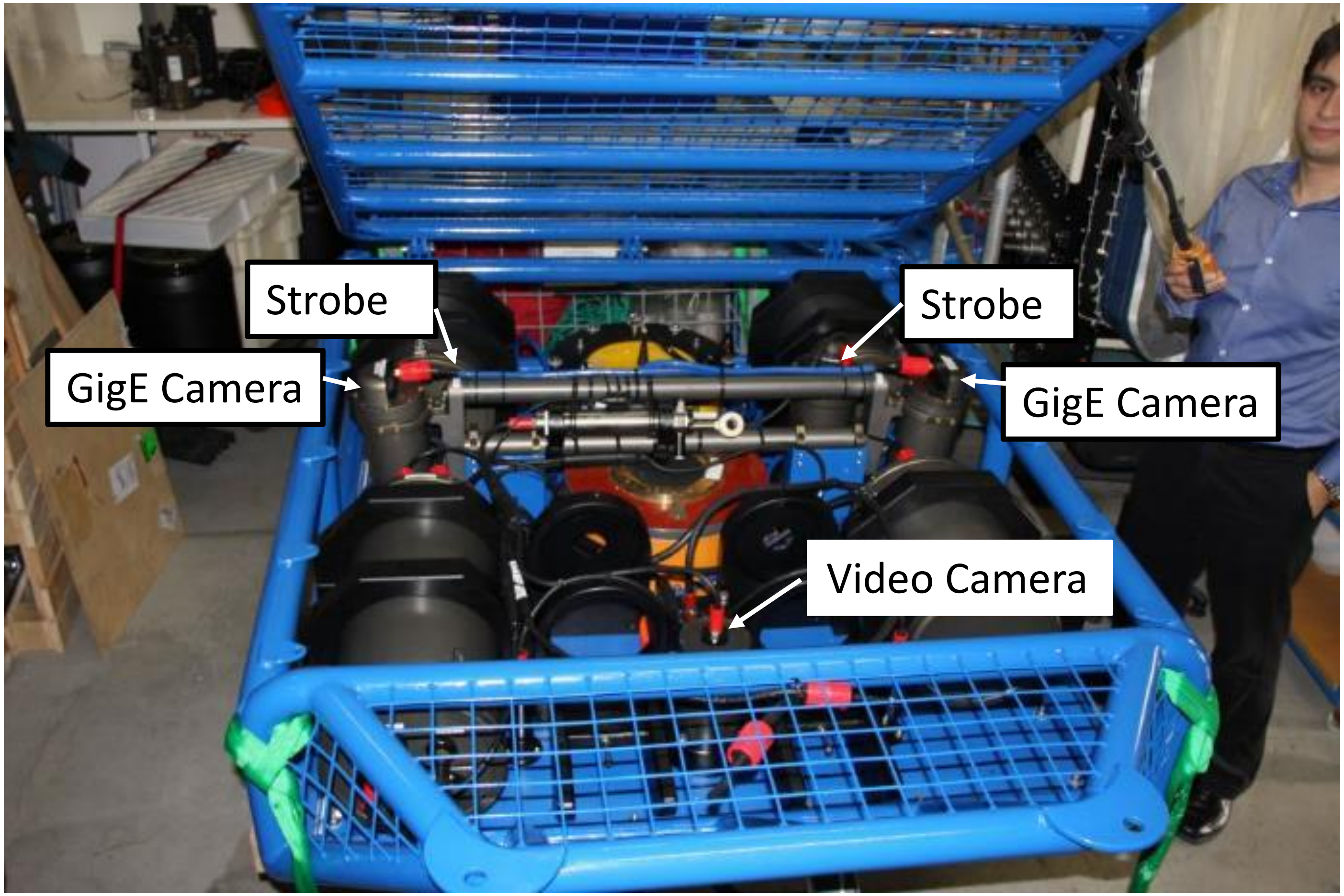
The AOS System



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- Once we know the relationship between the acoustic reflectance (target strength) compared to fish length we fly our system over spawning aggregations.

- By converting our targets to mass and adding them together, we achieve a biomass estimation which, when repeated over several years, can assess if the abundance is changing and management strategies can be applied.

