





**Membership News**

There has been 2 new members since the last newsletter. Please join with me in welcoming **Alan Hay and Jonathon Buckie** to the club. We look forward to seeing them at the lake.

The current membership now stands at 88, including 2 junior members.

**Nearest Defibrillator to Lake**

There was an incident at the lake a few weeks ago when regular non-member attendee Pete had a heart attack after being stung by a wasp. He was rushed to hospital by Andrew Will who allegedly jumped a few red lights!! Following this Barry

Parsons investigated as to where the nearest defibrillator was. It transpires that there is one mounted on the wall of the shop by the Roger Morris Community Centre which is just by the carpark for the lake.

I am pleased to report that Pete has made a full recovery and has been down to the lake.

### **Some Random Jottings**

I have a book called New Forest 222 in which the area of the New Forest is divided into 222 square miles with a place of interest described for each square mile.

Now I knew that the Forest was the location of a number of WW2 airfields, bombing ranges etc., the embarkation point for D Day troops, and Calshott being not only the site of one of Henry VIII's castles, built to defend Southampton Water, but also of the early days of Seaplanes and the Schneider Trophy air races. What I didn't know is that in the Church of St John the Baptist at Boldre is a memorial to the sinking of HMS Hood and a service held each May by members of the Hood Association.

If you are ever in the New Forest I can recommend visits to the Church and Calshott.

As an aside during the 1920s Calshott was home to one "Aircraftsman Shaw" who was actually T E Lawrence of "Lawrence of Arabia" fame who had enlisted in the RAF under an assumed name. One of our past members, Mike Tomlin, was a cinematic camera operator who worked on, amongst others, the film Lawrence of Arabia.



Next we have an article from Chris our Chairman on his experimental model.

**Ardupilot, Arduover: - “Flight Controllers”**

This is a short discussion of my adventures into the world of “Flight Controllers” and if they could be an advantage to us in the world of boats!

My interests.... By no means am I an academic or qualified in control systems, but was an apprentice in ships engineering, progressing to Part A of Chiefs certificate, passed 2nd's (motor) ticket, but only worked as a junior. Then worked in Natural Gas, Cryogenics, Turbo-Compressors, Refrigeration plant, and sweet making. But through all of those industries, I had a great interest in the control systems used in each of the industries. It is exciting what a well-designed, and well-built control system can do. (Very sad when it can't.) The application of the technologies to other fields is interesting, and can we benefit in the model boat world?

We suffer at being at the bottom end of the “user population” in the model world, but if we can use the busier plane/drone world to develop products that we can use in some way, in boats, submarines, and hovercrafts, then that's a benefit.

Initial exploration began with how to get the lights of the Southampton/Richardson tug, working with a different radio?! This started working with integrated circuit chips, then using Arduino's, a process logic controller, to do the job. Surprisingly it worked. The Aziz and Dusseldorf/Bramley were the last results.

**Ardupilot etc.**

The field of flight controllers (FC) is the current “game.” Drones and helicopters can be flown by very good pilots, in their raw arrangements. By adding in Global Positioning (GPS) Inertial navigation, (with magnetic & gyro systems,) barometric (for height measurements) LIDAR (light/distance) and SONAR (depth) systems, then the stability and controllability of the crafts becomes easier, and allows the less able operators to “fly” safely. Many developments have been made in these flight controllers, to do just this, with costs reducing, and the range and complexity advancing all the time.

The flight controllers use very fast calculations, from the various inputs, to know where the craft is, and where and how fast it is moving in all directions, to be able to rapidly stabilize, and move in a desired way, while avoiding “observed” obstacles. Stability and ease of operation came about, but along with this, if you know where you are, you can plan to go somewhere else, and come back again, while controlling motors, propellers & steering, battery and power systems. Routes can be planned, and stored, to be repeated again.

**The systems:** - Ardupilot and PX4 are some such firmware control systems that can do this. They began using Arduino's, but moved onto much more specific and specialized kit. There are several variants, tuned for different applications, for planes, helicopters, and “ROVERS.” Rovers are intended to include craft that move on only the ground or water, no altitude involved. Boats, sailboats, hovercraft, and lawn mowers are included here.

