
Radio C■ntrolled
Soaring Digest
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The New RC Soaring Digest

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In The Air

In September of 2022—early spring in Brasil—Rodrigo Lessaf captured pilot/builder Leonardo Horta's exotic-looking MMFLY Solaris working the rolling hills just above Belo Horizonte, Minas Gerais. (Links can be found in Resources below.)

Summertime and the livin' is easy.

In 1966 the classic surf movie *The Endless Summer* was released. Despite my parents' best efforts to get around Quebec's draconian prohibitions against kids under 16 attending movies — I was only five at the time — the plans for our family to see the future cult favourite were dashed as if they were breaking waves on one of the distant shores it featured.

I have some vague memory of that being particularly crushing for me. Mostly because it was yet another assault on my belief I was the oldest, most mature five-year-old you were ever likely to meet. But it was also because I was really disappointed I would be missing out on the secret of how a travel schedule could be arranged such that I would never encounter another Quebec winter again. Or any winter for that matter. That sounded like magic, pretty much.

Call it the moment when that five-year-old all those years ago realised the world was **not** flat, and I was not king of it, even with all the overwhelming evidence to indicate otherwise. Very belated thanks, Ma and Pa, for disabusing me of the former notion and making me *really* believe the latter.

Weirdly, I was reminded of this moment as I watched Lionel Messi and the rest of Team Argentina victoriously march down the airstair of their private jet after their flight home from Qatar 2022. As we shivered up here at the home office — the temperature of our office freezer was a degree or two *warmer* than outside the front door — it was still surprising to see the justifiably ecstatic, adoring, fanatical throng sweating it out in the blazing sun at the height of the Argentinian summer. All of it just to catch a fleeting glimpse of their superheros. Frankly, as an unapologetic sports fan, I get it. I really do. *(Sidebar: does anybody other than me think it was an absolute travesty to have such a great game end with what amounts to a coin flip?)*

I must say the weather I saw on TV down there in the south really made me want to get on the plane and head down for my own personal remake of *The Endless Summer* I had never experienced 56 years ago. Then I sadly remembered there's not much in the world which could make me get on a plane for **any** reason in the forseeable future. It made me wish that zeppelins as a mode of travel had succeeded — instead of blowing up — or that taking leisurely passage on a steamer was still an option. Formal dress for dinner, please.

The subtext for all of this is that last month there was much talk of it being *The Winter Issue* and all that. We cherish each and every reader wherever they may be. So it upset me to think I may have upset many others—in particular those who live in the southern hemisphere — that somehow my world was 'uni-polar' and that I was a rabid hemispherist. If this was the case I offer my unreserved apology here and now because nothing could be further from the truth. To try and make it up to you, I'm declaring this *The Summer Issue* in your honour.

I'm kicking that off with the key photo above taken this past spring (that is, this past September) in beautiful Brasil.

The Dumpster Fire That is Social Media

Without going into all the details — I'm absolutely sure you are already familiar with them — social media is a hot mess to put it mildly. And when I say dumpster fire I say it intending no offence or insult to self-respecting dumpster fires everywhere. I have mentioned in these pages that the New RCSD has a love-hate relationship with social. On the one hand, we're absolutely not blind to its gaping flaws. On the other, a substantial majority of our readers find their way to the Digest by way of social platforms. It's not clear at all they would find it using any other means.

Rest assured, though, that social platforms which screw up sufficiently we will drop no matter how much traffic they generate. Platforms where readers are found and — importantly—where said platform acts responsibly we'll keep. Taking the high road can be painful but it's still the right thing to do. It's a constant process of evaluation and re-evaluation that won't likely end any time soon unfortunately.

It's also important to know the New RC Soaring Digest is not just spinning in the wind and making it up as we go along when it comes to social media — unlike others I shall not name. From day one, RCSD has governed itself with a formal document called — not surprisingly — our *Social Media Policy* and I've linked it in *Resources* below. I suggest you take time to read it. It too is subject to ongoing review and revision, but at any point of indecision it can be used as a North Star to guide our humble journal through these tricky skies.

New Year's Resolutions

It's funny how we use a somewhat arbitrary calendar to box up our plans and goals for an equally arbitrary period of time. But tradition being what it is, ’tis the season for thinking about the year ahead. Except that I have an almost unparalleled record of **never** seeing one of my proclaimed New Year’s resolution through to a successful conclusion.

So, if it’s okay with you, I’m not going to make any promises I can’t keep, at least not for the New RCSD. Other than, that is, each month we’re going to strive to bring you the best product we can and then, in the month that follows, do it all over again only a little bit better again if possible.

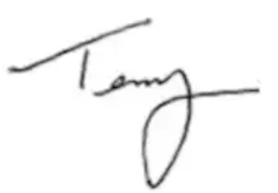
In return I ask only one thing: please remember the New RCSD being ‘free’ is actually an illusion. In reality, it costs quite a bit to bring you great articles from great authors every month. So if you enjoy what you’re getting out of the New RCSD, may I respectfully suggest one of *your* New Year’s resolutions for the coming spin-around-the-sun is help us find ways of making the New RCSD sustainable well into the indefinite future.

My humble thanks, in advance, for that.

On with The Show!

And what a great show it is — with articles from lots of contributors you know (and some you may not…yet). Thank you so much to *them* for all of their hard work and thanks to *you* for reading it. All of us here at the New RC Soaring Digest once again offer you and your families the healthiest, happiest and most prosperous of New Years and…

Fair winds and blue (it’s summer somewhere) skies!



