Catalyst

Journal of the Amateur Yacht Research Society

NUMBER 48 OCTOBER 2014

How to supply information for publication in Catalyst:

The best way to send us an article:- an electronic (ascii) text tile (*.txt created in Notepad, or Word, with no formatting at all, we format in Catalyst styles). Images (logically named please!) picture files (*.jpg, gif, or *.tif). If you are sending line drawings, then please send them in the format in which they were created, or if scanned as *.tif (never send line drawings as JPEGs because it blurs all the lines)

Any scanned image should be scanned at a resolution of at least 300 ppi at the final size and assume most pictures in Catalyst are 100 by 150mm (6 by 4 inches). A digital photograph should be the file that was created by the camera. A file from a mobile phone camera may be useful. Leave them in colour, and save them as example *clear_and_complete_title.jpg* with just a bit of compression. If you are sending a CD, then you can be more generous with the file sizes (less compression), than if emailing, and you can then use *.tif LZW-compressed or uncompressed format.

For complex mathematical expressions send us hardcopy or scan of text with any mathematical characters handwritten (we can typeset them), but add copious notes in a different colour to make sure that we understand. We can also process MS Equation and its derivatives. Include notes or instructions (or anything else you want us to note) in the text file, preferably in angle brackets such as <new heading>, or <greek rho>, or <refers to *image_of_jib_set_badly.jpg*>.

Otherwise: — If you write in longhand, and sketch or include photographic prints, and trust to snail mail (a copy, never the original) then all can and will be dealt with in due course. If you have trouble understanding anything in this section, email to ask.

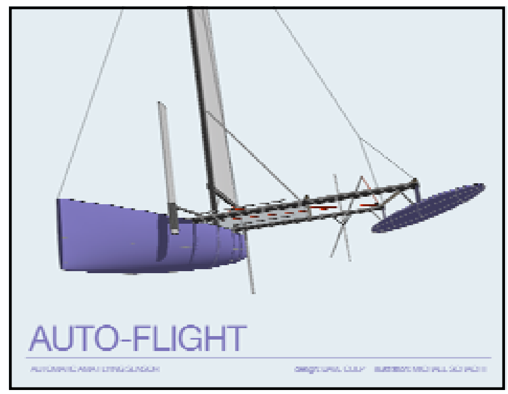
As examples, the polar diagram p16 of *Catalyst 28* was re-created from a second generation photocopy, photos of shunting in the Champion article in *Catalyst 27* (pp 19-21) were screen grabs from a video supplied on DVD. The rest of the images in that article were scanned from photographs, and the text was OCRed (Optical Character Recognition software) or keyboarded.

Send a copy of your work (copyshops can scan to file and email for you):

by email: catalyst@ayrs.org,
by post: Catalyst, BCM AYRS, London, WCIN 3XX

Features

Regulars



Dave Culp prepares for trials of his AutoFlight system

(Photo: Chris Luomanen)

Catalyst

Journal of the
Amateur Yacht Research Society

Catalyst is a quarterly journal of yacht research, design, and technology published by the Amateur Yacht Research Society, BCM AYRS, London WC1N 3XX, UK. Opinions expressed are the author's, and not those of AYRS. AYRS also publishes related booklets.

Contributions are welcome from all. Email them to **Catalyst@ayrs.org**, or send (at your risk) disks or typed copy with illustrations to the Society's office. AYRS can take no responsibility for loss or damage in the mail.

AYRS subscribers receive both *Catalyst* and the booklets. Subscription for paper copies is UK£20, Overseas UK£25/US$35/Eur35 per annum, worldwide for downloaded copies £10/$15/•15. Subscription requests and all other queries to be sent to the AYRS Office, BCM AYRS, London WC1N 3XX UK, email: **office@ayrs.org,** or can be purchased through the website **www.ayrs.org**.

AYRS is a UK Registered Educational Charity (No 234081) for the furthering of yacht science.

Website: http://www.ayrs.org

ISSN 1469-6754

AYRS needs your email address

As I remarked in an early Catalyst (No 2 I think), sometimes the day job has to take precedence over doing things for AYRS; and that is how it has been this past year for me. I bitterly regret that I have failed to get out a Catalyst since last January, but until someone, who has the skills and knowledge to keep Catalyst going to the standard Tom Blevins (the first Editor) set me, comes forward, you're stuck with me for the moment.

However your Committee recognises that things may have to change, probably in the direction of making more use of the website to publish articles so that they can be read while they are still topical. Even as I write, there are people working out how best we can do that; but it will take a while, and probably a few trials, before we can launch an online "magazine" on the world.

In the meantime however, a quick count shows that some 40% of our readership either do not have Internet access, or have not told us what is their email address. We're going to need that information so that when the new website system is up and running we can contact you and invite you to join in online. So, if you have email, but receive Catalyst on paper, please could you email us at office@ayrs.org and make sure we know what your email address is.

If you do not have email (and I know there are a substantial number of people who do not, either because it's not readily available, or because they don't need it) then fear not. As long as I am in this seat paper copies of the magazine will continue to be available.

But for the rest of you, if you have not already given us your email address, please do so now.

Thank you
Simon Fishwick

Payments to AYRS in US Dollars

As a consequence of the death of Frank Bailey, AYRS US Treasurer (see page 17), AYRS US$ bank account has been closed. The only way now to pay your subscription in currencies other than GP£ is though AYRS' PayPal account. We accept payments in US$, Euros and GB Pounds, and PayPal can be used with your credit card even if you do not have a account yourself. Further guidance will be found on the AYRS website, www.ayrs.org.

AeroJunk

Paul McKay

We all know what a junk rig looks like – a heavy fully-battened lugsail – and that it reefs easily, is seaworthy but performs poorly to windward. It also requires an un-stayed mast to work properly. But once hoisted it is wonderfully easy to sail in any wind. (Though a noisy pest in a swell with no wind when it bangs and slats against the mast.) Above all, Junks are a Fail-Safe design. If something breaks then gravity brings the sail down.

Blondie Hasler and Jock McLeod brought to the West the notion of fitting the Junk Rig to modern plastic boats and evolved design parameters to make that possible. Efforts have been made over the years since the Seventies to improve its windward ability. These all involve methods for adding camber to a sail that was held flat because of the battens. Hinged battens and double, curved (wishbone) battens placed to one side of the mast have both been tried. Both worked and delivered an upwind performance much like a normal lugsail but anything mechanical like a hinge can and eventually does break so hinged battens have quietly subsided. Meanwhile the Bermudan rig reigned supreme.

The wishbone junk did not take off so most modern attempts have concentrated on splitting the lugsail at the mast to make two sails on the same straight battens. Now to give camber the individual panels between the battens are shaped and sewn like sections of a barrel so that when held parallel the extra cloth pillows outwards on each tack. The Split Junk sail now echoes the jib and main of the Bermudan with jib vents similar to those seen on sports parachutes. These accelerate air over the lee-side of the mainsail in a similar way to the Bermudan "slot-effect". Pillowed Junks do work but are very complex to cut out and sew then join to the battens.

In the pursuit of simplicity I decided to resurrect the wishbone batten concept, this time with two sails to try and reproduce the windward ability of a standard Bermudan. My sail-plan is a balanced rig that rotates about the mast, a type of fully battened AeroRig. With this rig both sails are made from flat

cloth, simple enough to be made from plastic tarpaulin. The jib is self-tacking, with the leech free to blow from one side of the batten to the other on each tack (on my boat a distance of 600mm or 2 feet.) The main luff is held centrally between the battens behind the mast with the body of the sail free to blow to one side or the other.

In practice both sails follow the batten shape to take up a typical NASA profile with the greatest curve in the first 3rd of the sail. (Note the batten shadows on the mainsail in the photograph that demonstrate this statement) In addition the whole rig cants out to leeward from the top of the mast making the sails slightly more vertical than the heel of the boat.

The wishbone battens are effectively a single batten split into two, placed on both sides of the mast then formed by fastening the rear of the battens to the leech of the mainsail, spacing the battens apart in front of the mast with a Stainless Steel rod that also serves as a slide for the leech of the jib then joining the fronts of the batten with a plastic tube to which the luff of the jib is attached. The complete batten is held in compression by the S/S rod and tension from plastic cable ties through the luff of the mainsail immediately behind the mast and the jib luff tube: simple, cheap, effective and for the whole of last season, reliable.

In order to develop this rig I converted an Etap 23 lifting keel sloop called *Miranda*. This boat was designed with a fractional rig that allowed me to place the new mast in the same longitudinal position as the original. Because of the keel case supporting the original mast I had to place the new mast socket tube alongside and offset to port. This came down through the bulkhead between the galley and fore-cabin. It actually takes up so little space it might have been built-in by the factory.

The original sail area was 242 ft^2, main and jib, so my new sail was designed to copy that area. I have long been interested in sail design but as I am mathematically inept I work empirically. I have discovered (you might say re-discovered) that a balanced device cannot have an area (Jib) greater ahead of the pivot (mast) than 1/3rd of the area (Mainsail) behind the pivot. Thus the jib cannot be more than a quarter of the whole sailplan. I discovered this over 2 months of experiment.

The AeroJunk concept is a balanced sail and my first attempt had 34/66% distribution jib and main. This produced strange results in anything stronger than a Force 1 wind where the whole rig would swing at 90 degrees to the wind thus heeling the boat strongly. On that first occasion I panicked and reefed the sail by about 30% then spent an hour sailing with the whole rig self-setting and the mainsheet hanging slack regardless of where I pointed the bow. Strangely enough, according to the tell-tales, the sail seemed always to be producing drive. (See conclusions) But this was not what I had hoped for so spent several months experimenting with different sized jibs and batten spread until I found the magic balance ratio for this type of rig.

An engineer friend gave me a simple mathematical tool to use. Multiplying the area of the mainsail in square metres by its distance from the CE (Centre of Effort/Area)to the mast centre in metres gives a factor. I do the same for the jib then divide the smaller factor by the larger one to give a ratio. In my case the magic number was 0.195 or just under 0.20. This ratio allows the boat to sail normally with full sail up to the top end of a Force 4 and allows a single line sheet to be handled. Ratios smaller than 0.19 also work but increase the sheet load and move the combined C/E further aft. Ratios greater than 0.20 reduce the sheet load but move the combined CE forward and make the sailplan self-balance and turn broadside in stronger winds. I also found that if the ratio was too low then moving the jib further forward from the mast increased the ratio. Conversely if the ratio was too large then moving the mainsail further aft from the mast decreased the ratio. Both of these also move the combined CE.

My experiments involved smaller and smaller jibs to get the ratio down so my final sail area has dropped to 208 ft^2 but the boat sails like a Bermudan to windward and is fast, even in light airs. This I think proves the efficiency of the rig. Hoisting the sail is hard work but sailing is easy single-handed and reefing the work of a moment as I only need to release the halyard. The single rope sheet load is manageable without winches. I now have a safe and docile cruiser.