The programming language used is based on C++, and is a “modular” system, where there are units responsible for a specific thing, like power management/battery control, taking in signals and outputting a result that the master/main control unit can understand, and use to plan what the craft can do or should do in case of dwindling power. This modular approach means the changes can be more focussed, and if necessary only apply to a particular module, or mean a new module can be added to do something else.

**The hardware:-** The physical part of this flight controller has many varieties, but includes PIXHAWK, CubePilot, etc. These are both boxes of electronics, that sit on a baseboard, which has a range of different connection sockets, that link to different “sensors” or outputs, like RC receivers, battery monitors, GPS modules, LIDAR sensors, ESC’s/motors, rudders, and so on. All the calculations using the Ardupilot/Arduover/PX4 logic, are carried out in these units.

There are quite a range of methods that the sensors use, and most are handled by specific connectors and parameters variations in the flight controllers. These include telemetry, serial, SBUS, I2C, CAN, MAVLINK PPM, PWM and so on.

The calculated outputs are sent out, through a different set of connections, to ESC’s, servos, which are in turn connected to motors, rudders, ground steering, bait droppers, the list goes on.

During all of this, the radio control system is talking to the flight controller, and depending on the chosen flight mode, the flight controller decides what the craft is to do, and checks that that is actually happening, revising the plan, as changes are detected. Collision avoidance is part of this. In manual mode the pilot controls the craft in the conventional way, but in stabilized mode the signals from the transmitter are interpreted by the FC, and it helps or adjusts motors, to keep the craft level, at a constant altitude, as required. In Auto mode, a previously planned route is carried out by the FC, with minimal or no pilot actions, though the pilot can take over control if necessary. In case of low battery power, the FC can be set to automatically return to launch.

**The Ground Control:-** The last main part of the system is the ground controller. There are various forms, including Mission Planner, QGroundControl, Solex and others. The ground controller talks to the FC, directly via telemetry radios, or through the RC receiver. This is the link to the automated parts of the system, and where the route planning, mode control etc., is carried out. Some RC transmitters have built in ground controllers, though they could be used within mobile phones, tablets, or laptops.

**Ancillary kit:-** Many other bits and pieces can be included to do different things, like cameras, sonars, LIDARS, bait boat launchers, which depending on the way they are configured and matched into the FC, depends on what can be done with them. For example cameras can be controlled by the ground control, tracking a target,

zooming, or panning round, with displays on the RC transmitter or the ground controller screen. Many drone pilots use this video telemetry with goggles to be able to see what their drone is seeing, and control its movements, while well beyond useful sight ranges. Sonar and LIDAR can be used by fishermen, to see under their vessel, and know what is round or under them, helping with control. A favourite spot can be saved for future visits. The ground controller can be programmed to follow a route that zig-zags across our pond to cover and map, with sonar, the pond bottom, and show all lumps and bumps. (Perhaps it could even find Keith's boat!) (Might be too soggy.)

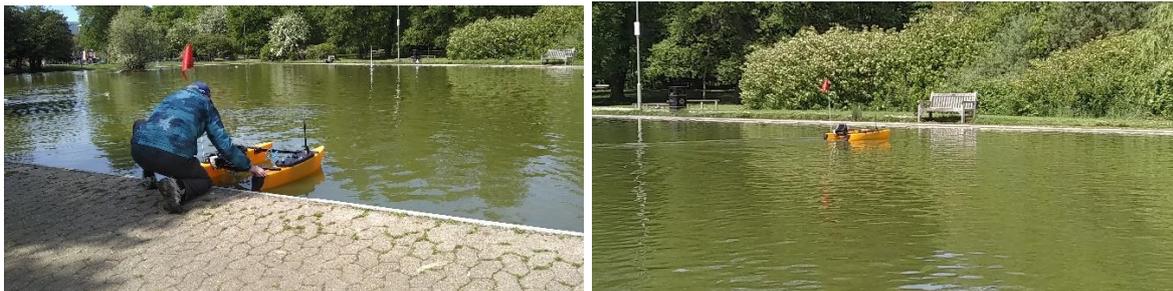
**The boat:-** the boat has have a bow thruster, 2 stern motors, and rudders. Additions may include sonar, 2 forward looking LIDARs, (for collision avoidance,) and a camera.