Resources

- The collaborators for the great key photo for this article were *MMFLY* the designer and manufacturer of the *Solaris*, *Leonardo Horta* it's builder and pilot and *Rodrigo Lessaf* who captured it so well for all of us.
- *Social Media Policy* — "Civil. Smart. Focused. Accountable."
- *The Endless Summer* — The 1966 surfing movie which kicked off this stream-of-conciousness ramble 'round the houses.
- *Summertime* on Apple Music. — A beautifully remasterered, lossless version of the seminal summer anthem featuring the immortal Ella Fitzgerald and Louis Armstrong. It is *The Summer Issue* after all.
- *AeroSPARX* — "the original market leaders in airborne pyrotechnics…we paint with light …"

***Cover photo**: This month's spectacular cover photo — and the photos immediately above, from the same series — were taken by Greg Perrins and are used here with his kind permission. Greg captured the AeroSPARX Grob G–109B motorglider performing its airborne pyrotechnics display at Weston Park Air Show in June of 2017. Happily these photos simultaneously evoke both the notions of 'summer' and 'New Year' rather beautifully. You are welcome to download the January 2023 cover in a resolution suitable for computer monitor wallpaper. (2560x1440).*

Here's the first article in the January, 2023 issue. Or go to the table of contents for all the other great articles. A PDF version of this edition of In The Air*, or the entire issue, is available upon request.*

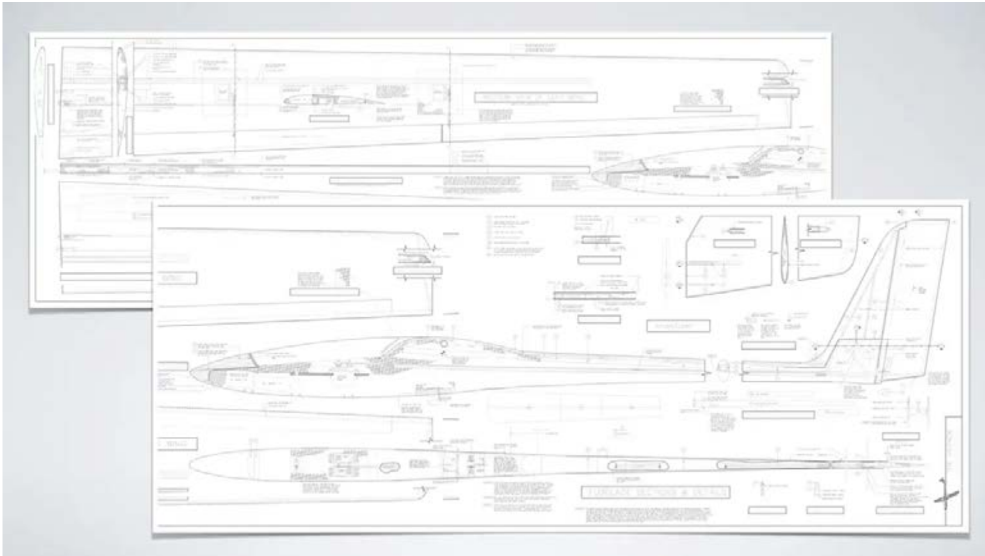
Letters to the Editor

Do we have a treat in store for you this month!

Bob Dodgson Makes Anthem Plans Available

I had my later plans like the *Anthem* set up so I could print them from AutoCAD on a wide carriage (13in I think) Epson dot matrix printer with a sprocket drive. It worked great and I could get about four sets of plans printed with one printer ribbon. However, since the plans are laid out for the wide carriage printer it may be hard to print them with other more square print methods. Anyway, I am sending you the file. I can no longer print them myself. I don't know if there is any way that Norrie Kerr can be helped in getting the full sized printed plans.

Bob Dodgson
Seattle, Washington



The PDF is actually one sheets 914mm x 2870mm. It is shown here in two parts simply for convenience.

Through the hard work of Steve Kerry in the UK, I'm pleased to announce that we have Bob's Anthem *plans transformed into PDF which can be downloaded directly from the New RCSD website — see* Resources *below. I want to personally thank Steve so much for his hard work and for Bob's permission to make these sought-after plans available to our readers. Perhaps there is somebody out there who wants to generate and contribute the files necessary to laser cut the parts? Dare we dream that somebody will do a limited run of fuselages?— Ed.*

Pozdrowienia Noworoczne z Polski

Tak sobie pomyślałem, że niedługo Dzień Dziadka? Nie wiem, czy w USA jest to równie popularne, jak w Europie. W każdym razie u nas koniec stycznia — to „dzień babci", a następnego dnia — „dzień dziadka".

Cóż może wzbudzać w dziadku radość? Wnuki! Przeglądając w świąteczne dni albumy ze zdjęciami pomyślałem, że podzielę się z Wami moją radością. Załączam dwa zdjęcia, które przedstawiają upływ czasu i mój powód do dumy! I jakoś tak jestem przekonany, że nie jestem osamotniony w swoich odczuciach? Może to się wydaje śmieszne w dzisiejszych czasach — ale jestem dumny ze swojego wnuka i szczęśliwy w swoim życiu.

Zrobione w okolicach naszego domku letniskowego w górach, w Beskidzie Żywieckim, okolice miejscowości Korbielów. Model sprzed dziesięć lat to *Backfire* czeskiego producenta P.Janku (genialny do dziś) a na zdjęciu z tego roku trzymam model *Agile* (Arthobby) a wnuk z modelem własnej konstrukcji. Pozdrawiam wszystkich szczęśliwych dziadków !

Noworocznie pozdrawiam!

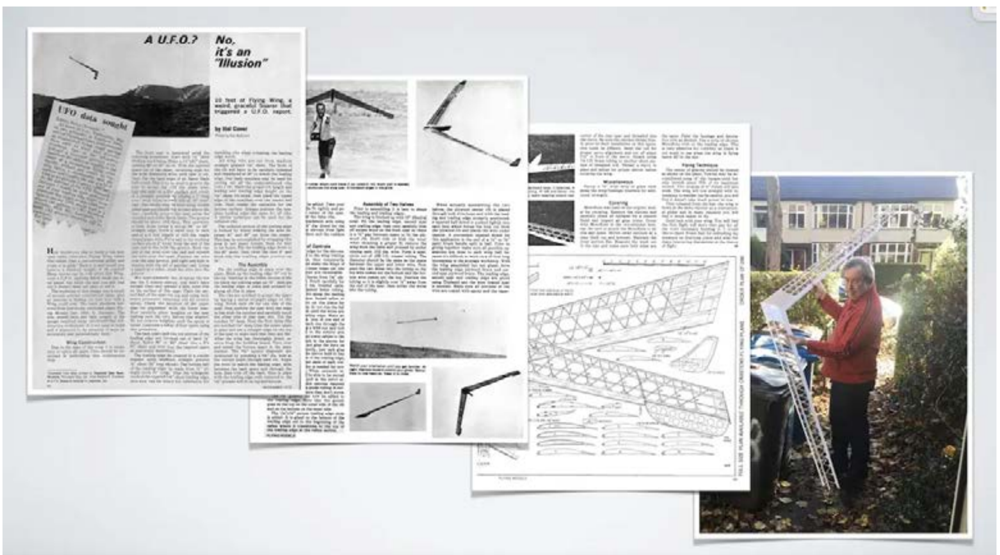
Jurek Markiton
Polska

Cześć Jurek — zawsze miło się Ciebie słucha i bardzo podobają mi się zdjęcia, które przesyłasz. Wiem, że czytelnicy też. Nie jestem pewien, czy „dzień babci" i „dzień dziadka" są powszechnie obchodzone (nie słyszałem o tym, dopóki nie otrzymałem twojego listu), ***ale powinno****! Dziadkowie są najlepsi! Jeszcze raz dziękuję za* *wspaniałą notkę i zdjęcia. Zdrowia, szczęścia i pomyślności dla Ciebie i Twojej rodziny w 2023 roku.— Ed.*