Miranda showing off-set mast tube socket

Conclusion

By starting with a mast position that is further aft than the norm for a Junk I found myself limited to a high-aspect-ratio sailplan and therefore a maximum sail area determined by the available ballast. This is because I am bound by the position of the original Centre of Effort and "lead". If I had made the sails longer at the foot I would have suffered increased weather helm.

Despite my initial panic, the effects of the "over-balanced" rig were fascinating. It was working as an asymmetric square rig that set its own angle of attack to the wind. The tell-tale streamers showed it was generating lift and the angle of attack was automatically maintained. Such a sailplan might be ideal for a multihull but would need preventer ropes to stop the main going too far forward of the mast and to haul the rig round for a new tack. Perhaps a pair of reins attached to the front of the battens instead of a conventional sheet attached to the rear.

AeroJunk batten. S/S slide rod spacer and cable-ties

AeroJunk. Tube fastenings for batten fronts

Auto-Flight

Dave Culp

Proas are uber-cool. They offer the most bang for the buck, they have least material stress of any multihulls, they have a super-cool backstory—proas have been the fastest sailing craft on Earth for 500 years. Who wouldn't want one?

Some of the first Europeans to witness proas saw a bit of the "secret sauce" that makes these boats so fast and so fun—"flying" proas. Let's face it, flying a hull is a blast. The wetted surface drag is reduced by a third. The wracking stresses and wave drag associated with two hulls trying to react to out of sync waves; it all drops away in that surreal few moments—dare we dream minutes?—of flying.

The risk remains though. Flying a hull is flying without a safety net. There's only a tiny addition of sail force between flying and capsizing, and for most of us, that's simply a leap too far. Flying a hull looks exciting, it's something we'd maybe like to experience one day…… but maybe not today!

But what if we could automatically limit the flying hull's altitude to some set height above the water, and never higher—or lower? What if we had a magic box that monitored hull flight all the time, yet let us actively sail the boat, when, where and as hard as we like. Our box would automatically ease the main sheet when we fly too close to the edge, yet follow our lead, bringing that sheet right back in as the hull comes down. This box would be Ginger Rogers to our Fred Astaire; we guide and she makes us look fabulous. Slow, slow, quick quick quick.

Yeah, sounds like we're talking about computer control, actively measuring ride height then reacting in split seconds to control side force from the rig to sustain and control flight. We'd need wave followers, we'd need sensors and CPUs. We'd need actuators and power supplies. We'd want both kinds of RAM—computer memory and hydraulics. The system will be expensive to prototype and always susceptible to salt water shorting, but boy oh boy, wouldn't it be fun?

OTOH, do we really need all this stuff?

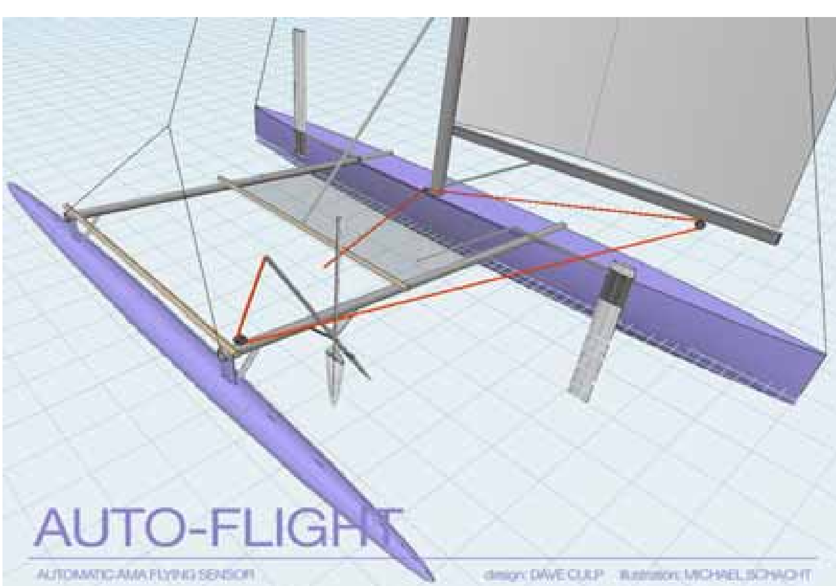
Can we envisage a purely mechanical "computer" capable of getting this job done? Most autopilots today are electronic computing works of genius, but once upon a time—and for hundreds of years—sheets were lead to tillers and the feedback loop/ programmer's wishes couple, which defines "computer", steered our boats across the world's oceans. Can we maybe do the same for controlling hull flight?

There are a number of ways to sense when the hull is flying. Historically we've measured the angle of heel or the length of time a sound pulse takes to bounce off the water, etc, but we can do better than that—we can mechanically measure the hull's proximity to the water surface directly; a simple flapper mounted near the ama will either be deflected back when immersed, or flop straight downwards when in flight. We can take this binary "wet-or-dry" signal and determine precisely when the hull is flying. Better yet, we can make the sensor narrow and deep, then bias it so that it is deflected more when deeply immersed and less as it is withdrawn from the water. Now we can accurately sense the nearness of the surface—we gain vernier control, and can automatically find and maintain a nuanced ride height, rather than senselessly banging the system on-off-on-off as the hull leaves and re-enters the water.

So there's our sensor. But wait, the actuator is easy, too. Let's balloon our narrow, deep flapper up to a useful size and cause it to react to its own output. Rotate the flapper pivot ~90 degrees so it is on a longitudinal axis. Imagine it as one blade of a wind turbine pointing straight down and with its fulcrum on or somewhat below the crossbeam. Now imagine an extension of the blade, a simple round shaft this time, pointing straight up. (Visualize a canoe paddle mounted vertically and set edge-on to the water flow, for instance)

Now, rather than acting as a simple stalled paddle sensor at 90 degrees, our flapper has become a proper foil, creating a variable and potentially large side force—perpendicular to the boat's course—anytime the ama is in the water and the system is switched on. When the ama flies, the force goes to zero as the foil is withdrawn by the ama's flight[1]. This foil's AoA might be adjustable in order to tune the system, but might also be fixed during actual automatic flight — it might be permanently set to zero; using only the boat's own leeway to create the effective AoA.

Mount this, for instance, on one cross-beam mid-way between ama and main hull, and allow it to rotate perhaps 45 degrees either side of vertical, so that now we have a powerful lever, ready to do some real work. Importantly, our grown-up little flapper still has its ability to sense the nearness of the water's surface, so we've retained the nuanced control that softens our final output.



(1)The Auto-Flight blade must not provide all or even the major portion of the total side-force for the craft. If asked to do so, the net torque on the Auto-Flight will be a near-constant, defeating the function of the device. Leeway will automatically vary to match total paddle side-force to total side-force from the sail as with any sailing craft. It is necessary that leeway be somewhat constant for Auto-flight to function properly. This can be arranged a number of ways, using asymmetric hulls, ordinary daggerboards or foils. It is only important that the Auto-Flight paddle not provide more than perhaps ¼ of total side-force. Negative side-force (paddle lifting to leeward) is probably OK, though not optimal as described earlier.

Details to worry about

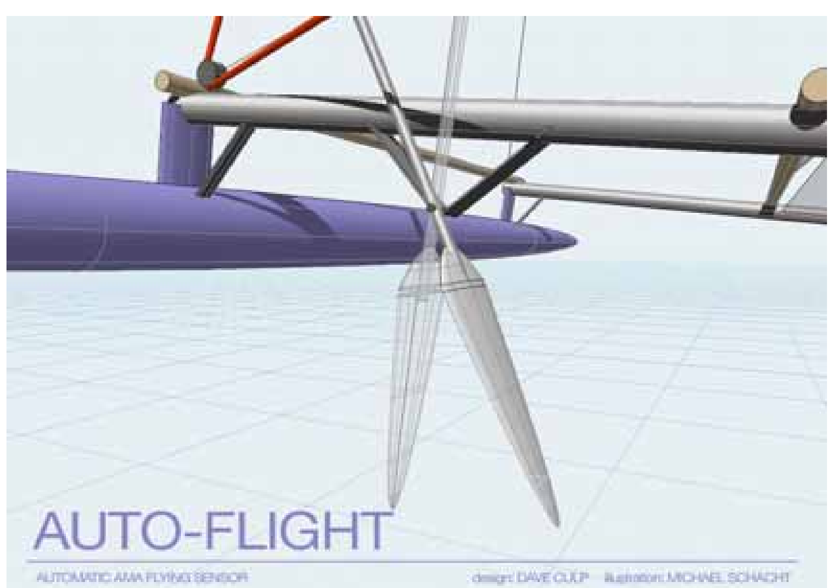
To put numbers to it, consider a foil of 6inch chord by 20in deep, at rest. Taper the bottom 1/2 of that span, from full chord to perhaps an inch, in order to attenuate the force as the foil is lifted out of the water by the ama's flight. This foil will be about 100 sq inches, and at rest, it's CLP is about 8in below the water's surface. At 8.5 kts boat speed and with a foil working at a lift coefficient of 1.0, we will generate about 1.5 lbs lift per square inch of foil area. So we're going to generate about 150 lbs of force from our sensor/actuator, and, taking its fulcrum on the cross-beam at perhaps 2ft above the foil's CLP, we've got a whopping 300 ft-lbs of torque to work with. If we extend our lever arm the same 2ft above the fulcrum and allow it to work through +/- 45 degrees of swing, we've got an actuator force of 150 lbs, over about a 3ft total throw. Full throw in the space of one second would be equivalent to about 1.5 horsepower, at 90 degrees per second rotational speed or 15 rpm. Pretty torquey, which is just what we want. The force curve won't be quite linear, assuming we use a straight rather than a quadrant lever arm. The force will be about 30% lower near the ends of the throw, 150 lbs only near the middle of the range.

We should note that these forces will diminish, rapidly, if the control force is asked to act very quickly. For a control movement requiring the same velocity as the boat for instance (14 ft/second in our example), angle of attack of the foil will be nearly halved, and resultant force nearly halved as well. Similarly, if the boat speed is halved—or doubled—the actuator force reacts to the square of that change; 1/4 as large at half speed, and four times as large at double speed. That's 600 lbs of force at 17 kts boat speed. Lots of available horsepower, but clearly, we will want to respect and control power at times as well.

What to do with this actuator power? The most effective way to vary a sail's force is to sheet it in or out. There are other ways, but sheeting in and out is effective and intuitive—it's the way we "throttle" our sails everyday. It's helpful if the control force causes a reasonably linear change in sail force—we'd like the first 6in of boom movement to have approximately the same effect as the next 6in, and the next and so on. As designed, AutoFlight should be relatively tolerant of variation, but as with any automated system it's helpful to match the actuator's power curve to the load's curve. It is absolutely necessary that the one never falls below the other—we must have excess available power, compared to required power at all times. Our system is biased towards excess power, so imbalances shouldn't be show-stoppers, but an overly sensitive rig, for instance, may cause the system to be twitchy. An insensitive rig may cause AutoFlight to "hunt" around it's equilibrium point—or reach the limit of its throw without sufficient effect to do its job.