The aim is to discover what can be done, and getting all the bits to work together, to do what is expected. Tuning may at times be required, to smooth things!

The hull is a recovered mouse eaten, dried out wooden test tank hulk, from an old naval architecture firm which was based at Worting House. A simpler system could be "blended" onto the AZIZ.

So other hobbies developments can be used by us in boats, subs, or hovercrafts, with some adaptions, to explore, investigate, stabilize, or collision avoid, while at the pond. Radio control systems, ESC's, motors and so on are so much more capable, than when we all started in the hobby, and of course the traditional 2 stick RC control of a boat, is often all that is required, but for variety, there are many other things that can add (or confuse) to our experiences.

*Since writing this article Chris's experiments have continued and he has also sourced a large yellow Catamaran used for survey work which he has been using as another testbed for autonomous operation.*



### **The Houseboat – Keith Ebsworth**

About eighteen months ago, while browsing the travel section in the Sunday paper, I spotted a picture of a houseboat. There was no caption but I think it was Sri Lankan. If anyone knows different, please let me know. That's unusual I thought, you don't see many of them at the pond, perhaps it would be good for a future build. So, I put the picture in my boat file and got on with other things.



Mid October 2024 arrived and I decided to start on my usual winter build so, I dug out the boat file and there was the houseboat. As some of you will know I like a challenge and decided to try and cut the whole boat on my cnc router. This immediately highlighted a problem. I wanted the boat to be a reasonable size, somewhere between 300 and 400 mm deck length but my cnc has a maximum cutting size of 285 by 165 mm. The obvious solution was to cut everything in panels and glued them together. I finally settled on 380 mm long deck as I could scale everything in the picture to twice the size which would save me having to do any complicated calculations.

The reed panels looked to be the trickiest to design so I started with them. To get the layered detail I needed to use reasonably thick wood but wanted it to be something that was easily obtainable in case anyone else wanted to build one. I settled on 3.6 mm plywood as I knew from previous builds that it is generally about 3.2 mm so would allow several layers of detail and still maintain its strength. The other advantage is that it is readily available from diy stores, although the quality does vary between the different companies. I used Wickes for the schooner build and it has proved reliable so that is what I choose. A 600 by 1200 mm sheet is currently £11.

Using my favourite 2.5d software, Carbide Create, and a combination of 0.8 and 3 mm cutters I made the cabin walls followed by the frame parts to glue the walls to.

The pitched roof looked tricky so I modelled it in my 3d software, FreeCad, so I could measure all the lengths and angles. After that it was easy to use these measurements in Carbide Create and design two roof panels which are duplicated and mirrored to give the eight panels needed for the complete roof.



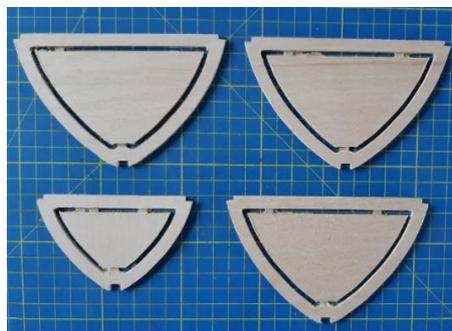


I then started work on the deck which was easy as it was mostly straight with curves for the bow and stern plus a hole under the cabin to allow access to the electrics. The hull was going to be a different prospect as most of it is under water in the picture so I was going to have to make it up as I went.

I had the length and width at deck level so I started mocking up some bulkheads and a frame in FreeCad as it allows you to draw in 2d then pad items into 3d and view from all angles. The bulkheads looked quite small so I cut some out of cardboard and, they still looked small. I was worried that the hull would be under size for the rest of the boat but I had a light bulb moment.