Steve Kerry's Fascinating Winter Build

Here's info on *Illusion* from 1972. This is part of my bucket list, to build all those things that I was always going to get around to but never did. *Illusion* should be flying next year when the sun comes back, followed hopefully by a few of my own design, and one that has always been in the top five of my list.

Steve Kerry
United Kingdom



What an truly fascinating project, Steve! Can you keep us posted as the build proceeds and when you eventually get it flying? — Ed.

Resources

- *Bob Dodgson's Anthem* (1.5MB PDF) — The plans as they were originally delivered with the kit. A local print shop should be able to transfer them to paper at a reasonable cost.
- *Google Translate* — The 'go-to' for all of the New RC Soaring Digest translation needs.

Send your letter via email to NewRCSoaringDigest@gmail.com with the subject "Letters to the Editor". We are not obliged to publish any letter we receive and we reserve the right to edit your letter as we see fit to make it suitable for publication. We do not publish letters where the real identity of the author cannot be clearly established.

*All images by the author unless otherwise noted. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

Cool New Stuff

The Shaka in its natural element. (credit: FlightPoint)

Santa skip your house this year? If so, treat yourself to one of these great new products.

Shaka Slope Wing

A small and convenient glider for your backpack or car boot.

The impetus for *Shaka* wasn't new — the need for a portable slope glider to carry around in a backpack or car trunk is a popular, well-established requirement. Pilots also want to know if a good location is spotted while out and about, the aircraft had to be quick and easy to get ready for launch.

When the design process for *Shaka* kicked off, there were quite a few similar options already, but not a lot based on durable wood construction. The main task, therefore, was to adapt the portability and rigidity of the popular foam *Alula*, for example, into a classic balsa glider. It was a challenge but with a great result in a form of a small, lightweight, easy-to-build and stiff construction that doesn't break the bank.

Shaka is designed and manufactured by FlightPoint located in the west of Ukraine. Perhaps surprisingly, there weren't a lot of slope spots near the FlightPoint factory, so they also created a powered version of *Shaka* which is how it got its FES (front end sustainer). This makes *Shaka* a very capable all-rounder as a result. It also provides a failsafe in the event the lift band in an unfamiliar location doesn't pan out as expected — perfect for the 'discovered enroute' slope site!

The size is relatively small with just under 1m wingspan. However, it breaks down into parts that will easily fit in a regular backpack. All that's needed to setup *Shaka* is a screwdriver for the two nylon bolts.

Left: Shaka in its disassembled state for a backpack. | Right: Ready to fly! (credit: FlightPoint)

Importantly, the airframe is lightweight and even the powered version can be build under 250g that will make it legal to fly in most countries without special registrations and licenses.

The powertrain for which this glider was designed includes reasonably priced drone motors and can employ cheap and powerful drone ESCs with no BEC if used with high voltage servos.

Shaka on the slope. (credit: FlightPoint)

The flight performance of a *Shaka* is very satisfying. It can fly slow and catch thermals on a field as well as doing a sweeping passes in wings on a slope. If you'd like to learn more about the Shaka it can be obtained directly from the FlightPoint website.

Magnetic Switch 45A HV

A robust, hidden, 30V switch designed for RC but with many additional applications.

(credit: Composite RC Gliders)

This new switch from Composite RC Gliders is a clean and easy way to turn on your model — just place the magnet adjacent to the switch for three seconds. Typically it's mounted inside of the fuselage, out of the air stream, and the magnet will easily activate the switch from outside. No more fumbling for little external switches or plugging in awkward connectors.

While it's a general purpose switch designed for RC, it has many additional applications including RC submarines, diving lights, car or motorcycle immobilisation and many other potential uses where activating the switch from outside the vehicle hull is an advantage.

It also has a built-in failsafe function: it remembers its state for at least ten seconds even when disconnected from the battery. It will protect the switch from power glitches and spikes caused by poor electrical connections.

The switch has an ultra low stand-by consumption while in the off state — so low that the switch can be connected to a small battery for several *years* without discharging it. Additional specifications are as follows:

- Input voltage range: 6v~30v
- Output current constant: 45A @ +25C ambient temperature

- Output current burst: >90A
- Ultra low stand-by current: 8μA (micro-ampere)
- Connectors: XT60
- Weight: 15g / 0.53oz
- Dimensions: 46mm x 18mm x 13mm / 1.81in x 0.71in x 0.51in
- Operational temperature range: -40C to +85C

Additional information can be obtained directly from the Composite RC Gliders website.

New RC Soaring Digest Cover Photo T-Shirt

December 2022 Edition

The almost sculptural cover photo was taken by Pierre Gumy at Oberiberg in the Swiss Alps in December of 2017. The aircraft is an *Elf* from Vladimir's Model of Ukraine. According to Pierre, it's a modest 100cm span, weighs just 100g and he says "it's a fantastic little plane to fly anywhere in very little wind. It's very relaxing to fly and one of my favourites." Thanks again, Pierre, for the opportunity to feature your beautiful photo.

This beautiful t-shirt feels soft and lightweight, with the right amount of stretch. It's comfortable and flattering for all. 100% combed and ring-spun cotton; fabric weight: 4.2 oz (142 g/m2); pre-shrunk fabric; side-seamed construction shoulder-to-shoulder taping.

This product is made especially for you as soon as you place an order, which is why it takes us a bit longer to deliver it to you. Making products on demand instead of in bulk helps reduce overproduction, so thank you for making thoughtful purchasing decisions. More information can be obtained from The New RCSD Shop.

Say you saw it in the New RC Soaring Digest.

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The Road to Ulm

April 2022: The author at the Model Flying Ranch in Spain, with both of his PCM Elvira. (credit: Jos Medley-Rose)

This has been one helluva year!