For these reasons, the main sheet should be double-ended so the pilot can choose the most effective range of boom movement for instant conditions and for his boat. One end is actuated by the auto-flight system and the other end is in the pilot's hands, or cleated nearby. The pilot can now "fine tune" the automatic system just by sheeting in or out to find the best range of boom travel for automatic flight under the current course and speed. This can be done with the AutoFlight system working, with the effect adjusted as they sail. Importantly, the double-ended sheet also allows the pilot to over-ride the automatic system, instantly.

When the pilot is satisfied with the gadget's performance, they can cleat off the main sheet at their end and the auto system will continue to control flight. Magic! Increasing the boat's righting moment (moving to windward for instance) will

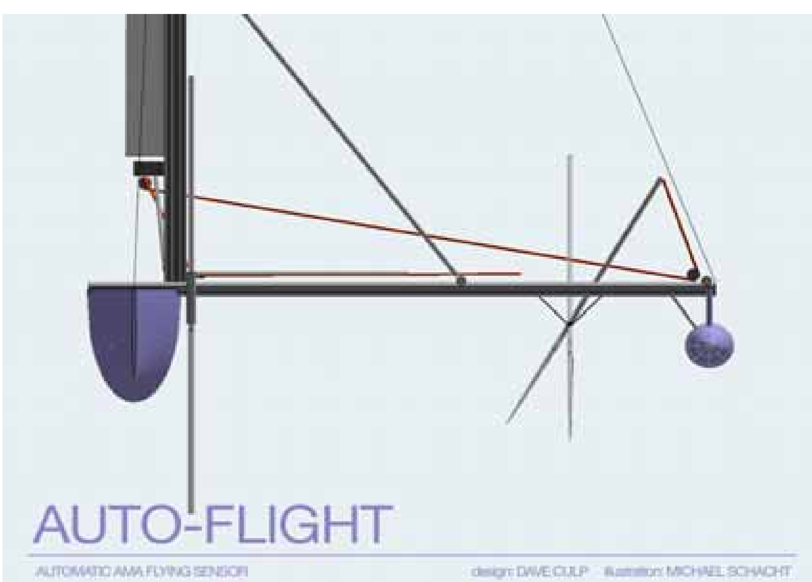


cause the automatic system to call for more power to maintain flight altitude, thus increasing boat speed. Moving to leeward will cause the system to call for less power, slowing the boat. The ama flight altitude remains unchanged and the pilot continues to set course wherever he likes, and to adjust the mainsheet to keep the rig fully powered on whatever course is selected. He can dump the sheet on a moment's notice, the ama will splash down and the boat will stop, as normal. This needn't be accompanied by inactivating the AutoFlight system; simply dumping the sheet will ease the main, the auto system is instantly rendered ineffective and the system self-deactivates as it reaches the end of its throw. Recovery and reactivation are just as simple—the pilot sheets in his end of the mainsheet and he's off again, all systems normal.

Alternative Arrangements

A pivoting (canting) daggerboard or leeboard can be fitted to the ama, replacing all the hardware above. This board only needs to be large enough for the auto-flight system, the boat will still need a leeway preventer, as this board is providing little side force while the ama is flying. (See also Note 1)

The entire ama may be designed to pivot/cant where it connects to the cross-beam, making the simplest system of all. The ama can be asymmetric, or have a fixed daggerboard, etc. Bias on the ama cant angle can be either via gravity or via mounting the windward shroud in such a way that it biases the ama's rotation in the direction wanted.



Engagement/operating procedure:

- Place foil in fulcrum clamp and set AoA to zero.
- Test sail to confirm that the foil force is zero. Cant the foil shaft at its fulcrum by hand so it moves to the limit of its travel (failure to do this may cause the foil to do so itself, quickly and forcefully as soon as AoA is altered—beware!)
- Be certain you have rotated the foil and shaft to the proper stop—the shaft should be near the ama and the foil near the main hull. Be careful to set the AoA so that it drives the foil shaft towards its stop and not the opposite.
- Adjust the foil shaft in its clamp to give positive AoA—try somewhere near 10 degrees, test the amount of force created by attempting to lift foil stock from it's stop while sailing. Adjust AoA to suit and tighten the clamp.
- Attach one end of mainsheet to the foil shaft, while still against its stop.
- Place crew where you want them while flying the ama. (This will depend on the boat's basi stability).
- Sheet in with the opposite end of the main sheet, maintaining appropriate sail shape, until the foil shaft comes up from its stop and stands approximately midway through its available throw.
- Given sufficient wind, the ama should immediately fly, raising the foil until its tip nears the water surface, then the foil shaft should automatically and immediately sheet the boom out a bit, maintaining flight with the foil tip submerged a few inches. The depth of submersion depends on the force needed to maintain precisely the correct sheet tension for conditions, and will likely trend up and down a few inches during flight.
- If the ama flies with the foil tip clear of the water, the foil should immediately rotate to its opposite stop, dumping the mainsheet to the limit of its throw and lowering both the ama and the foil back into the water. Do not take this slack up with the opposite end of the sheet or you risk capsizing, as you'll have compromised the system's ability to sheet out..

Notes:

It is entirely possible to capsize the boat with this device. This shouldn't occur while the system is functioning properly, and most system failures will be fail-safe, depowering the system, but as described, there is no defense against incorrect or reversed settings, jammed components or accidental obstruction by the crew. For this reason it is NOT recommended for application to boats larger than can be safely capsized and re-righted by its crew in deep water, unless and until the gadget is thoroughly sorted. It is easily possible to design and rig limiters, stops and lockouts to render the system "fool-resistant" but thorough knowledge of the system—via practice—is critically important.

Make all adjustments, except for an emergency dump of the main sheet, slowly and in small increments until you know your system. Do not auto-fly with the foil shaft near the end of its throw; there must be sufficient available throw for the automatic system to dump the sheet and de-power the main. This is easy to do from the "pilot end" of the double-ended mainsheet. If the boat has multiple sails or multiple masts, it is necessary that the sail(s) connected to the system be sufficient to power/de-power the flight altitude of the ama. It is perfectly acceptable to control multiple booms and/or sails with a single auto-flight foil, so long as there is enough power designed into the system.

AuroFlight can be successfully set up to deliver its power stroke either towards or away from the main hull, depending on AoA at the foil fulcrum. There are consequences from which is chosen: if the power stroke is away from the boat, you can take the sheet directly from the boom to the end of the foil shaft, however, the net force from the foil will be to leeward, fighting your daggerboard. In addition the foil will be delivering its stroke while its CLP is moving towards the main hull, incrementally decreasing the system's sensitivity to the ama's altitude. If the power stroke is set towards the boat, the foil compliments the daggerboard, but now you will need to take the mainsheet through a turning block mounted to windward of the foil on the ama or cross-beam, then back to the boom (as in the diagrams). Providentially, the stroke is now taking the foil closer and closer to the ama, increasing the system's sensitivity to ama altitude. For most applications it is therefore recommended to set the power stroke towards the main hull, and use the sheet extender and turning block shown. These can be pre-rigged and preloaded with a bungee to keep them lying quietly on the trampoline, ready for attachment.

AutoFlight as illustrated will not auto-shunt (though it may be rigged to auto-tack if a tacking boat). A tacking boat will require two altitude control systems, one for each tack, or a single one on the centreline, rigged for both tacks. The sheet lead(s) will need careful thought and, likely, snatch blocks to reroute them during the shunt/tack. The foil might be set permanently to zero AoA, and deliver the necessary power stroke in both directions without adjustment (using the boat's leeway to provide AoA). In virtually all events, however, the mainsheet setting during the maneuver will be at the "pilot end" of the double-ended sheet while the auto-flight system is parked against its stop, so auto-shunting is largely moot. Watch out for that foil shaft coming across the deck—it's every bit as dangerous as a gybing boom.

With thanks to Michael Schacht for inspiration and the amazing graphics!

[Editor's footnote: Dave has since conducted trials of this system with varied results. We hope to have a report of his sctivities in the next Catalyst]

Human-powered Craft

Mike Bedwell

Who Needs Rowing?

What a question! Imagine the reaction at Henley, or from the dragon-boat racers who – or their bosses – believe that they will thereby bond and so become better 'team players'. Or what about heroes like John Ridgeway who, having helped pioneer sailing the Atlantic, earned a place in the Guinness Book of Records after joining forces with Chay Blyth to row instead? Or going back into history, the exploits of Captain Bligh, Erik the Red, the Greeks and Phoenicians in their galleys?

What is Rowing?

We need to ask this question in order to answer the first. A popular description might be 'sitting in a boat facing the wrong way, usually with two or more others each with an oar sticking out on one or other side'. The more knowledgeable might add that sometimes the crew have two oars each, one for each side, a variant the *aficionados* call 'sculling'. But, irrespective of terminology and notwithstanding its long history, rowing suffers a number of inherent disadvantages. One of these is that having oars 'sticking out' makes it difficult to manoeuvre in confined waters, a crucial problem in UK's narrow (7ft about 2.1 m) canals. Most of the other disadvantages follow from Newtonian mechanics,:-

1) Energy is wasted through windage during the recovery part of the stroke.,

2) With the notable exception of the Gondola, the blade enters and leaves the water at the beginning and end of each stroke, so even in calm conditions there are impact losses.

3) Again with the exception of the Gondola and certain N American craft, the crew sit. This has the advantage of low 'hull' windage, and allows the crew to pull on their oars with a force greater than their weight, but the disadvantage that either:

i) Only partial use can be made of the leg muscles, or

ii) A sliding seat must be fitted. This not only carries a cost and weight penalty, but further impairs the exchange of momentum between the crew and the boat.

These disadvantages are largely avoided in lift devices, for the same reasons that the propeller is now generally preferred over the paddle-wheel. However, the parallel should not be pushed too far, since propellers operate at Reynolds numbers better suited to machines than human beings as prime movers. Further, if drag is fundamental to impact devices, it represents a waste of energy in lift devices.

If Not Rowing, then What?

I'd recommend anyone seeking to avoid rowing while still using muscle-power, whether as the auxiliary or as the sole means of propelling her/his vessel, to begin by entering these five words into Google.

RO SCULL YULLAH YULOH GONDOLA

You will find, *inter alia*, some exciting video clips, but may leave you wondering why there seems to be no systematic way of making an informed choice from among the different variants.

This note is an attempt to fill that perceived need.

Terminology

1) Unless otherwise stated, from now on I restrict the word 'scull' to the use of reaction- or impact-operating paddles..

2) Yullah or yuloh (various spellings) is where the paddle is used as a lift device, and can be viewed as a slowly-rotating, variable-pitch propeller that moves through less than half a revolution before reversing direction, the change of pitch being effected by a lanyard wrapped round the loom.