It occurred to me that I had multiple boats that ran well and it obvious had something to do with their displacement in the water. Checking the hull length, width and depth on existing boats I discovered that the depth seemed to be proportional to the length and width.

Applying the same calculations to the houseboat it turned out that the bulkheads were correct. I'm still not sure if this is a coincidence and perhaps, I've got it completely wrong but time will tell. I decided to make two copies of each bulkhead so after they were glued together, I would have a reasonable thickness for gluing stringers and planking to. I left the centre sections connected so I have a reasonable area to clamp to and push then out once the hull is glued together



With the bulkheads cut I started designing the keel. I knew the length and depth so I modelled the keel in FreeCad, took the design into Carbide Create and cut it into two

pieces to fit the cnc. I wanted to double the thickness of the keel so I made a copy and offset the cut point so there would not be a weak point when the four pieces were glued together. After cutting the pieces I realized the keel was 20 mm too short, somehow, I had made a mistake on my calculations. Rather than waste time and wood cutting some longer pieces I designed a small fill in piece and modified the existing keel to fit them. I think with some sanding and painting it shouldn't show.



I designed the top frame of the hull so that it fits into a notch on the prow and sits on the back of the keel. The rest of the frame will be stringers that fit into notches in the bulkheads and attach to the prow and stern.



Normally when constructing a hull, I use a base board with wooden blocks glued to it. I then clamp the bulkheads upside down to the blocks so everything is held at right angles and add the stringers with the keel going on last. With the protruding prow this was going to be a problem so I decided to build it right way up. With the addition of a piece of scrap wood and some 3d printed right angle blocks I clamped the keel in place. I wanted some blocks for a future woodworking project so printed them early and used them to clamp the bulkheads. I then glued the top frame and highest stringer on both sides in place. The frame was now sturdy enough to remove the bulkhead clamps to gain access the fit the lower stringers. While waiting the obligatory 24 hours for the glue to go off I started working on the veranda section of the cabin.



So far, the build has gone well with only a couple of minor errors where I had to change the cnc files and the existing parts were easy to modify.



I still have to sort out electrics and running gear plus a bit of planking and some painting but I'm aiming to have her finished by the spring for a maiden voyage. More to follow when I've may some progress.

*Many thanks Keith and we hope to see the model on the lake in the not too distant future!!*

### **Thinking about scale – Dave Cleveland**

Scale is something we talk about and use in the building and sailing of our boats, but having started to think about it in a bit more depth, there were aspects that I'd never really considered before and I thought that this might be the same for you. Apologies if this is all old hat – if so, please skip to the next article. Otherwise maybe it'll shed a little light somewhere useful for you too.

#### **What scale?**

Models of large real boats tend to be on a smaller scale: for example, a 1:8 model of the Titanic would be over 100 feet long – big enough to carry passengers (and probably in greater safety than the original). Conversely, a 1:200 scale model of a 20' cabin cruiser would be just 1.2 inches long – fine for putting in a bottle, but hardly practical for sailing on a lake. We also consider the storage and transport of our models when deciding on the scale.

The scale of a model boat is typically between the ones above, so a model of the Titanic (862' 9" long) at a scale of 1:200 would be 4' 4" long and a model of a 35' sports boat at a scale of 1:8, would be about the same length.

The modeller's dexterity and the desired degree of detail in the model also influence the choice of scale. Faithfully representing, for example, a 1 metre tall stanchion with rails on a scale of 1:200, requires it to be no more than 5 mm high and less than 0.1 mm in diameter with the rails less than a mm apart; at 1:50 it would be 20 mm tall and 0.4 mm diameter, i.e. rather more practical for most of us. If only we could scale our hands down to the model's level for the duration of the build!

For a model to look realistic, all of it needs to be to the same scale, i.e. the same number of times smaller than its equivalent real one. We use the scale to determine the sizes of the bits when designing and making a model and we sometimes work out the scale of an existing model by measuring elements for which we know the real size.