This is a sequel to Iain's very popular The Road to Gruibingen*, which you may want to read before proceeding with this article. As usual, click on any image for a higher resolution and also check out* Resources*, at the end, for relevant links.. — Ed.*

The story so far? The essence of it boils down to I found GPS Triangle Racing (GPSTR) tried it, liked it and entered the first *Sport Class World Championships*. They were cancelled because of the pandemic and as soon as the entry for the new event in Erbach, Ulm opened I pestered the organising committee in a particularly persistent manner until the entry list showed my name.

Having a significant flying goal for 2022, this is what happened and some of the learning that was achieved along the way. In many ways the attraction of GPS racing is the learning and challenge, and in some cases one of the things that makes starting out a bit daunting.

Onwards

After a very satisfying October at the *Model Flying Ranch* in Tortosa I even managed to fly some triangles on the 2nd November 2021 in the UK. Everything felt very positive as the calendar slid towards Christmas. I even managed to get some work done on the electric fuselage for my original *Elvira* that was to become my number two model until such time as my new GPS rocket ship turned up.

Suddenly the date on my phone was telling me it was the 14th March 2022, and I'd only flown on the slope during what had been frankly a less than wonderful run of weather through the early part of the year. Okay the testing of the Aeroic Composites' *Alpenbrise* had been a fun distraction and trying to rag the wings off it was very enjoyable, but it wasn't flying triangles. The 14th March was the first triangle of the year and was less than a month to departure date for Tortosa to fly the *Model Flying Ranch Easter Challenge Cup*.

My first big issue was the number two plane for the *World Masters* was still not ready. Second on my list of issues was the lack of flying I'd had. GPSTR does not forgive low flying hours, your skill level can drop off very quickly. Third on my list of concerns was the week cycling in Mallorca booked in the gap between the 14th March and setting off for Tortosa — for which my fitness was woeful and I was feeling really run down. So run down, in fact, that I spent the first four days in Mallorca recovering from a massive cold.

Tortosa, Spain, looking towards the Model Flying Ranch waiting for the weather to improve.

Arriving in Tortosa on the 15th March with two *Sport Class* planes was a good start and probably the first success of the year! The rest of the event was, from a flying point of view, not great. My light class plane succumbed to an invitation to become a cloud of airborne confetti on the 17th. Whilst I was fulfilling the intention to fly the new *B* model and get it set up I was also flying really badly. My key goals in Tortosa were:

- Fully set up and match *B* plane to *A* plane
- Practice flying a representative set of scenarios for the *World Masters*

- Ensure all the actions and events around each flight were fit for purpose to minimise risks and performance impacts on *World Masters* competition flights
- Shake down all the hardware

Overall, on reflection, all of this was achieved. Both planes motor mounts de-bonded in use and needed repair. Luckily neither event resulted in a fire, but it was close. The cause was storing the planes on their noses in the hanger. Re-bonding and carbon pegs through the fuselage and motor mount has resolved the issues.

In addition some of the wiring on the charger for my receiver batteries was found to be not as robust as it needed to be. Again — long term use showed up a weakness and that has been resolved.

In terms of the flying challenge I spent all week grinding out scores — flying for half an hour whatever the conditions were. Because of the nature of a full-on competition I had taken the view that you have to fly when you have to fly and that may not be in the greatest conditions. Likewise, you may have started a flight and the start window has expired. Then the lift dies and you are faced with 25 minutes flying time to fill with triangles from 300m or land after three laps. You have to find lift and stay airborne at all costs. As Tortosa was a challenge event all the other competitors were restarting if they had poor air and of course getting some decent scores. I wasn't and two things improved — my F*%&$@g swearing, and my soaring at low level with a fully ballasted glider.

Frankly, on my return from Tortosa I was disheartened. Low scores, my flying was not at the level of 2021, the planes were set up but they felt like they had been fighting back. Then we had a spate of scrappy weather in the UK that coincided with a load of commitments that got in the way of flying.

After a month of not flying the first opportunity to fly was at a new field. Bam! Fourteen laps in less than perfect conditions. A strong breeze and the first two laps took 10 minutes with 200m of height loss on the first lap. The thermal climb to nearly 600m downwind saved the flight. Twelve laps at between 1min 22seconds and 1min 55seconds were a proper blast.

A new flying site, just five minutes drive from home and it has some great lift sources around it.