3) 'Ro' is at first sight simply the Japanese term for 'Yullah', but appears to differ from yullah in at least two ways: first, that the shape of the blade allows its use as both a lift and a reaction device, and second that the change of pitch is effected not by a lanyard but by a mechanism at the crutch..

Pros and cons

In the table following, most of the devices are lift. This is both for the reasons already given, and because the body motion is substantially athwartships, thus avoiding the momentum-exchange disadvantage of conventional rowing. The two exceptions are the Pedalo, familiar on park lakes, and the icon of Venice, the Gondola.

The photograph shows the initial trial in 2012 of my new test-bed raft christened 'Tandem Yuloh'. Speeds of over 4 knots were achieved, but the following problems found:

1) Winds above force 1 – common enough, even on rivers – impair control

2) Although almost impossible to capsize, her light construction means

(a) Moving about the deck is disconcerting, especially when manoeuvring into a lock, and

(b) Stress in my lumbar regions because of the effort to remain standing. .

3) I have been using the same paddles as in my erstwhile 2-tonne steel-hulled estuary cruiser *Mercia Maid*. These are less suitable for the raft since

- Having steel shafts, will sink if dropped overboard, and are clumsy to ship and unship.
- Have inadequate blade area

To overcome (3), have designed a paddle in which it is possible to vary the linear dimensions and sectional shape of the blade. I speculate the other problems may ultimately need a return to steel construction .

Would be delighted to hear from anyone keen to try out any other type of paddle, whether or not mentioned above.

Michael_Bedwell@hotmail.com

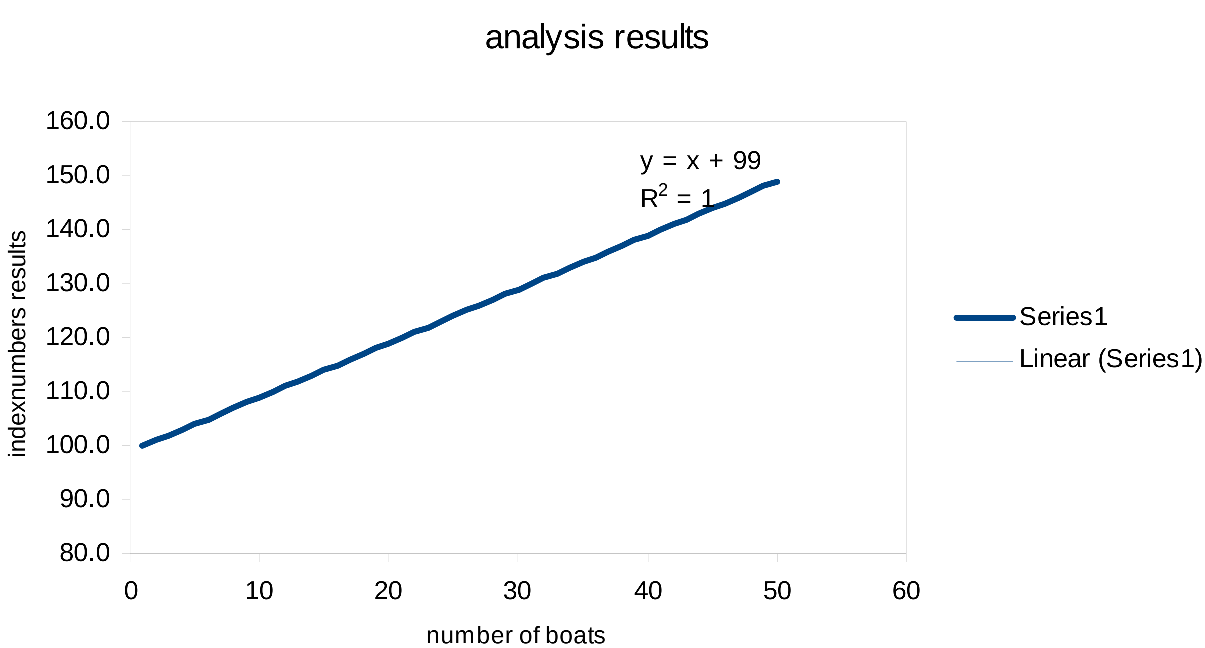
	Advantages	Disadvantages	Notes
Gondola	Technique proven over many centuries. Crew face forward. In modern Venice use seems to be extended to punts of conventional design.	Technique needs skill. Traditional hull of sophisticated asymmetrical shape. Relatively high air draft.	French Feature Film 'Impardonables' (2011)
Pedalo	Low windage, high stability, crew face forward	The human body better at rocking than rolling! Greedy for cockpit space. If used with paddlewheel, the disadvantages discussed above.	
'Stern Sculling'	Lift technique despite name. Widely practised for auxiliary or emergency propulsion in dinghies and sailing yachts of up to at least 8 metres LOA.Uses simple oar with blade section symmetrical about both chord and width. Economic on cockpit space.	Impairs roll stability, as crew stands. Slightly impairs pitch stability. Technique requires practice, as angle of attack controlled by wrist rather than hydrodynamic forces. Operator faces aft	
Oriental yullah	Widespread technique proven over many centuries. Uses simple oar with blade symmetrical about chord, and coaxial with shaft.	Impairs stability as above. Greedy for cockpit space; pitch is controlled by lanyard rather than hydrodynamic forces. Shaft curved.	
Ro	As above, but more economical on cockpit space. Blade reported to be usable in both lift and reaction.	Impairs stability as above. Pitch is controlled by device fitted at crutch rather than hydrodynamic forces. Operator faces aft	Tabakian, G. "Wave Propulsion'AYRS Catalyst 44(2011), 12-15
Scullmatix	Apparently a proprietary development of Ro, commercially available in the West.	As Ro above.	
'Flowtiller"	Facilitates use of rudder to propel sailing dinghies.Axis of rotation about 25% chord width from leading edge of blade. Blade incidence auto-controlled by fluid dynamic forces. Uses no cockpit space. Crew sits facing abeam, so good view forward and no loss of stability.	For best performance, needs blade with tear-drop-shaped offering high lift/drag ratio. Established NASA and sail-related data of limited value because of low Reynolds number. Uses arm muscles only No record of use since first published 10+ years ago. Might be banned by racing rules.	See AYRS website: Hazelwood 112=19-23
'MB Yullah'	Seeks to exploits Flowtiller principle, but needs no moving parts. Uses short, straight shaft but specially shaped blade. Can be used in tandem*.	Impairs roll stability, as crew stand. Crew faces aft. Hull must provide large lateral stability, for reasons comparable to those when sailing close-hauled. Difficult to design a paddle which both (i) remains near the vertical when temporarily out of use and(ii) floats if accidentally dropped over the side.	

How to judge racing results.

Nico Boon

Having been active with the development of rating systems for multihulls since 1980, naturally, part of my work had to do with the analysis of race results. Not for the least reason to know if the handicap method used is doing what crews may expect.

Various methods of analyzing race results have been practiced. One of the remarkable things found in all studies is the fact that if you try to describe the results by using graphs, a simple straight line graph always has been sufficient. Why is this so?



How to judge any race with one design boats or groups of boats using any handicap system

1 Sort all results that need to be judged in the form of sailed times or corrected times.

2 Convert all times sailed, or all corrected times, in indexnumbers. Winner (1) = 100.0

3 Copy the values of the indexnumbers calculated in column B of this file.

Remarks

The formula produces a calculated index number.number = a * boatnumber (X) + b

The example in the file above results in : a = 1; b = 99 and R^2 = 1 - A perfect straight line. The lower the coefficient “a”, the closer the results within a class or all classes on the overall list Coefficient “a” indicates how good the class has raced and/or the rating system has worked. This can be used too to determine how good one class is sailed compared to another one.

R^2 is the determination coefficient. The correlation coefficient R is its square root. The correlation coefficient R is above 0.9. (See below the table for an explanation of R and R^2.)

This aspect makes it possible to introduce an extra method to judge ANY boat race. Of all one design racing as well as all races using ANY system for handicapping.

This can be a kind of Portsmouth Yardstick rule, a so-called TOT (time on time) system. Or the widely used PHRF system, a TOD (time on distance) method. Fundamentally the rating numbers of both systems, are based on studies of race results, using statistics mainly.

This simple graphic method can also be used when for handicapping not a yardstick method but a rating system is used,. A rating rule is not based on statistics of results but on accurate measurements of boats. These measurements result in a calculated rating by formulas. For multihulls the Texel rating formula is widely used.

What can we 'explain' with this extra judging method?

For 'one design' racing we want to know how good crews in a certain class perform, and how good, compared to crews in other classes.

For races organized for a mixed fleet, needing a handicap for each boat, or class, we are interested to know how good the rating numbers equalize the differences between the designs. That is the main purpose of any handicap system. In some examples below will be shown how good that aim is reached

The input values required to judge race results by a graph are simple.

1. You need to express all race results in sailed (elapsed) times (for one design boats) or corrected times, when a rating method is used.

2. The final sheet requires conversion of all times to index numbers. The number one, the winner of each class and/or, the overall winner, gets 100.0.

3. To produce a graph you need to copy the values of these index numbers on the sheet with the graph. The short sheet can receive up to 50 index numbers in column B. A separate one, on another scale, is available for races with up to 485 rated boats.

To get a nice picture of the graph and the correct final formula of the straight line, you need to delete all index numbers still in column B, not used by you.

The final equation of the straight line = a * boat number (X) + b.

If you 'imagine' that all boats pass the finish at 'exactly' the same moment, which never will happen, the value **a** becomes zero. You easily can test this, by making all index numbers equal to 100.0. A horizontal graph line will be shown.

a = 0 here. **b =** 100. R^2 has no value in this special situation.

For safety of the formulas etc., the accompanying spreadsheet has been protected. Only the values in column B are available for input and one cell in the top for names of class or race. No password has been used.

To illustrate what this short program can do, a small table is given below with the results in formulas of the Round Texel Race 2012. Earlier results are available.