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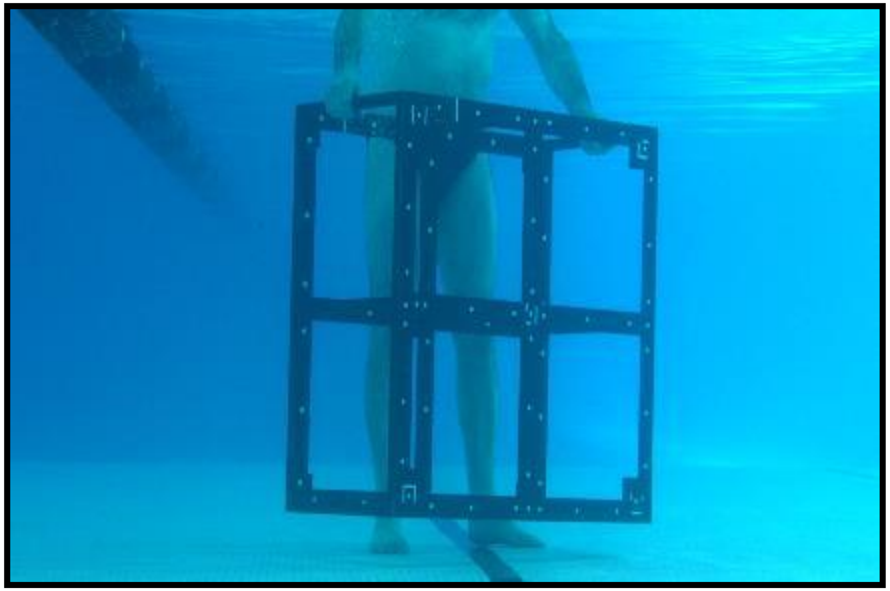
- The AOS System

A PC detects targets and issues commands to the stereo cameras to take a photo.

These are conventional cameras mounted on a frame with a slight offset so the view ports overlap at 5m.

We calibrate in a swimming pool using a cube with measured targets.



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- One of the problems we have is to ensure certainty that the target is the same as the one in the image. Ideally we need only one fish above the seabed. If there are more, there is some uncertainty as to which image corresponds to which target.

- Here is is an image and although it looks great it has little scientific value.

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Too many fish

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Another Problem: Two fish close together might appear as a single fish

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- Too many and mixed species.

LED Strobes – some background

- It’s not uncommon to take over 3000 photos in a commercial trawl and maybe we’ll only get a few scoreable shots. We need :-
- Fish centred in the beam
- Only one fish
- Must be off the seabed
- Both Port and Stbd Cameras must have the full fish in frame
- To get an image like this…