Investment in Success — You Need to Spend Time

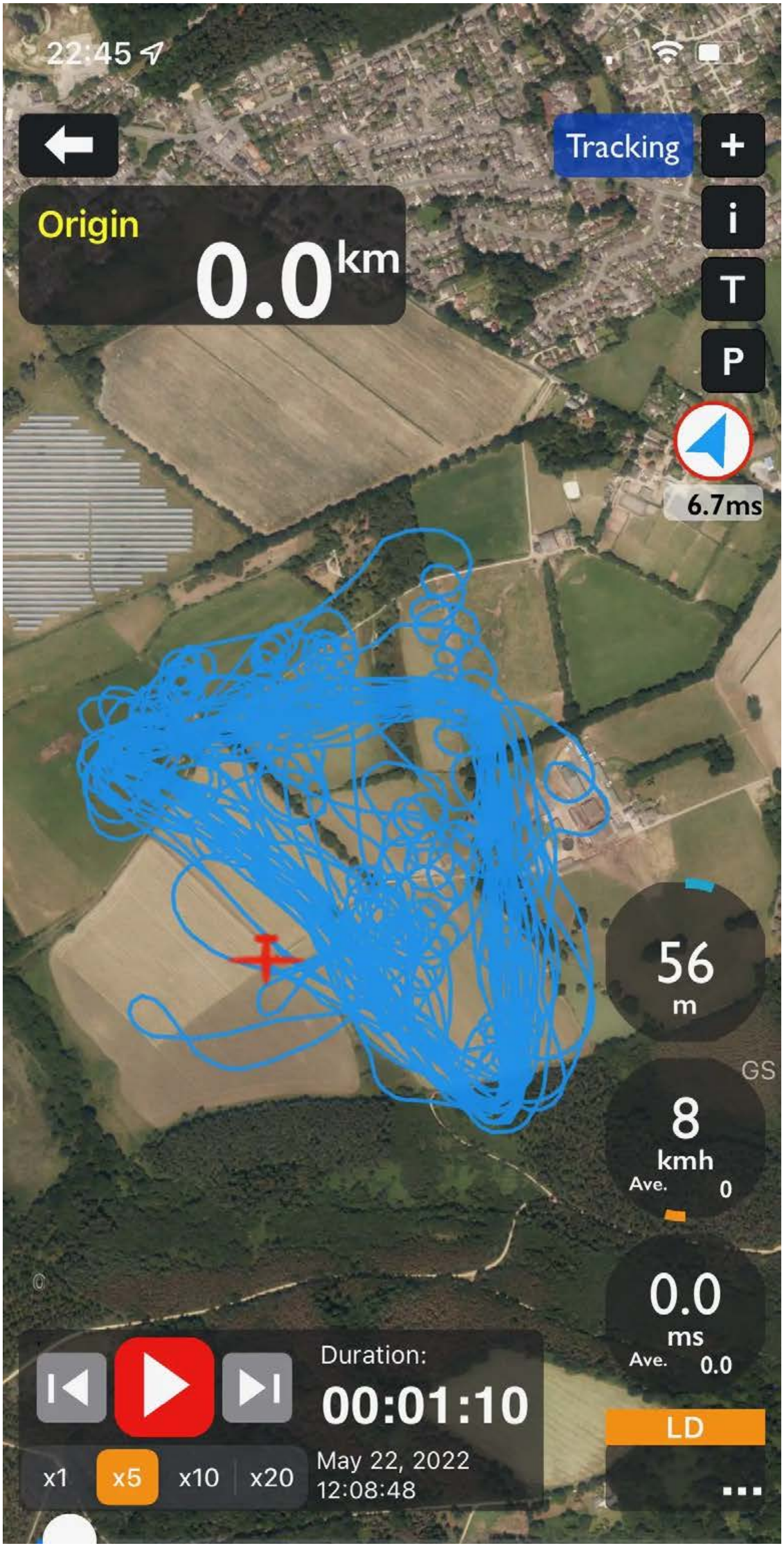
> Setting up your plane for GPS racing — this is a topic that you will hear many views on. Ultimately you need to have a plane that suits your flying style — or you need to spend a long time adapting to a plane that is great at the task but needs a different style. Once you have a plane you then need it to support you with maximum performance, whilst also being as easy to get round the course as possible. Maximum performance in simple terms for this type of racing is:

- *Really good glide at a speed allowing 1min 20second laps*
- *Easy thermal climbs at a good rate*
- *Don't loose height at the turn points because it needs fighting around the corners*

> Achieving these set up goals requires you to set the Centre of Gravity for the task, apply the right exponential curves and balance the control movements in all your flight modes. Time spent doing this is not wasted.

Happy Birthday — a little break from GPS flying for some slope soaring on my birthday. On the left 2013, on the right 2022. Freestyler 3 from TUD Modelltechnik. (credit: Jos Medley-Rose)

Three days later Greg Lewis — my team mate for the *World Championships* and the pilot who had flown the best ever *Sport Class* score of 24 laps at a speed of 90kph — came down to try my new field. Yet again some good flying and some reasonable scores before the sea breeze came through.



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May 2022: Albatross displaying lots of triangles with lots to analyse. Practise, analyse, learn, repeat.

A fortnight later another good session, including a personal best. The middle of June yielded yet more high quality flying, another personal best (PB), and things started to feel good with less than a couple of weeks to go until Germany. Even better our new *PIKE Paradigms* had arrived in the UK! All sparkly and fecund with servos. Only needing us to chuck the drivetrain and some avionics into the fuselages before setting them up then.

So, lets talk about distractions. Trying to build a new plane that isn't quite as simple as it looks is a good start. A few days turned into nearly two weeks in the workshop and cost me three flying opportunities. The weekend before departure my wife develops appendicitis whilst guiding on a mountain bike ride. Another family member in hospital needs visits. No flying for nearly two weeks. All of a sudden the zenith of preparation turned into a nadir.

The good lady Doctor of Chiropractic, her indoors and I were originally departing the UK for the *World Championships* on Thursday 29th June. On the Tuesday before, I had collected the aforementioned good lady from the surgical ward and was faced with one option. She needed time to convalesce at home, so I emailed the *GPS Sport Class World Championship* Contest Director and withdrew from the event at about 1430hrs UK time.

Unbeknownst to me there were plans afoot.

Later that afternoon friends insisted that they would take on convalescent care. Moments later another friend knocked on the door and said: "I hear you need a team helper. I don't know anything about GPS glider racing but I'll come to Germany and be the EPH" (extra pair of hands). Thanks to these incredibly supportive friends by 1800hrs UK time my entry was reinstated and Greg Lewis and I were a team again.

On the road to Ulm we passed Gruibingen!! So I really did get there in the end.

Fast forward a few days and we are on an airfield in Germany. The Sportfliegerclub Ulm is a fantastic airfield that’s perfect for GPS Racing. Let the games commence!

A Word about the Event Organisation

> This airfield is 450m above sea level near the River Danube on the southern edge of the Swabian Jura, about 220km south east of Stuttgart. Unusual to UK residents was the shared nature of the airfield. Two flying clubs, both with gliders and powered planes. The hangers had a diversity of types — including autogyros — and storage options. Gliders winched into the rafters, planes on a turntable in one hanger and in the hanger cleared for the competition organisation there was a Fournier *RF 4*. Between a railway line and the river Danube way off in the distance the venue boasts a huge flat expanse, a great runway and some incredible facilities. Ample space for the camper van and camping competitors and good facilities for feeding, washing and filling people with beer finished off the basic ingredients for a classic event.
>
> Organisation had seemed quite laid back and in some places lacking in detail from the correspondence. However Michael Knoblauch and the team involved in setting up this event did a superb job. All the items to run the event came into place in time. The facilities were good and the running of the event excellent. Well done and thank you.

Multi-use aerodrome — RC flight, autogyros, gliders, light aircraft and even hot air balloons. You can find it all harmoniously co-existing at Sportfliegerclub Ulm.

Obviously the first thing you need to do when flying somewhere new in a competition is to spend as much time before the event getting acclimatised. The organisers provided a session on the Sunday afternoon for pilots to fly and it was incredibly useful. However it was also too short and didn’t provide all the information we needed for the event. In the future we will have to build in acclimatisation into our preparation. More on how this affected our performance later.