Round Texel 2012

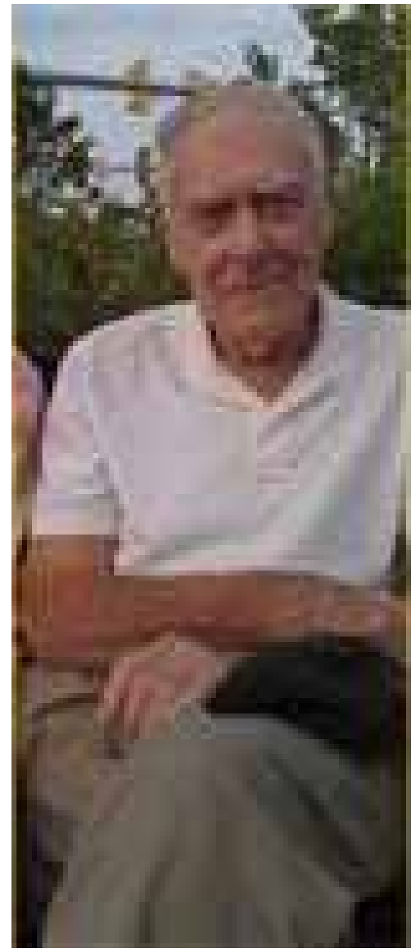
Formula	a	b	R^2
Overall 1-210 (all)	0.22	105	0.97
Formula 18 1-63 (all)	0.70	100.2	0.95
Formula 18 1-50	0.63	101.6	0.99
Dart 18 1-18 (all)	1.34	96.8	0.93
Dart 18 1-17	1.20	97.7	0.97
Hobie 16 1-18 (all)	1.23	102.0	0.97
Nacra 570 1-6 (all)	1.85	98.9	0.95
Na Infusion 1-13 (all)	2.42	99.1	0.83
Na Infusion 1-11	1.65	102.5	0.86
Na Infusion 1-10	1.58	102.8	0.81
Na F20 carbon 1-9 (all)	3.50	96.4	0.95
Na Inter 20 1-7 (all)	1.65	97.8	0.94
Tornado 1-7 (all)	3.61	95.9	0.99

It is clear that the use of a rating brings the results more near each other. The coefficient **a** is with 0.22 the lowest of all. Relatively, this line is the most horizontal.

b is the index number where the straight line crosses the vertical axis. With the second line for the Dart 18 is illustrated how its last finisher, who took much more time, influences coefficients **a, b,** as well as R^2. This R^2 is called the coefficient of determination. It is the square of the correlation coefficient R. Both numbers indicate how good the straight line fits the real race results.. The example, with the straight line gives $R^2 = 1$, a complete correlation, for $R = 1$ also.

In the Nacra Infusion class, a small group in the middle of all 13, finished very close to each other (small differences in index numbers). This made the line more horizontal in that range. This lowered R^2 a bit more (0.81), as shown when only the numbers 1 -10 are put in the graph. The Tornado and the Nacra F20 carbon as a 'class' did not do very well, as shown by the high coefficients **a**. These illustrate greater differences in crew quality. With the Tornado there also are differences in boat quality.

Frank Bailey, AYRS US Treasurer



Frank Bailey Jr, AYRS US Treasurer since about 1986, died at his home in Grove City, PA, on January 25, 2014. He was 88.

He was born on April 18, 1925 in Pittsburgh, PA. He entered Princeton University but was drafted into the U.S. Army after only one term. Having returned to college and graduated with a B.S. in Mechanical Engineering, he joined a Pittsburgh fabricator of steel equipment. After 32 years there, he retired early when the U.S. steel industry collapsed. He then took up boat building, founding the Toad Hill Boat Co, and campaigned a sailboat for fourteen years on a nearby lake.

He filled his home with over twenty-five ship models “of almost museum quality” and a plethora of hand crafted items he so loved to create. He was a passionate dog lover, amateur cartoonist, and “always kept his lawn cut” (according to the local press). He is survived by his son, daughter, three grandchildren, and two great-grandchildren; his wife having died in 2011.

I first met Frank in person in about 1998, when on a visit to the US which coincided with an AYRS New England Group event, although he had been AYRS US Treasurer since the 80s, and we had corresponded by email for some years. He had an enquiring mind and a great sense of humour. Along with the articles in Catalyst published under his real name, there have been other letters to AYRS, sometimes deliberately provocative, written under pseudonyms. He used to write to us, sending the AYRS US bank statements with various cartoons and other quotations and thoughts which had come to him. Some of those cartoons were published in Catalyst. We miss “Uncle Frank”, as he often signed himself, greatly.

Kim Fisher - A brief resumé

Kim joined the AYRS Committee at the January 2014 AGM(the notes of which are on the AYRS website)..

For those who don’t know him, he describes himself as a 61 year old Product Designer who retired from British Telecom (phone company) 3 years ago, married with two children - daughter(27) Doctor, son(25) Vet. We live in Martlesham Heath, Suffolk on the East Coast. Have sailed dinghies since I was 11 years old. Currently have a Laser 16 on a mooring at Woodbridge, Suffolk and also a K1 single hander (http://www.k1sailing.com/). Photos of mine are on the website (sail No. 9). Past boats sailed/owned: Mirror, TOY, Fireball, GP14, Thai Catamaran. Class 3 land yacht.

Past AYRS project which I had published was the “Understanding and development of Aquaplaning Wheeled Sailing Yachts” - Catalyst Number 32 - October 2008 - Runner up for John Hogg Prize. Current project: Design and Build of a single hander [QUILL] with a Crab Claw derived mainsail and sliding seat/pontoon stability. The method of construction is also novel using Industrial GRP sheet. The photo is of 1/4 scale model sailing . I have also been building a prototype Carbon Fibre exoskeleton to help me when sitting out my K1. Both projects were shown and discussed at 2014 AYRS Barton Turf and Thorpe Village meetings. Special interests include: modern/different boat construction methods and materials. Also like re-visiting past designs of boats to see if modern materials could revitalise the “build it yourself” sector of sailing.

AYRS Meeting, Thorpe Village Hall, 26 January 2014

Report by John Perry

Good to see a better than usual attendance for this meeting that once again was held in Thorpe village hall to the south west of London and was chaired by Fred Ball. Fred introduced the meeting and showed some slides of the AYRS stand at the London boat show and also some of the other exhibits that caught his eye at the show. After that it was time for the first tea/coffee break.

After the break I gave a presentation about Michlet software. Michlet is not new, it has been available as a free internet download for quite a few years. It was produced by Leo Lazauskas who works at the University of Adelaide. The relevant website is http://www.cyberiad.net.

Michlet is a computer program for estimating the drag of hulls and determining the pattern of waves in the wake behind a moving hull. It does have limitations – it's based on 'thin ship theory' and as such is only suitable for hulls with a length to beam ratio of more than about 6:1. It is not suitable for planning hulls and it does not calculate the changes in draft or pitch trim that may occur with changes in vessel speed. However, if you happen to know what these changes are (e.g. from sea trials) you can put that data into the program and it will be taken into account. Michlet can be used for multihulls so can, for example, be used to study the interference between the waves made by the individual hulls of a catamaran or trimaran, or for that matter between the hulls of vessels proceeding in tight convoy.

Michlet calculates the skin friction resistance and wave making resistance separately. The skin friction calculation is the easy bit – the program uses the well-established ITTC 1957 formula (the ITTC 1957 'line') to determine a skin friction coefficient and hence the skin friction resistance of the hull, or you can ask it to use Grigson's algorithm rather than the ITTC 1957 line. Both these methods use empirical formulae, based on experimental measurements that relate the skin friction coefficient to a Reynolds number. I understand that there is also an allowance for form drag lumped in with the skin friction calculation.

The wave resistance calculation is the clever part of Michlet and if you look at some of the papers referenced from the website you will see that the mathematics is far from simple. As far as I can tell, it is based on Havelock sources and sinks, so it's basically an ideal flow prediction but allowing for the presence of a free surface and it can also allow for flow separation at a transom stern.

When you run Michlet don't expect a modern style graphical user interface as seen with software written for Windows or Apple systems. Michlet harps back to an earlier era of computing and you need to read the manual and remember certain keystroke combinations to get it to produce any output. My Windows 7 system opened a small DOS style window for Michlet to run in.

My reason for trying out Michlet was that I was curious about whether a semi-circular cross section for the underwater part of the hull of a multihull is the best, or whether it might be better to go for an elliptical section with draft either more or less than half the beam. Purely for comparison, I generated input

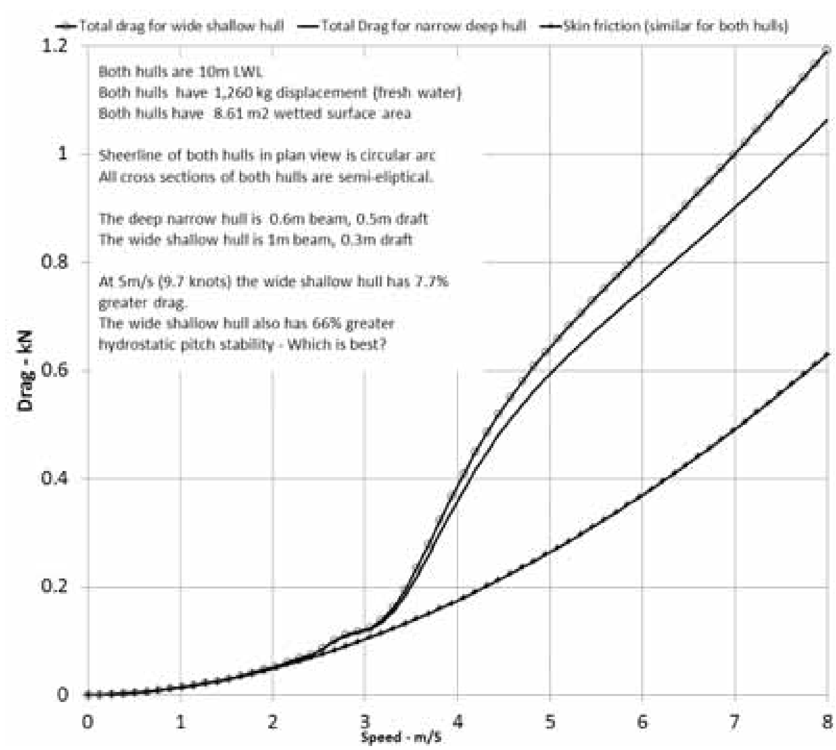


Figure 1

files for two very simple canoe stern hulls, both having the same displacement, waterline length and wetted surface area, but one relatively deep and narrow, the other wider and shallower. The results are shown in Figure 1.

From Figure 1, wave making resistance only really starts to matter above about 6 knots. The deeper narrower hull has less wave making resistance than the wider shallower one and hence less total resistance at the higher end of the speed range. However, this may not be the whole story – for one thing this does not take account of additional drag due to pitching in waves. Multihulls with deep narrow hulls have a rather bad reputation for pitching in head seas and if this reputation is justified this could perhaps favour a wider hull. I have discussed this via the internet with professional naval architects and my impression is that such matters are not yet fully understood and so naval architects are still designing by intuition and on the basis of what seems to have worked in the past rather than on a fully rational basis. Perhaps this will change as software continues to improve.

As well as generating predictions for hull drag, Michlet produces pictures of the wave patterns in the wake of the boat. Figure 2 shows just one example of this, actually the wave pattern from my narrower hull example running at 4 knots. This is very much the kind of thing you see if you look down onto a boat proceeding across a calm lake. Note that this picture only shows the wake aft of the stern, Michlet does not predict the 'near field' waves around the bow and sides.