### **Length and size**

The real Titanic was not 200 times as big as a 1:200 model: 200 such models would have fitted comfortably in one of the lifeboats (sadly the same couldn't be said for passengers and crew in April 1912). And if we use the usual scale value to determine the weight of the model, we'd end up with needing about 260 tons of ballast. We need to use the volumetric scale: in this case 1:8,000,000 (i.e. 1: 200 x 200 x 200), which results in a model weight of about 14.4 pounds, or about 6.5 Kg. About 8 million such models would take up the same space as the real one, albeit somewhat deformed to make the same overall shape.

Here's a table of volumetric scales for a range of linear scales:

<b>Linear scale 1:</b>	<b>8</b>	<b>16</b>	<b>25</b>	<b>32</b>	<b>48</b>	<b>75</b>	<b>100</b>	<b>200</b>
<b>Volumetric scale 1:</b>	<b>512</b>	<b>4,096</b>	<b>15,625</b>	<b>32,768</b>	<b>110,592</b>	<b>421,875</b>	<b>1,000,000</b>	<b>8,000,000</b>

### **Small scale or large scale?**

The terminology for scale can be a little confusing: in fact it is confusing, so just to be clear: a small scale model is proportionately smaller than a large scale one for the same real thing, but the smaller the model, the larger the scale number for the same original. So a 1:200 model of a boat 100 feet long would be just 6 inches long and this would be considered a small scale model whereas a 1:20 scale model of the same boat would be 5 feet long and considered a large scale model.

### **How about speed?**

The speeds of boats are usually quoted in knots. One of these is equivalent to about 1.15 miles per hour, or 1.9 kilometres per hour.

So what about the speeds of models? Well, if we ran a 1:8 scale model of a 20-knot real boat at that same speed it would complete a circuit of our lake in about 7 seconds: clearly that's too fast (although many a model is seen skating around at something approaching that: and very impressive they are too!).

Because speed is about how far an object travels in a given time, it's one-dimensional and so we use the basic (linear) scale in working out the scale speed. If you're uncertain about why models need to go slower than the real ones in inverse proportion to the scale number, think of it this way: the speed of a boat can be

measured by recording the time it takes for the stern to get to the position the bow was in at the start of the measurement, so if the object is longer, the stern has to move faster to get to where the bow was in that time and vice-versa. This measurement for the real Titanic at cruising speed would be about 24 seconds - the same as for a 4'4" model of that ship going at the correct scale speed, but the model is only covering 1/200th of the distance in that time, hence the much slower speed, which makes the model move in the same manner as the real one, which is what we aim for (?).

The cruising speed of the Titanic was 21 knots, so a 1:200 scale model should cruise around at 0.105 knots. That's not a number that's easy to relate to for our models: a bit of arithmetic gives us a more useful version of that speed: about 10.6 feet (3.2 metres) per minute.

The distance from the island to the car park end of our lake is about 160 feet so a round trip for that 1:200 model should take about half an hour. Does that surprise you? It surprised me when I did the calculation, but it is the right answer.

A 1:8 scale model of a 15-knot 35' boat (in fact, of any 15-knot, 1:8 scale boat) should take about 1 minute and 40 seconds for that same round trip.

Here's a table giving the equivalent model speeds (in feet per minute) for a variety of scales and real-boat speeds (to get the speeds in metres per minute, divide the values in the table by 3.25):

'Real-boat' speed (knots)	5	10	15	20	25	30	40	50
<b>Scale 1:</b>								
8	63.3	126.5	189.8	253.0	316.3	379.5	506.0	632.5
16	31.6	63.3	94.9	126.5	158.1	189.8	253.0	316.3
25	20.2	40.5	60.7	81.0	101.2	121.4	161.9	202.4
32	15.8	31.6	47.4	63.3	79.1	94.9	126.5	158.1
48	10.5	21.1	31.6	42.2	52.7	63.3	84.3	105.4
75	6.7	13.5	20.2	27.0	33.7	40.5	54.0	67.5
100	5.1	10.1	15.2	20.2	25.3	30.4	40.5	50.6
200	2.5	5.1	7.6	10.1	12.7	15.2	20.2	25.3
300	1.7	3.4	5.1	6.7	8.4	10.1	13.5	16.9

**Acceleration**

Of course to get our boats moving requires that they accelerate. Acceleration is a measure of the rate of change in speed and described as 'distance per time unit per time unit' or 'speed per time unit'. 60 mph is 88 feet per second, so to get to 60 mph in, say, 10 seconds from stationary, the object needs to increase its speed (on

average) by 88/10 feet per second every second giving an acceleration of 8.8 feet per second per second, or 8.8 feet per second<sup>2</sup>.