Another distraction for me was that I had my brand new Samba *PIKE Paradigm* to test fly. Greg had finished his more quickly than I and had some air time already. He chose it as his *A* model after the Sunday session. So, with that in mind I was very keen to test mine and make that risky decision — stick with my trusty *Elvira* as both *A* and *B* planes or risk an unknown plane in the *World Championships*. From the first few metres it was obvious that the design has great handling. Up to a reasonable height, quick CG dive test, a few turns, loop, roll and stall turn — then a bit of stooging and trying out the trim and thermal turns. All felt really good and scratching at low level felt easy. So, no vices, another climb and let's have a go at the course.

Hmmm, is that a smoke trail? Oh yes it is! Full crow flap and down on the ground from 300 plus metres followed by a very hurried peeling out of the totally melted ESC. Luckily the wires had been desoldered due to the heat and the battery disconnected from doing any harm. Unfortunately, decision made. Despite offers of components it was not the right decision to do a powertrain installation the night before the event. Ultimately this was a disappointment.

GTRUK in action. Greg waiting to launch for Iain. Iain spotting for Greg. (credit: Sean Blackmore)

So, lets talk about the *World Championships* — the first *Sport Class World Championships*. Not a blow-by-blow account, but rather a look at the key lessons that we (GTRUK) learnt and some of the trends in technique and technology. We'll look at the highs too.

So first high — in a big competition the thing you really want to do is fly in the first round. **Not!** Actually, as a newbie to GPSTR it was not a problem. There is a psychology to flying competitively that is discussed somewhere else in this article. In fact there is chance that this was one of my best flights of the event — second place in the round was a good opener and I suspect a surprise to some. The key thing about this flight was the training that I had done, with the objective of grinding out the best score I can by keeping my plane in the sky for as long as I possibly can. All that time bumping and grinding out scores in the run up to the event payed off.

One of the things GTRUK were starting to see was that the lift was different to what we were used to. At this point we were not yet able to determine how to respond. Greg flew well but his first round saw him bottom of the heat. Not something we see in the UK, he is usually miles in front of everyone else.

Second round and Greg was close to the top. But one of the things we were having to adjust to was the distance off course that people were flying to stay airborne. For both pilot and spotter this was an issue and tracking down all the possible lift sources was something we were getting a very hard lesson in. We still hadn't really spotted what was different for us.

The third round saw Greg get a 1000, and I took a right stuffing. Our post day debriefing was an interesting one! Overall it had not been a bad day, definitely a challenge though. Looking back at the data the bulk of the field were also having good and bad flights. The conditions were challenging and punished even the smallest error.

The second day started well and both of us got okay scores in the first two rounds of the day. By the third round of the day things took a bit of a dip. The wind on the flight line was often light but out on the course at over 200m it was quite strong. A couple of times there were thermals that could be seen as active and strong but by the time the plane had been flown around the next turn and directed towards the obvious thermal — the lift was either too far downwind or had risen out of reach. By the time the glider was anywhere near it those who had been 30 seconds in front were enjoying the lift with their planes as my vario sounded the dropping tones of sink and despair.

Once again we retired to the debriefing room at the end of the day, celebrating the good results and examining our mistakes to see if we could avoid repeating them. One thing we did discuss was how strong the sink was. Some of the thermals were very powerful but dropping over 200m in a lap was something we only experience rarely in the UK.

Left: Daniel Aberli — AKA Mr Chocofly. Flying the revised Appollo 46 Slick. Right: Philip Kolb — flying the Samba Pike Paradigm that he designed with Benjamin

Rodax. Behind him is Tobias Ebner, also a Paradigm pilot. Philip won the event and Tobias was second.

The third day was not too bad overall — after an object lesson from Philip Kolb in the first round of the day most things then went well. If, that is, you ignore the failure of my *Albatross* application to start the task for the speed round! Greg did well and got 960 points. I just got to practice my swearing — a lot — again. One lesson we learnt from this is to keep flying the course. For this event the organisers had software that allowed the SD card in the *Swift* or *Sparrow* to be interrogated and if the course had been fully completed they could take the data and yield a score. This was a valuable piece of learning that we relied on later in the week.

Day four was probably our worst day. It was an emotional one, we both took turn points and went back for the thermal we'd just flown through prior to the turn point. Both of us got punished for this, as a tactic in this event and the prevailing conditions it was not working. What was really hurting was the inconsistency of our outcomes. Although not alone, most people other than the top four or five were having good and bad rounds, this was difficult to reconcile. Our afternoon cup of tea was a tense one. We'd both been dumped out early at least once, and we'd both had to grind out a climb in weak lift whilst watching others going away in what looked like 4–5m/s lift. In the run up to the event one of the things that I certainly hadn't adopted was a conservative attitude to my flying, and Greg has always been a very aggressive flyer. So being on the back foot was a challenge.

Our day four debriefing gave us four tactical changes to work with: work the lift in a different way; only go on to a turn from lift if there is thermal to go to or the thermal that's been left will be able to be picked up again; modify our approach to the start window; and spotting/calling needed a different approach.

Hitting The Start

Here's what you need to think about: the declared start window is based on the number of pilots in each flying group. Most slots had a 9 minute 59 second start window. So 0950:01 to 1000hrs would be the start window for a round commencing at 1000hrs. Getting airborne before the start window is allowed — so that you can enter the course and start an attempt at the beginning of the window. As it is possible to fly a lap in well under two minutes you can get easily three laps a sniff of lift off the course and a climb back to 400 plus metres in 10 minutes. So starting well is a key element to success in GPS and using that time before the start window closes is key.

One lesson we were learning was that *when* we entered the course in the start window was having a huge effect on the outcome. Over the course of the competition we started to manage our starts much more actively. Launching before the start window and having a good look around the course is really important. We were already doing this but changed our tactics and methodology after the first two-and-a-half days. With volatile conditions there was a possibility of luck affecting the outcome. Flying the start window effectively reduces the luck element. We've certainly improved our performance in this area. It does open up a new set of decisions and one thing that you really need to practice is your entry into the course in a variety of conditions. Broadly into wind and down wind starts need to be repeatable and if you are pushing against the back of the start window you need to be able to guarantee your start is going to be under the maximum height and speed limits to avoid a penalty.

In simple terms you need to know what height to be at when heading towards the start line to manage your entry onto the course. As you can see this means that in strong lift with a 15m/s tail wind the challenge is to stay below 400m and 120kph GPS speed. In sink with a 15m/s headwind if your entry pattern is too low and too far out you can easily have a plane limping over the start at 320m at 25kph.