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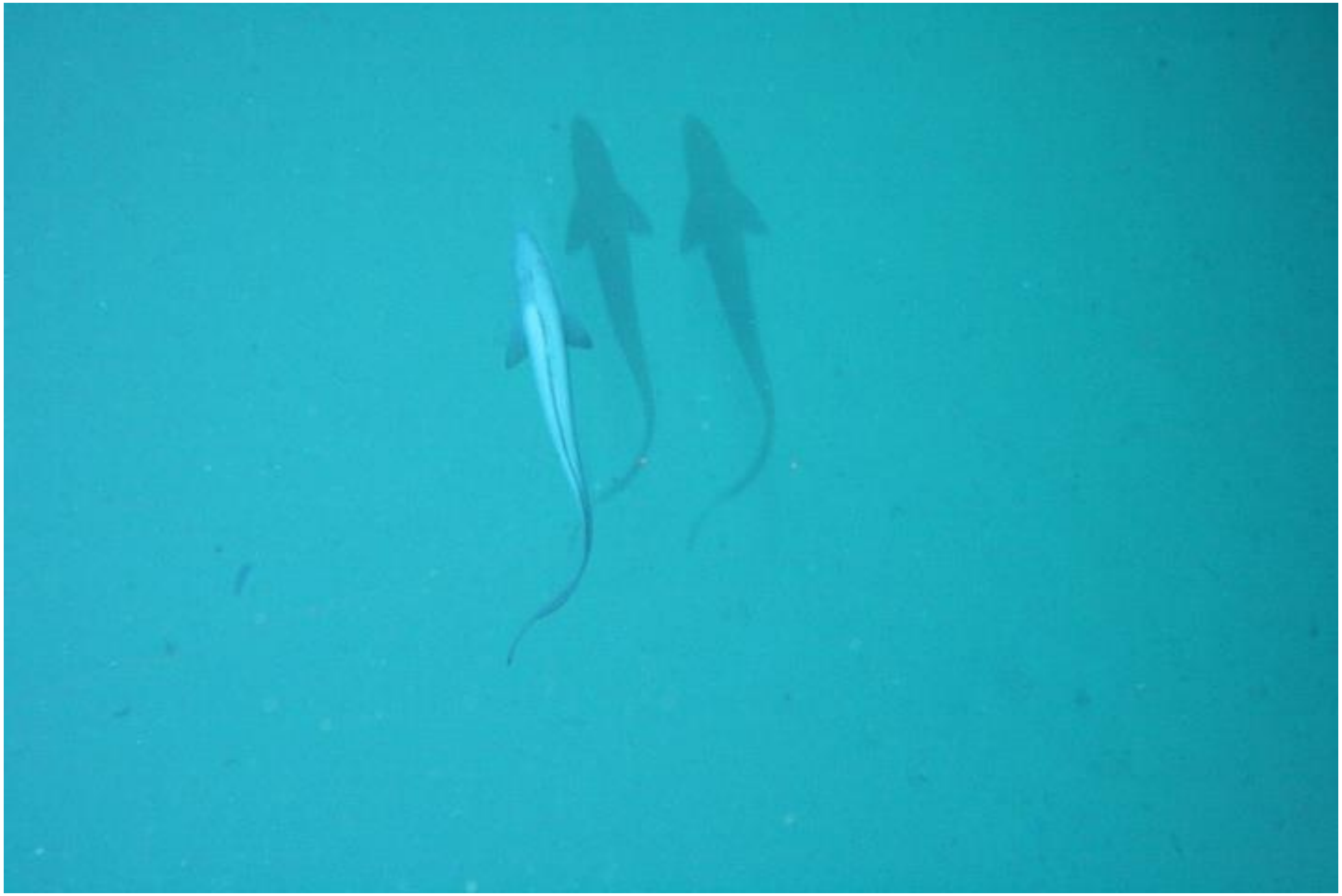

It’s a shame it isn’t an orange roughy!

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To get a scoreable shot we need to:-

- Take a lot of photos as the net is moving at around 5 knots (2.5m/sec).
- Take 4 shots/sec (i.e. 4Hz) to capture enough images so we can track the fish as it progresses through the echosounder beam.
- It's hard to find a strobe that can recharge at this rate and deliver a lot of power. Discharge lamps generate a lot of heat and eventually fail.

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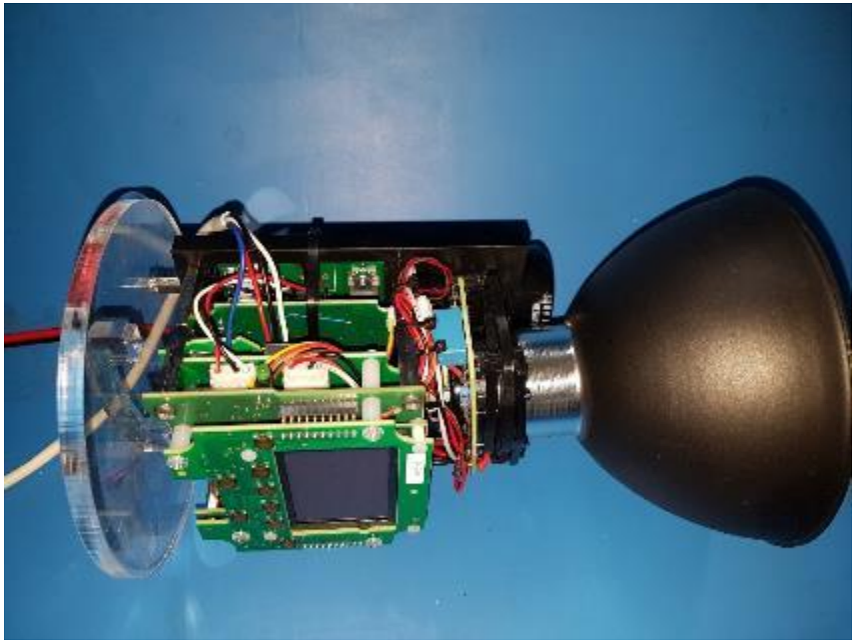
- We converted a Quantum strobe to fit into a pressure canister. We had to hack into the control circuit to force it into manual mode on start-up.