I have to say that soon after I tried Michlet, Leo Lazauskas announced via the internet that he is about to release a new free of charge program called 'Flotilla'. Apparently Flotilla will be superior to Michelet in most respects, at least for monohulls. Unlike Michlet, Flotilla will not deal with the interactions between multiple closely spaced hulls, at least not in the free version, so although you could presumably use it for the individual hulls of a catamaran or trimaran it will not allow for the effect of hull interactions. Flotilla will predict and allow for the changes in hull pitch and draft as speed changes and it will be suitable for slightly fatter hulls than Michlet, perhaps to 5:1 length to beam. Also it will plot the near field wave pattern around the bow and sides of the boat as well as the far field pattern astern. Like Michlet, it will not be suitable for planing hulls.

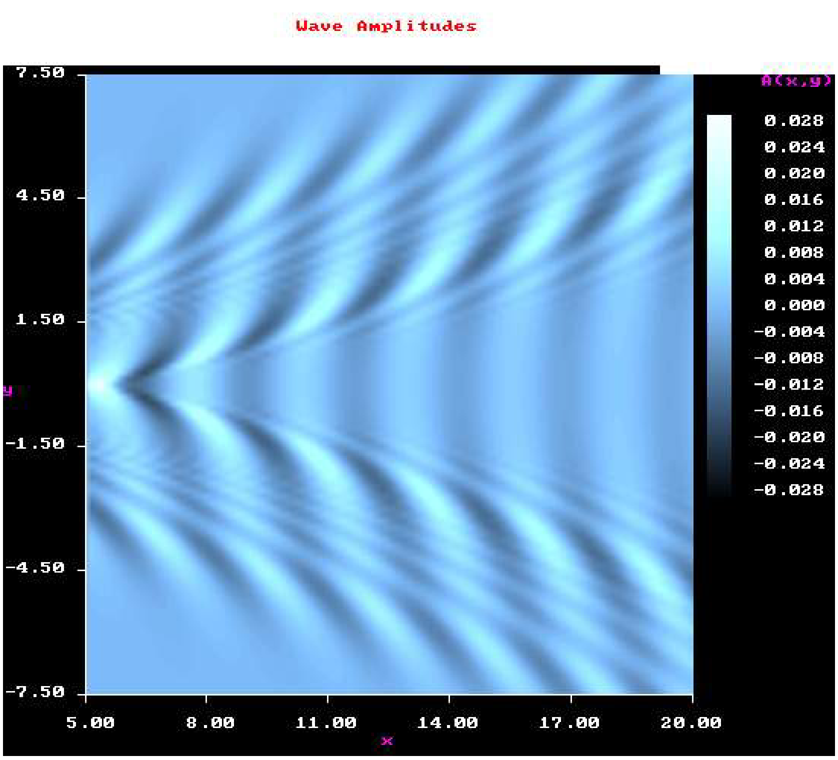


Figure 2

Fred Ball & Slade Penoyre

Fred and Slade were working to produce an AYRS entry in the 2014 Cordless Canoe Challenge (CCC) for boats powered by cordless power tools that takes place on the lake at the Beale Park Boat Show each June.

Fred had done the hard work to produce the white painted parts of the craft shown in Figure 3, the darker coloured parts including the rope belt driven stern paddle wheels are inherited from Slade's previous CCC entry. I think Fred has done a pretty good job on the hull and I can see it becoming a perfectly practical little boat, say for use as a yacht tender. The hull actually divides into two sections but the joint is good enough that it is not obvious in this picture. When separated, the bow section nests in the stern section and this allows the whole boat to be transported in either the back of Fred's van or the back of Slade's estate car.

Figure 3

Figure 4

It seems that AYRS has given up on winning the CCC outright since it is known that at least one contestant is likely to turn up with a long narrow hull powered by a whole array of expensive cordless drills. However, this year's show includes a new contest with more emphasis on manoeuvrability and practicality for passenger carrying. This AYRS entry is targeting that prize, together with the innovation prize. The idea is that the boat will be amphibious, it will be able to run on land using the large paddle wheels as rear wheels and the smaller wheel that you see resting on the bow near the coffee cup will be fitted under the bow and will be used for steering on land.

Another point is that the two halves of this boat can be joined with either a flush bottom (as shown) or joined out of line to make a stepped bottom. The idea is that once the CCC races are over the boat can be converted into a stepped hydroplane with a large outboard motor (Slade would like a really big one, but Fred says the transom won't take it!) - and I thought that AYRS was just about sailing boats! [*Of course it isn't, it's about ALL boats. - Ed*]

Kim Fisher

Kim Fisher came to this meeting with a whole array of interesting models and gadgets, perhaps the most immediately impressive being that shown in figure 4 .

It looks a bit like half of a medieval suit of armour, but made from vacuum bagged carbon fibre. Kim explained that he races a K1 keelboat, a 15foot long single handed fairly narrow beamed boat with a ballasted fin and bulb keel. Kim explained that hiking out on the gunwale is essential to make these boats sail well in a breeze and he is fed up with the young fit guys seeming to be able to sit out further for longer periods of time and so win all the races. This contraption will solve that problem. Kim described it as an exoskeleton – it has enough joints in enough places that you can walk around on shore and move reasonably easily in the boat but once you are in your sitting out position, balanced on the gunwale with feet under the toestraps, you just flick down the yellow levers at your hips and the main joints then lock up solid so you can relax in comfort until the next tack! It's really rather clever and it's well made so I think it's going to work. The next modification will probably be to incorporate emergency buoyancy in a more aerodynamic form than a conventional PFD. Kim has gone to some lengths to make it as light as possible using carbon fibre but I did wonder whether a heavier construction would actually be an advantage, but perhaps that depends on what the sailor weighs to start with. There was some discussion as to how long it will be before the governing bodies of the sport get around to banning this thing!

Figure 5

Figure 5 shows a little concept model Kim has made, with a crabclaw sail and a sliding seat. Figure 6 shows Kim displaying a rudder blade that has a series of bumps along the trailing edge. This is not something Kim has designed or made himself, but he tells us it is something that some


Figure 6


Figure 7

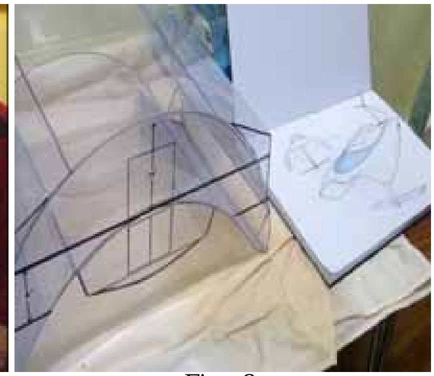


Figure 8

racing dinghy people are trying out. It's an example of bio-mimicry – the bumps are copied from the fin of a certain kind of whale.

Chris Watson

Chris Watson had a couple of new things to show us. Figure 7 shows what could be described as a manually powered outboard motor for a small dinghy. It is actually upside down in this picture – when in use the two white fins (Chris is holding one in his right hand) would be underwater and the device would be clamped to the transom of the boat – the unpainted plywood rectangle at the other end represents part of the transom. At the top of the device (bottom in this picture) is a tiller. Turning the tiller sideways steers the boat in the usual way. Pumping the tiller up and down operates a push/pull rod down through the stem of the device to make the fins flap up and down. The fins are pivoted so that they take an angle of attack to the water and drive the boat forward. This is a bit like the fins of the now familiar Hobie 'Mirage' drive, but these fins pivot rather than twist. You might not want to use this device over long distances, but fitted in combination with oars it could be handy for working into tight spaces.

At a previous Thorpe meeting Chris had shown us a model boat propelled by wave action and based on devices for ocean research as made by the company Liquid Robotics Inc. – see www.liquidr.com. Chris has been thinking about much larger vessels based on this concept, although I think he also has conventional powering in mind as an alternative option. Chris makes many of his concept models from clear PVC sheeting – this is easily gluable and produces models that allow you to see inside. Figure 8 shows a sketch and concept model for a large catamaran. The model is just an amidships section of the vessel, it is watertight and has been made for the purpose of studying stability and motion in beam seas.

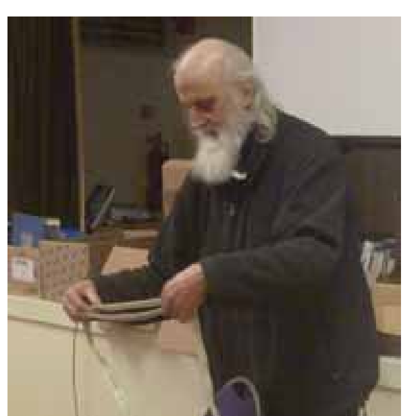


Figure 9

Roger Callan

Roger has an interest in tying knots and finding new knots to be tied. Even though specialist text books list hundreds of different knots, Roger has managed to develop new knots that no man has ever tied before. To round off our meeting Roger demonstrated a number of special knots intended for specific uses in sailing, not all of them particularly complicated. Some of the knots Roger showed us were for conventional ropes and some for use with webbing. In Figure 9 he is demonstrating one of his knots for use with webbing.


Figure 1 – the main wave tank


Figure 2 - the smaller wave tank

AYRS South West UK Area Meeting 19 February 2014 Report by John Perry

For our South West Area meeting this year we combined an afternoon visit to Plymouth University with an evening meeting held at Cargreen Yacht Club (CYC). We invited the CYC members to join us for both the afternoon and evening and that did swell our numbers considerably

Our guide for the university visit was Jasper Graham-Jones, who is both an AYRS member and Associate Professor in the Department of Mechanical and Marine Engineering. Our party met for lunch in the café on the campus then we proceeded to the new Marine Building to view the wave tank that occupies most of the ground floor of that building.

The wave tank is a newly built facility that is used to study the effect of waves on offshore structures and sea defences and also the motion of ships and boats at sea. At one end of the 35 metre long tank there is a row of electrically powered oscillating paddles (left side in Figure 1) that generate the waves and at the other end there are wedges of a foam plastic material to absorb the energy from the waves. The water is pumped through the tank to simulate current and the floor of the tank can be raised and/or tilted to change the depth or to simulate a shelving sea bed.

When we first entered the building the paddles were all moving in unison creating a tidy pattern of parallel waves as below. These waves were about 1m high, any higher and they would have lapped over the wall of the tank. We then saw how different patterns of paddle movements produced different wave patterns and how it is possible to produce much more random wave patterns, typical of what you find at sea.

The big wave tank shown in figure 1 is mainly used for commercial work but there is also a smaller wave tank for student projects which is actually built above one end of the big tank.

Our tour continued to the various other laboratories and workshops, there was much to see. Jasper explained that they try to make the student project work match the interest of the individual student. Many of the students do have a passion for marine subjects and looking around the laboratories and workshops we noticed plenty of model boats, canoes and surf boards. It looked a fun place to study. Jasper did re-assure us that the students do have to read up on the theory as well as making their model boats!