Our second speed rounds were an interesting swap of fortune. I flew an okay round but after the issues with the earlier speed round it was not my best. Greg started and his *Albatross* application crashed as his plane was crossing the line to start. With speed task there are no second chances and once you have gone above 400m in a climb you can't use your motor again. So using the lessons learnt from earlier in the event when my *Albatross* failed to start Greg flew the course. Now, because we have both got secondary ground stations slaved off of the primary and the kit in the planes also records data to a MicroSD card we had most options covered. As it turned out the slave device recorded the score.

The Psychology of Competition

(If I Knew Then What I Know Now)

> *On this journey I've developed an understanding of how crucial your mind can be when competing. I personally don't think you can 'up' your game in a competition – and once you get your head around that it becomes simple. The first two points below are easy to achieve but may require time to step up another level. The third point is the most difficult – but can lead to a huge drop in internal distractions when competing leading to a huge performance gain.*

- *Always do your best flight, every flight*
- *Examine what could have gone better and add something to your training to strengthen your performance — or effect the change in your next flight*
- *Understand the things that affect your mental approach that hold you back from delivering your best flight. Manage those mental states so that they are not affecting your performance. This may mean practicing something you find difficult until it is easy for you. It might mean that you need to address your inner chimp and learn to control the 'demons'.*

> For me this approach has made a huge difference to my competitive flying and I wish I'd worked out a simple system 30 years ago.

Many, many metres of carbon fibre! The competitors in the first Sport Class World Championship, July 2022. (credit: Sean Blackmore)

Reflecting on the event it was successful in some ways and disappointing in others. The chance to fly in a large competition with a number of very accomplished GPS pilots certainly provided some very valuable lessons. Flying at a site which has a very different airmass gave some powerful insights into setting up the planes; some different flying techniques; a new range of strategies; a different perspective on the tactics for GPSTR.

Not being in a better position in the rankings and suffering from some inconsistency was personally very disappointing. However, the post competition pumping in the debriefing room showed that both Greg and I had flown some incredible flights and had pushed our capabilities on massively. Before the event I think it was, for instance, unlikely that either of us would have followed thermals so far off course. Our default approach would have been to take some lift and then press on to do another triangle, and trust to picking up another thermal on our way around the course. The speed of departure from the ground of the thermals at nearly 500m and the high wind speed at height made that a very high risk strategy — so we adopted a more thermal regatta style of flying.

In still air I get four-to-five laps out of my PCM *Elvira* gliders from a good start (400m entry at 100kph). The newer gliders specially designed for Sport Class are now easily getting five laps. However the air at its least active in this event would typically yield three lap flights if no lift was encountered. In the run up to this event the practice I had done actually proved to be invaluable. Flying GPS in all conditions is something you need to consider, it is tempting to only fly on the good days, and it will really benefit your competitive flying to fly all conditions.

Top left: The Dähn brothers ‘Alpina’. Benjamin managed at least one 1000 point score with this plane. Top Centre: Fluro Paradigm. Top Right: Thomas Leigeb flew his own design which uses the PCM Elvira fuselage and tailplane. The wing tip panels are from his F3B design and he made a new centre panel. Very effective. Bottom Left: Chocofly Appollo 46. Very popular and an updated version with a slimmer, longer fuselge is now available. Bottom Centre: The Appollo tail configuration. Bottom Right: The Paradigm tail configuration — more F5J than the Appollo.

Make Sure the Dilithium Crystals Can Take It!

(Ballasting For Success)

> Ballasting was also an interesting issue. Generally, I now fly my *Sport Class* gliders at 7kg whatever the weather. Undoubtedly the general view of flying at 7kg all the time is a good starting place: best glide, at the highest speed, at all times. However, there were a few occasions where I flew at less than that in Ulm. At 6.4kg I was able to work weak lift and stay airborne. Unfortunately, once the lift had been exploited the lack of 600g was an issue in getting the best glide out of the plane. Undoubtedly staying up was the better result because the plane was airborne for 30 minutes and not 13 minutes! Eight laps not three! My personal conclusion around ballast is to spend as much of my flying time at 7kg and the maximum wing loading for the class. On a few occasions I might pull the weight back to 6.4kg. Bottom line is this is a gliding competition that requires the maximum distance in the fastest time, so fly full and practice your soaring until you can get your plane into any lift that exists.

Having returned to the UK my first few weeks were spent looking after the good lady Doctor of Chiropractic and visiting her very poorly mother. In the gaps I did, however manage to stick the new motor from Leomotion GmbH into my new, but slightly pungent Samba *PIKE Paradigm* along with the brand new ESC that had been waiting for its moment.

A very blustery, cloudy day was the first available opportunity to test fly the Paradigm. Eleven laps and a flight time of 29mins showed two things. One, the Paradigm is pretty good; and, Two, I probably should have spent the Sunday evening before the *World Championships* in Ulm fitting a new motor and speed controller.

So with two proper flights and a flame out flight I arrived at the *UK National Championships* at the end of August. Two GPS flights since the 9th July felt like a little less practice than would be ideal. As usual with GPS events at the BMFA National Centre, Buckminster the weather was rubbish. Third place for me was okay, but the combination of not enough flying and a bit of fine tuning left to do meant that I performed very averagely in the face of some increasingly good competition. In context though the best flight of the day was five laps and several rounds were won with three laps! As is the way of things, the weather clear up as we were packing up.

Samba PIKE Paradigms after the UK National Championships. First place and third place. However, the second placed glider was a Valenta Thermik XXXL — proving that it is possible to do well in GPS racing with most cost effective machinery. BMFA National Centre, Buckminster, UK.

Another session on the 10th September was excellent. Four of us met up for an informal competition and it was interesting in the less than amazing conditions that Greg and I made the full flight times in the first round. Even though it was only four of us and the flying was very informal it was very useful for all involved. Whilst the *PIKE Paradigm* was going well I was still waiting for the final two bits of ballast weight to turn up and was therefore flying at 6.4kg. At the end of this session I had now racked up 15 flights with the plane. The first two were trimming flights and the rest in some form of competition. In reality I was feeling that I really needed some quality time to actually set the plane up. There were some issues with the coupled aileron rudder mixing and some of the flap settings needed tweaking.

September 2022: Dick Whitehead, Paul Eisner, Graham Tolhurst and Greg Lewis. I was driving the camera. Collectively — The Old Codgers GPS Group.