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Additionally, the AOS has a video system with fixed lighting. There are latencies between triggering and strobe activations which means we can't always reduce the shutter speed as much as we'd like.

The duration of the strobe illumination controls the quality of the imagery.

If it's too long the video lights will bleed into the images and cause blurring.

LED Strobes

- Although there are a few companies that produce LED strobes, we found that they were extremely expensive and it was doubtful that they would have the power that we need to fully illuminate a fish at up to 8 metres in water at 1000m.
- We bought a couple of LED arrays and started some experiments to see how much power we could achieve with a short duration pulse using a signal generator and a FET.

A LED array can have over 396 LEDs and produce over 19000 lumens. They are very bright but the heat needs to be managed.

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We have previously used a reconfigured Quantum Qflash Trio, which will happily run at 1 Hz at full power, but if the duty cycle increases we have to reduce the power. Some of the other commercial strobes could achieve this but would eventually overheat and fail.

We performed a comparison with this strobe and a Luminus CXM-32 COB array.

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LED Strobes…. the who's who in our team…

- Laurance Papale was a 4th year engineering student who performed most of the testing and hardware design with support from one of our senior engineers, Jacques Malan.

- Nicole Morgan wrote the firmware for the control circuitry. The pulse lengths can be reprogrammed via a serial link should we need to do this.

- We built a system with 5 arrays. Our mechanical engineer, Andrew Fillesti, managed to tweak the middle array so that we could fit the new strobe into an existing housing. This saved us a lot of work when testing the prototype.

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The first task was to see if a LED array could produce the same amount of power as a conventional discharge strobe. This was the easy part, although there is an obvious difference in colour temperature.

Quantum Qflash Trio

Luminious LED Array

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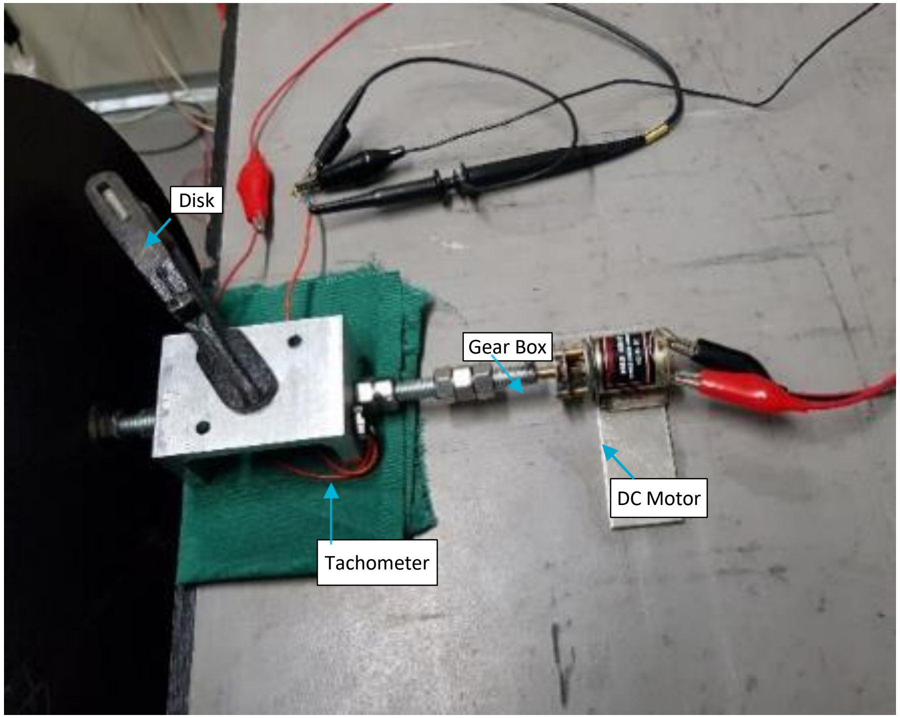
The next step was to see how our imagery was affected by movements. Our first jig had a motor with a large disk with targets painted on it. The speed was measured with a tachometer.