Instinct says that, like speed, acceleration is lower in the same proportion to the scale of the model, but is this true? Considering our example Titanic, let's assume, reasonably, that it took 30 minutes to accelerate from drifting with the tide to its cruising speed of 21 knots and that the acceleration was constant: that's an average acceleration of about 71 feet/minute<sup>2</sup>, and dividing that by 200, gives an acceleration value of 0.35 feet/min<sup>2</sup> for the scale model.

1/200th of the ship's 30 minutes to get to its cruising speed, is 9 seconds.

If we look at the distance travelled to get from stationary to cruising speed, the real ship would have taken about 6 miles and 1/200th of this is about 160 feet.

So how do these numbers stack up?

Inserting the above numbers into the formulae that relate speed, distance, time and acceleration we get the following results:

The acceleration of 0.35 feet /min<sup>2</sup> results in a time of 30 minutes to achieve the 10.6 feet per minute cruising speed for our model (ref the above table).

The distance of 160 feet results in a time of 30 minutes and an acceleration of 0.35 feet/min<sup>2</sup>.

However, the time of 9 seconds results in an acceleration of 71 feet/minute<sup>2</sup>. So not everything can be scaled down by the scale number: time is the exception, just as it was for speed in relation to the size of the model. It's also clear from the foregoing numbers that for our models, to truly reflect the behaviour of the real equivalents they need to accelerate much more slowly than I think we (well certainly I) usually make them do.

In general, the larger the (real) ship, the longer it takes to reach cruising speed. Think of big tankers, cruise liners and container ships: they typically take between 45 and 60 minutes whereas a cabin cruiser does it in a fraction of that time, probably less than a minute. Speedboats do it in a few seconds – maybe they should be called 'Acceleration boats'?

The acid test for all aspects of modelling is whether it looks right and I will be less heavy-handed on changes to the throttle in future in an endeavour to improve looks (of my boats: other looks are beyond improvement!).

Doing the calculations for individual models using the basic laws-of-motion formulae below could be a revelation.

### **Closing note**

In calm water particularly, the sight of a true-to-scale and well-constructed model of something that has a real counterpart is something to savour and admire. Creating

miniature versions of real things is what modelling is all about (in my humble view) and making them move realistically adds much to that image.

### **The basic laws of motion**

Sub-atomic and cosmological scale excepted, speed (strictly speaking velocity), distance, time and acceleration are related according to Newtonian laws of motion (s is distance; u is initial velocity; v is final velocity, a is acceleration and t is time)

If we consider these things from a stationary start state, the initial velocity is zero so the formulae are simplified to:

$a = v/t$  or  $a = (2 \times s)/t^2$  and  $s = (a \times t^2)/2$  or  $s = (v \times t)/2$  and  $v = a \times t$   
and  $t = (2 \times s)/v$

*Thanks Dave for a well thought out and very interesting article, I too like to see models moving close to their scale speed.*

### **Close**

Well that's it for this issue, for those of you taking bets on this, according to word count there are a massive 4813 words in this edition plus quite a few pictures. Many thanks to Chris, Keith and Dave for their contributions. Articles from members for newsletters are always very welcome so if you are restoring a model or undertaking a new build do share your experiences with the whole club.

*Cheers  
Andy*

*To save costs the Newsletter is printed in black and white so you miss some of the detail of the photos in colour, etc. – if you would like to see it in full colour I will as usual ask **Carl**, our “**Pembrokeshire located member**”, to add a copy to our BMBC website.*