One of the workshops is dedicated to 3D printing with machines that make parts from a computer file, typically by depositing material in thin layers. These machines can make really intricate models and they can make some objects that would be hard to make by other means, for example chains with no joints in the links, or a ball inside a seamless hollow sphere. Some of these machines are relatively inexpensive, in the region of £1000, so perhaps a fun thing to play with at home. We also looked at a waterjet cutting machine that cuts almost any material to intricate shapes using a very high pressure water jet. An abrasive powder is added


Figure 3

Figure 4 – tooling for a model yacht hull

Figure 5 - Tony Head and Triple Venture

to the water jet to cut the harder materials, for softer materials this is not necessary. Not only can this type of machine be used for cutting out steel plate up to several inches thickness, apparently it is also used for cutting food products – factory made biscuits and cakes for example. Our tour ended in the composites workshop which is particularly relevant to modern boat building, both amateur and professional. We saw the equipment and moulds used for techniques such as vacuum bagging, resin infusion and autoclaving, also the various glass and carbon fibre materials including the pre-preg materials that are stored in a fridge prior to use. In Figure 3, Jasper is showing us a section cut from a wind turbine blade and in figure 4, tooling for making a model yacht.

Once everyone had gathered in the clubhouse at CYC, I introduced our evening session by talking a bit about the AYRS. I used some video clips to make the point that there is still much activity in yacht research, indeed arguably more than at any other time in history. In just the past three years a sailing boat has circumnavigated the world in 45 and a bit days, another has achieved 65 knots over a 500m run (with an AYRS member at the helm) and at the end of last year the America's Cup brought us competitive 'round the buoys' racing at speeds reaching over 40knots. The greatest advances in sailing technology have all happened within the last few decades and progress is still very much on-going.

Tony Head, a past commodore of the CYC, continued with a talk about the Jester challenge and the home built self-steering gear that he has used for over 15,000 miles of single handed sailing, including the Jester challenge. He covered the history of the Jester Challenge and explained that it is definitely not a race, although it does feature a group of small single handed sailing yachts simultaneously setting off across an ocean with most of the skippers probably hoping to make the fastest passage they can manage. He had the steering gear at the meeting and it was clearly a robust and practical system as shown in the photos.

Figure 5 shows Tony on board his 28 foot Twister class yacht 'Triple Venture'. The wind vane is on top of a column mounted from the 'pushpit' on the stern. The vane swings about a near horizontal axis and is connected by light ropes and pivoting links to the trim tab mounted from the rudder stock. As shown in Figure 6, the rake of the rudder stock is approximately 45 degrees and this gives the blade of the trim tab a good lever arm about the rotation axis of the rudder, resulting in a powerful amplification of the force available from the wind vane.

Tony said that he uses the wind vane self-steering for most of his offshore sailing but he uses an electric autopilot to steer a compass course in light following winds. He also uses an electric autopilot for congested waters since it allows more rapid adjustment of the set course. He has on board four electric autopilots, all of the 'tiller pilot' kind and all the same make so that parts can if necessary be interchanged between them. Like other single handed ocean sailors, Tony considers reliable self-steering to be a high priority.

Our thanks are due to Jasper Graham-Jones for showing us the facilities at Plymouth University and to Tony Head and to the CYC committee for the use of their clubhouse.

Figure 6 - The lower part of the mechanism

AYRS North West UK Forum Meeting 15th March 2014

The meeting was opened by John Alldred giving a presentation on the development of a suitable hull to support the next phase of his FLIPFLOP device. First of all he admonished the perpetrator of the idea of using a length of gutter as a test tank. He explained that his tiny test craft merely pushed the water in front of it and gave no meaningful data. Mike Howard owned up as the originator of the 'bad' idea, explaining it was the relative size of the test model to the test tank cross section that was important. John went on to explain how he had manufactured a catamaran centre section and a bow section in order to test the resistance qualities of each hull shape. He presented test data for the bow section and the centre section, firstly loaded down by the stern and subsequently loaded down by the bow. The resulting time/ distance graph clearly showed the differences between the three samples. The models were accelerated along the length of the timber test tank using a preset weight attached to a cord over a pulley, falling due to gravity.

The meeting then moved on to examine the material used to construct the model hulls. John presented the meeting with a sample of CORREX, a hollow fluted core polypropylene used as a floor protector and as a base board for printing disposable signs. The material is available in 2440 mm x 1220 mm sheets from 2 mm to 10 mm core thickness. Mike Howard 'discovered' the use of this material in the construction of simple boats. (For those of you interested in viewing sample boats on the Internet type into your browser: *Paul Elkins Coroplast Boats* or *Ken Simpson's Coroplast Boats*). John showed the meeting a one fifth scale model of a 'speedboat' hull produced from the material. Mike Howard told the meeting he has downloaded a half dozen designs using Correx as the main material for the hull.

John went on to explain how difficult the material was to bond to itself. He had tried several different adhesives ranging from wood glue to superglue, with varying amounts of success. Heat treating and abrading the surface helped but did not solve the problem. John then presented the meeting with three glued up samples. He had sanded the faying surfaces before applying the adhesives. The samples all used a 'superglue' used to bond uPVC fascias. Two of the samples were applied straight to the Correx while the third sample had been pre-treated on both faces with Loctite for Plastics activator primer. John then attempted to peel the two layers of Correx apart. The first two samples were delaminated very easily while the third sample came apart with much effort, tearing the Correx surfaces in doing so. John has prepared a comprehensive matrix on most of the adhesives available in the marketplace. .

After tea, coffee and banana cake Peter Gilchrist, who had recently returned from a holiday in New Zealand, related the historical details of the colonisation of New Zealand by expedition voyagers from Polynesia and how the Maoris abandoned the traditional Waka (catamaran) in favour of mono-hull canoes for trading and war. He described in detail the steps undertaken to build an eighty foot long war canoe over a period of four to five years. Of particular interest to the meeting was the high 'tail' mounted on the stern of the canoes. Peter explained that during a conversation with one of the Maori elders he was unable to ascertain the reason for this device. John Alldred suggested it would prevent the canoe from turning turtle in the event of a capsize while Roy Anderson suggested it might be a steering aid, helping the canoe to remain head to wind when at rest. Peter got the impression it had an effect on the rolling of the canoe in a seaway by increasing the roll period.

Mike Howard gave a short update on progress (or lack of it!) on the Morley Tethered Kite Sail Project.. Roy Anderson admitted he had been conducting some 'dining room table' trials of his own, using a small model and a desk fan. He had concluded that the rig produced an inbalance which could be countered by adding an identical rig in the aft end of the boat. Much of the discussion centred on whether the boom needed to be locked or whether the rig could be left to self align. Mike Howard stated he felt the boom needed to be locked to get the sail to power up, thus defeating one of the main objectives of the rig which was that it was supposed to be self trimming.

AYRS North West UK Forum Meeting 28th June 2014

The meeting opened with a report from John Shuttleworth on the Beale Park Boat Show held at the beginning of June. John, a regular visitor to the show, felt that the this year's show was a shadow of previous years and that the organisers were sure to 'spice it up' next year as a number of exhibitors had expressed the same opinion about the format.

Next to report was Colin McCowen who stated he had not made any further progress with his Towed Hapa Hydrofoil. He is looking for someone with a power boat so he can carry out high speed (unmanned) trials before committing himself to manned flight! John Alldred offered to put him in touch with a guy he knows who runs the safety boat for a local sailing club.

Colin then outlined his conversion of a Canadian canoe to allow it to be propelled by oars. His sliding seat comprises the wheel assembly from a roller boot with a sculptured seat attached to the top of it, guided by a pair of aluminium angles. His foot straps were even more ingenious. A pair of hinged boards have been attached to the bottom of the canoe. A pair of sandals are then screwed to the boards, thus safely retaining his feet in position while rowing. Colin told us he has trialled his rowing canoe on the river Mersey and on the Manchester Ship Canal. He also mentioned he had fitted a skeg to the keel of the canoe to aid directional stability.

Colin then went on to describe how he intends to convert the canoe for sailing, using a dagger board attached to an outrigger arm, in turn, connected to a pivot point on the side of the canoe so the dagger board operates in free water about half a metre from the side of the canoe. The dagger board will be symmetrical in cross section and will remain parallel to the canoe's centreline, while being moved fore and aft by pivoting the outrigger arm, thus altering the position of the centre of lateral resistance. The canoe will be rigged with a simple sprit sail and will be sailed proa style with a steering oar over the appropriate stern..

Both Adrian Denye and Mike Howard advised Colin on the proportions and position of the sprit and how the sail should be trimmed, Adrian adding that it was a little undestood sail which had tremendous drive and was easy to rig and control.

John Alldred outlined his investigations into the bonding of Correx, fluted polypropylene board. John has tried many different recommended adhesives with little success. The main problem is trying to secure two pieces together when they are under tension. Adrian Denye suggested stitch and glue to which John disagreed stating that stitching is fine but it still left the problem of which glue to use. Mike Howard stated he had seen a folding boat design which used monofilament to 'sew' the plywood parts together using a kind of 'cross over figure of eight stitch.' If this method was used to take the loads of two pieces stitched together under tension then Gaffer Tape could be used inside and outside to effect a seal.

Several other discussions took place, one in particular centring on suitable varnish products that could be applied 'wet on wet'. Adrian Denye suggested several manufacturers. Adrian updated the meeting on the latest America's Cup design changes and features. Brian Shenstone reminisced about steering an ex German E Boat during his National Service in the Royal Navy, while stationed on the river Elbe. Although the above subjects seem totally disconnected, such is the variety of conversation at our meetings that we 'float' easily from one subject to another.

Finally, Mike Howard announced that he was ceasing work on the Morley Tethered Kite Sail project, as, for personal reasons, he was giving up boating as a hobby. He reassured members that he would continue to run the AYRS North West Group and also retain his lifelong interest in ships and boats of all kinds. He added that after last year's trials, using the original demonstrator sail mounted on an inflatable dinghy, he had failed to get the rig to set. He was now not convinced that the system would work. Research on the Internet had also shown him that a similar freely rotating rig had to have a restraint added to the rotating mast to prevent it continuously weather cocking. This was what he had experienced with the Morley Tethered Kite Sail last year. If this feature was fitted to the Morley rig it would completely invalidate the Inventor's intention.

Slade, Marcus and Ruby the dog on the return leg of the C Tender Challenge

Dennis Adcock and Lady passenger on their winning return leg of the Cordless Tender Challenge. The odd lean is because the seat back had collapsed! Dennis builds lightly.

August 2014 Newsletter from Fred Ball

Beale Park Boat Show was as usual very enjoyable with plenty to see and do, Slade and myself took part in the Watercraft CCC and while we didn't win any class we did win a prize for steady endurance.

The event was organised by Watercraft Magazine and sponsored by Makita Power Tools. I've just received the latest copy of Watercraft Magazine and I am able to report that the Cordless Canoe Challenges will take place again next year with the same rules so, if you want to enter, start thinking now

Another interesting boat was this folding RIB sailing boat (opposite), the rigid hull was made in several sections with protrusions and indentations at the end of each section which engage to make a rigid main hull when the tubes are inflated but allow the main hull to be folded when the tubes are deflated. 4.5m long, approx. 5 sq m sail area, hull folds to 1.4 x 1.00 x 0.45 m and weighs 80kg.