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- The targets painted at different radii. This gave us a range of angular velocities. The pulse duration was adjusted to give best resolution. In our case 1 mSec appeared to be optimal. Anything slower blurred the detail.

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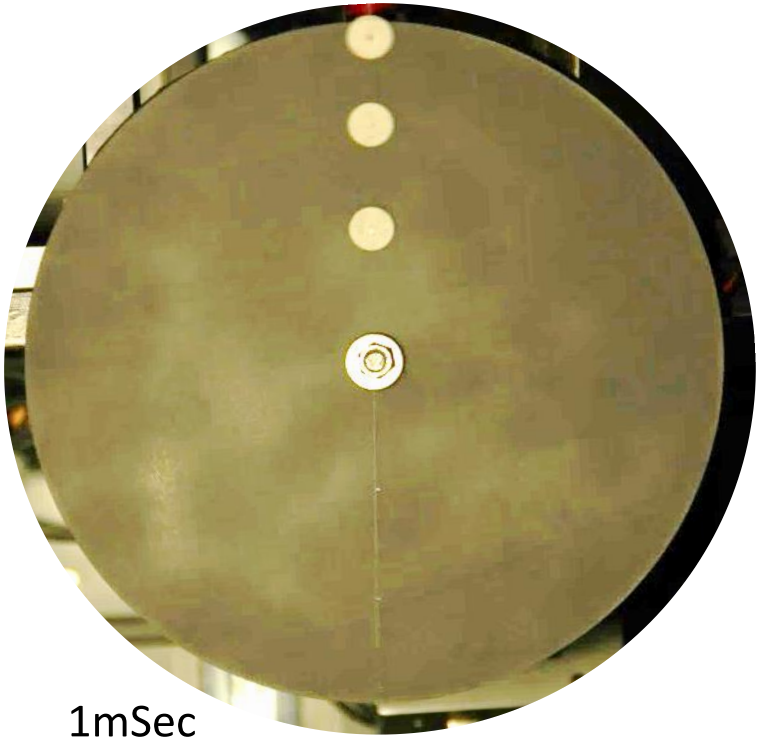
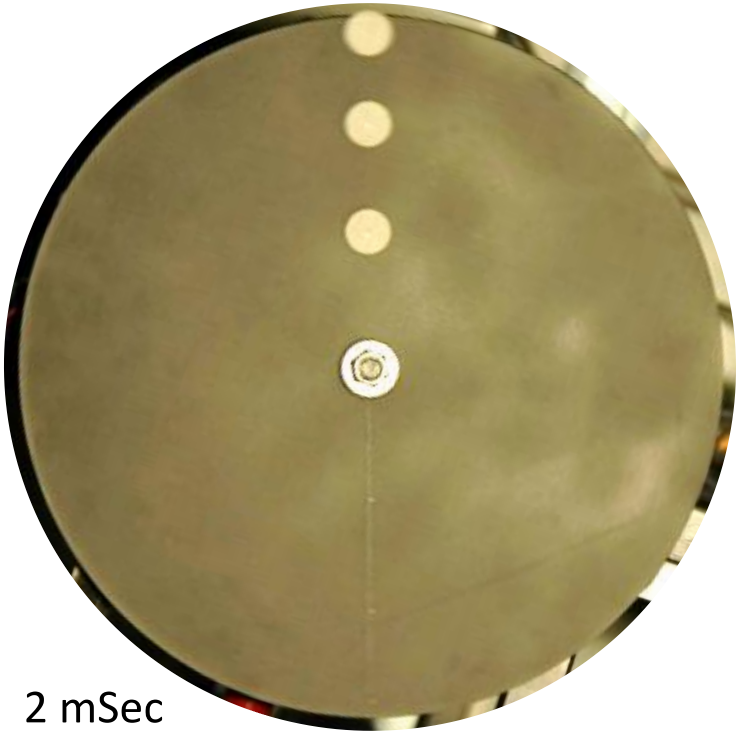
The dot in the outer ring becomes increasingly blurred as the duration increases.



1mSec



2 mSec

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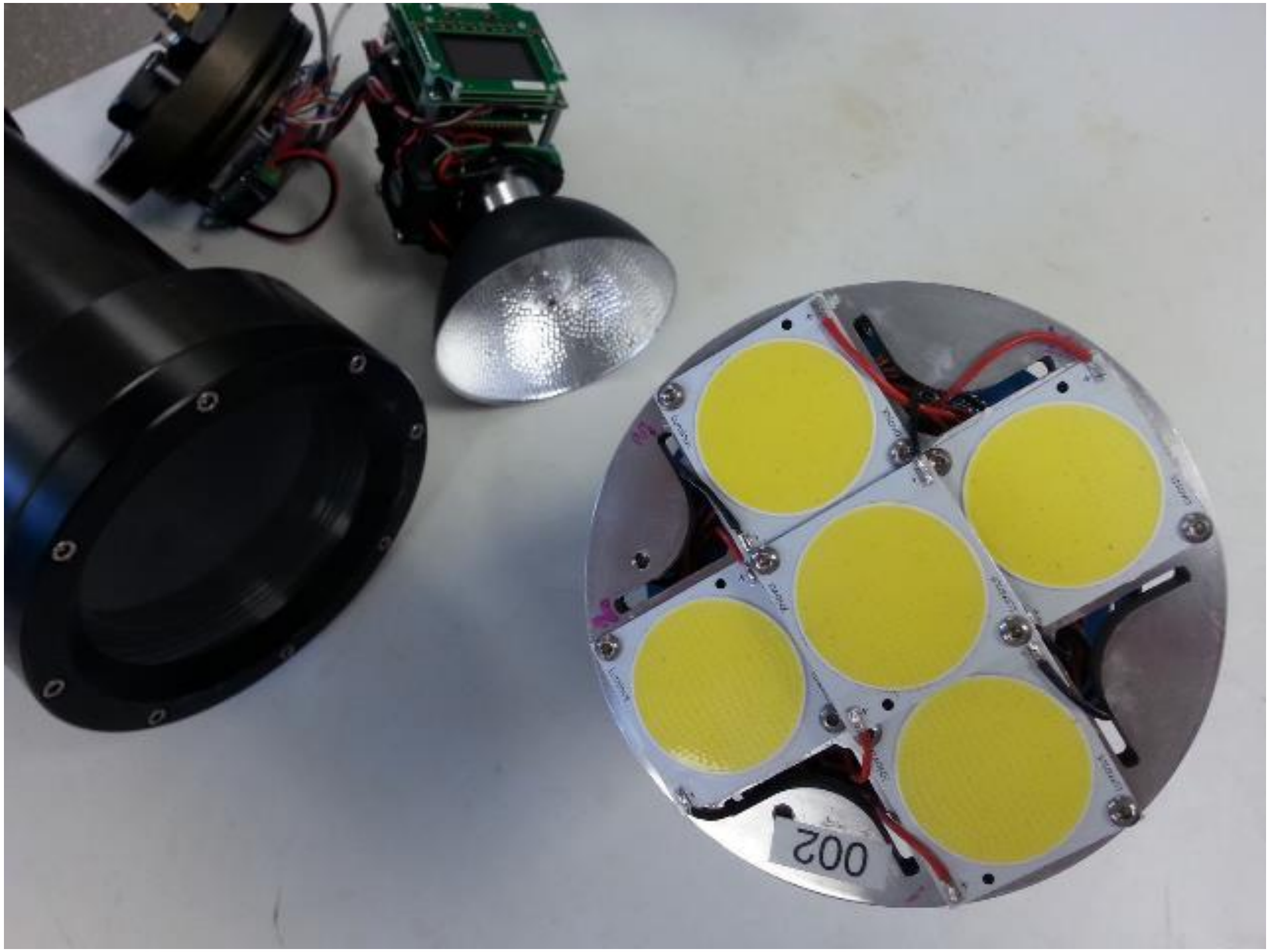

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- Testing. We would have liked to show you some comparisons. We've tried to deploy this on two occasions and both times the vessels have had problems with main engines. We've had to return to port without testing.
- We don't know how the flash will look without a reflector. We may have to address this if the light is too dispersed.
- We will probably need to tweak for colour temperature. The LED arrays can be changed to accommodate this.

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CSIRO is always interested in working with partners.

If you have any experience or would like to discuss collaboration please give me a call.

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Any Questions?

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Thank you

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