Shortly after Beale Park I went to Seawork, a commercial workboat exhibition, where I saw several things of interest including a catamaran by Nauti Craft where the bridge deck was separated from the hulls by a suspension system, which avoided the bows-up attitude before planing, and heeled into turns (like a single hulled planing boat).

Also a line handling tug strangely like the mini lake tug at Beale Park. This was actually 9m long and prices started at £180,000. My highlight of the day though was a demonstration trip on South Cat 24m wind farm support vessel. What really impressed me was the way that she was able to manoeuvre

"Chicken Nugget" the Southampton University student's entry, convincingly leading Dennis in the final of the Cordless Canoe Challenge

This home built mini (16 foot) version of an American Lake tug was powered by a 5hp Honda outboard in a discrete well but had sound effects representing a single cylinder diesel

around a buoy with her bow remaining about 2 m away from the buoy the aim being aided by the centre stanchion of the pulpit being painted yellow. This was done using just her water jet propulsion units.

Safety equipment was of course much in evidence. I thought that a manually inflated life jacket made by Crewsaver with 60N permanent buoyancy (like a buoyancy aid) made sense, as a short trip in a dinghy hardly needs the use of an auto-inflating one with the expense of rearming if used, but it would give you the benefit of flotation in case of the accident that can so often happen in that short trip ashore. Crewsaver Evolution 250N Lifejacket

Another item was a MOB recovery system. "QuickSling", still being developed, is essentially a semi rigid buoyant frame about 0.7 m square with a lasso velcro'd inside it on the end of the tether. The idea is that you throw the device towards the MOB, who ducks into it, and is then tethered to you/mothership, and can be drawn towards you. If the victim is still strong enough they can use the frame as a step to help their retrieval; otherwise the lasso keeps them safe while hoisting is arranged. (I'm not sure the constriction of the lasso would be a safe form of hoist).

Another highlight of my summer was going to the Human Powered Flight meeting at Lasham Gliding Club. Getting up early to be there for 5.00am was well worth while. Airglow made several flights of 300-400 metres on one of the two mornings I was there. It looked so easy! But the pilots took turns to maximise stamina, and were careful to "warm up" before launching. The delicacy and precision of the construction can only be admired.

Airglow, Britains only flying human-powered aircraft, flying at Lasham.

Catalyst Calendar

This is a free listing of events organised by AYRS and others. Please send details of events for possible inclusion by post to Catalyst, BCM AYRS, London WC1N 3XX, UK, or email to **Catalyst@ayrs.org**

January 2015

9th – 18th London International Boat Show
EXCEL Exhibition Centre, London Docklands. AYRS will be there, probably for the last time! Helpers are wanted to staff the stand (No E062A), sell publications and recruit new members. If you would like to help (reward: free ticket!) please contact the Hon Secretary email office@ayrs.org

25th All-Day AYRS Meeting
9.30am-4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey (off A320 between Staines and Chertsey – follow signs to Thorpe Park, then to the village). Tea and coffee available but bring your own lunch. Donations invited to pay for hall. Further details from Fred Ball, tel: +44 1344 843690; email: fredball@ayrs.org.

25th AYRS Annual General Meeting
4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey (as above). Note: Items to be formally considered by the AGM, including nominations for the Committee MUST be received by the AYRS Secretary ASAP(email: secretary@ayrs.org)

February 2015

Late February (to be confirmed)
AYRS North West UK Area Forum visit
Ellesmere Port Boat Museum. Contact: Mike Howard, email: ecotraction@aol.com

28th –1st March RYADinghy Show, London
Many sailing dinghy classes and beach cats will be on display.. For details see www.rya.org.uk

March 2015

Date to be confirmed
AYRS North West UK Area Forum meeting
Contact: Mike Howard, email: ecotraction@aol.com

April 2015

11th AYRS South West Area Meeting near Plymouth, UK
For this year we will return to a simple format, just a gathering to spend an hour or two (or more!) chatting about boats and sailing. This will probably take place at our house, but if we do manage to attract more people we could of course hire a suitable room. As before, we can offer overnight sleeping space for a handful of people travelling from afar and we can perhaps think of something we can do together on the Sunday morning.It would be good to get an advance idea of the number of people interested in this, please contact me at j_perry@btinternet.com

26th Beaulieu Boat Jumble
The National Motor Museum, BEAULIEU, Hampshire, UK. AYRS will be there!

May 2015

11th-15th AYRS Boat trials, Portland, UK
Probably at the Portland and Weymouth Sailing Academy. We will have a Safety Boat there on Tuesday, Wednesday and Thursday to assist with boat launching and recovery. We will be able to do some timing on Tuesday, Wednesday & Thursday so anyone wishing to come down for a day will be welcome to join in. This includes Windsurfers and Kiters as well as BOAT Builders. This is a Social Event and we will eat at different venues in the evening. We invite all AYRS members and Speedweek enthusiasts to come along or just pop in for the day. Contact: Norman Phillips email: wnorman.phillips@ntlworld.com; tel: 01737 212912.

22nd– 25th *Broad Horizons 2015* AYRS Sailing Meeting, Norfolk, UK
Barton Turf Adventure Centre, Norfolk UK, NR12 8AZ. Note: All boats limited to 1.2 metre max draft! Everyone welcome, overnight accommodation can be arranged. Possibility of a wingsail-building workshop if enough interest. See www.ayrs.org/ Broad_Horizons.htm, or contact AYRS Secretary, BCM AYRS, London WC1N 3XX, UK; email: office@ayrs.org.

June 2015

5th -7th Beale Park Boat Show
As usual we will have a stand and would appreciate small exhibits and display material and of course offers of help to run the stand. Contact: AYRS Secretary, email office@ayrs.org

Date to be confirmed
AYRS North West UK Area Forum meeting
Contact: Mike Howard, email: ecotraction@aol.com

AYRS Annual General Meeting 2015

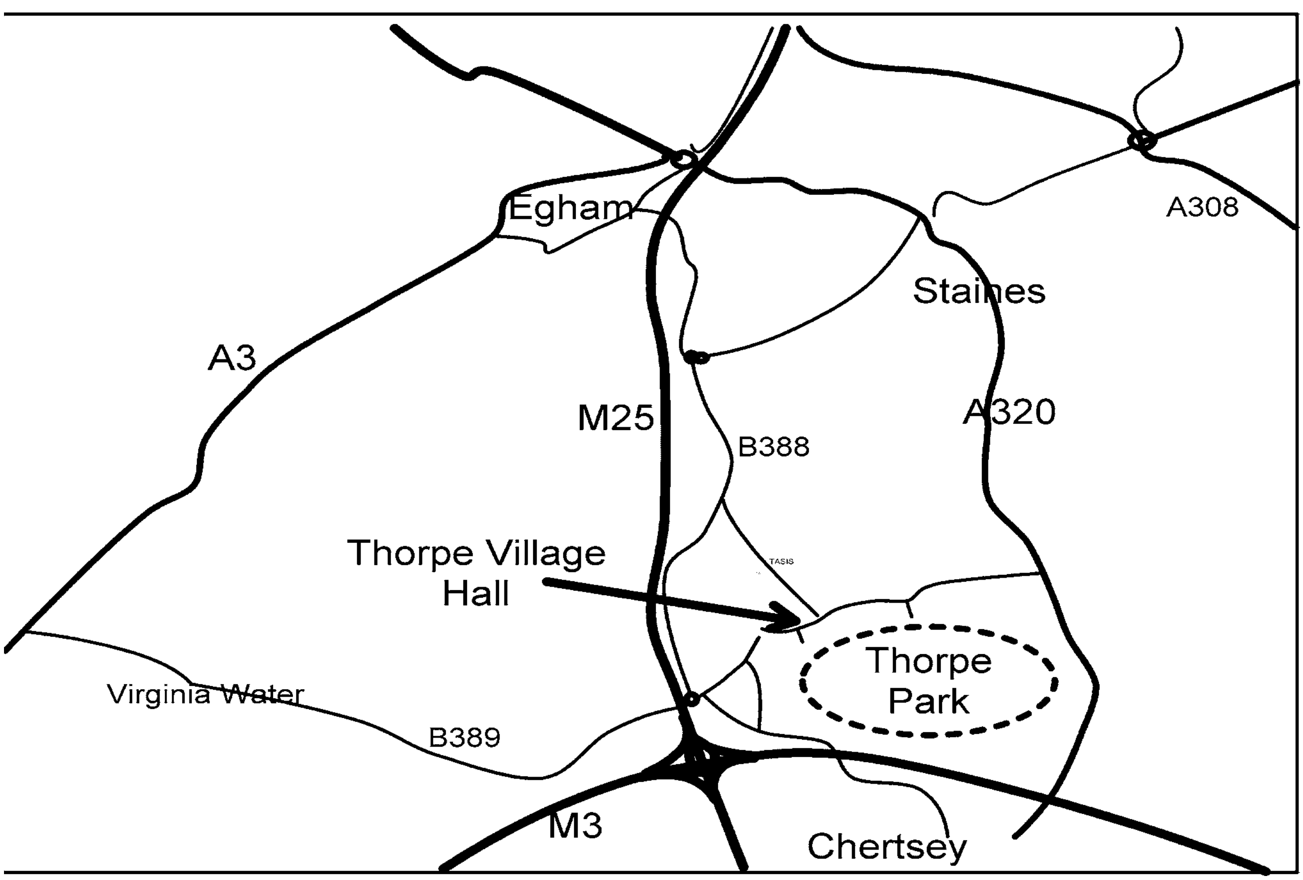
Notice has been given that the Annual General Meeting of the Amateur Yacht Research Society will be held on 25th January 2015 in Thorpe Village Hall, Thorpe, near Staines, England, TW20 8TE, starting at 16.00 hrs. All members and their guests are welcome to attend, but only paid-up members may vote on resolutions.

The business of the meeting will include the following, not necessarily in this order:

1. Receipt of apologies for absence
2. Minutes of the previous AGM (on the AYRS website)
3. Chairman's Report (on the AYRS website)
4. Treasurer's Report and Approval of Accounts (on the AYRS website)
5. Election of Officers and Committee members
6. Appointment of a Reporting Accountant
7. Any Other Business

Relevant documents will be posted on the AYRS website www.ayrs.org.

Matters for discussion under Item 7 should be notifi ed to the Hon Secretary as soon as possible. Email hon.sec@ayrs.org. Any queries should be addressed to the AYRS Office, email office@ayrs.org.



Catalyst — *a person or thing acting as a stimulus in bringing about or hastening a result*

On the Horizon . . .

Wingsail construction

Hydrofoil action

More sources and resources: reviews, publications and Internet sites

ISSN 1469-6754
48
9 771469 675009

Amateur Yacht Research Society
BCM AYRS, London WC1N 3XX, UK

Printed by Rapidity Communications Limited, London EC1V 7JD