My next flying opportunity was an event at an excellent site in Lincolnshire at the end of September. Sandhays is a private field owned, run and maintained to a very high standard by some dedicated glider fliers. The surface on the flying field and the airspace around it are beyond perfect for GPSTR. Over this weekend the plan was to provide a low key competition and some coaching. Day one went well despite some less than ideal weather. Close of flying on day one was good news for me — I was ahead of the field and that meant I was ahead of Greg. Unfortunately my wife had tested positive for COVID so I had to chuck everything in the car and get home — 230 miles in just under four hours — leaving me unable to complete the second day of the event.

My final GPS session in 2022 was in October at the *Model Flying Ranch* back in Tortosa, Spain. One of the things about this event is that is a challenge event and missing the first day left me at a disadvantage. However the main goal of this trip was to get plenty of quality flying with the *Paradigm* and also up my 'endurance'. One of the things that you really need to be able to do with GPSTR is to make good decisions after long periods of intense concentration. Flying long flights and lots of them every day was the main training goal. Flying on the penultimate day was educational: 27ºC (80ºF) in the shade is fatiguing if you are not used to it, and because the sun was behind us I found the maximum temperature threshold for my GPS phone — when it crashed with a really good score about to be hoovered in!

July 2022: Elvira and Paradigm at rest during the Sportclass World Championships, Sportfliegerclub, Ulm. (credit: Sean Blackmore)

Because of the relaxed nature of the *Flying Ranch* we had an informal race with slots on the final day, which was fantastic. Third in the challenge cup and a lucky second in the one day contest were a reasonable finish to the year.

So How Did It Go and What Have I Learnt This Year?

> Reflections on the GPS year are positive overall. Some good outcomes, but some issues that must not happen again.
>
> **Having clear training goals is vital** — I chose a couple of key things to train and they were perfect for the competitions that mattered.
>
> **Assess the events for the year and maximise training to those** — As above I picked some good areas to train and have identified goals for next year based on this years experience.
>
> **Learn (and don't repeat) mistakes —** You can avoid mistakes by having assessed the task. You can also apply certain clear actions and processes to events that ensure you always default to a safe, reliable outcome when you are tired.
>
> **Use the tools available to understand what went well —** The equipment and recordings from it allow a very detailed analysis of your flights. You can review the outcome against your decisions and use that to grow your understanding.
>
> **Understand your plane — if it isn't an extension of your flying style change it —** Unfortunately you need something that is really low workload to fly and you don't want to be tinkering with the sticks all the time. Invest time in trimming your plane, setting the CG and making sure it is right. Fighting your plane will only lead to poor performance and frustation.
>
> **Localise! —** If you are going to fly a 'proper' competition abroad, study the local environment and determine what you need to

> practice before you arrive. Even if you do that, get there early and fly in the prevailing conditions.

Next year — well let's say 2023 — has four big events for me:

- First one is my second Samba *PIKE Paradigm* arrives. I have found a plane that I think flies really well so am going to stick with it.
- In April 2023 I should take delivery of my self launch system (SLS) scale glider for GPSTR.
- In August 2023, assuming I can get a place in the events, I will be flying in both the *SLS GPS World Championships* and the *Scale GPS World Championships*. Both these events will be in Neresheim, Germany.

This whole experience would not have been possible without the amazing support of friends and family, thank you Jos, Greg, Giles, Olga, Sean, Dave, Markus, Bernie and Neil.

Resources

- *Tortosa Model Flying Ranch* — "a hotspot for all kinds of model flying. But especially the friends of gliding will find a thermally strong area here, which invites to hours of flights in the mild air of the Mediterranean climate…"
- *World Masters 2022 Results* — From the *GPS Triangle* website.
- *PCM Elvira* — "*Elvira* is the logical continuation in our series of gliders. Thanks to it's great wing span, the high aspect ratio and the weight the model performs considerably better and retains more momentum than its smaller predecessor…"
- *PIKE Paradigm* — "Our new project, which we are currently working on intensively, is *PIKE Paradigm*. This model is designed by Philip Kolb and Benjamin Rodax…"
- *GPS Triangle Regulations for Sport Class Gliders* (PDF) — "GPS Triangle competitions are meant to build a bridge between model soaring and full-size soaring competitions…"
- *Sportfliegerclub Ulm* — "You will find here…current information, pictures and reports…"
- *Albatross* — "Android App…for perfect [GPSTR] navigation…"
- *GPS Triangle Eurotour* Facebook group. — "All about GPS Triangle flying…"

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Dream 2700 | A Tailless Tale

Spoiler alert: a happy pilot after the maiden flight! But there are lots of steps leading up to this point as described in this third part of this series.

Part III: Lets Build It!

Those who have not yet done so may want to read the first two parts of this series, then continue with this article — Ed.

Every time you build something you have designed, you get scared! Is it going to be a single prototype? Do I want to build more than one or even a small series? Is it worth to go all-in with molds? And even more tricky: is it really going to fly or will it be a disaster? What I want to demonstrate with this build? Do I want to just make a sanity check of my design, and what is the confidence level I have? Things can get quite expensive depending on the manufacturing process you choose and the quality of the result is affected as well.

Agile Methodology Applied to RC Building

For professional reasons in the last two years I've been exposed to the *Agile for Hardware* methodology (see link in *Resources*, below).

This is a product development process that started in software development and, lately, has been succesfully applied to hardware industrial development. In a nutshell, *Agile* focuses on faster deliveries of products by applying a step-wise release process which minimises the risk of failure and maximises the value delivered at each step. Each incremental delivery is called an MVP (minimum viable product). An MVP includes all the main features a product should have but with a level of details and industrial readiness that grows from MVP1 to MVPx. After each iteration, leading to the release of an MVP, you can make a sanity check on your product to make sure you are still in line with the final objectives. If you see a deviation — no worries — this is the right time to stop, analyze the issue, and maybe pivot towards another solution, limiting the efforts you put into the project.

> Personal note: I was introduced to the *Agile* methodology by my former manager and great friend, Norbert Neumann. He challenged me in embracing this new challenge in my role as an innovation manager. I fell in love with *Agile.* Once I tried it, I discovered there's nothing special or magic — it is simply a very human-centered and natural way to approach issues and define priorities. I believe everyone is *Agile* in the way we naturally takle everyday problems in our personal life. Thanks, Norbert!

To test my comprehension of *Agile*, and to see how that methodology works on an 'out of the office' project, I applied to use it as much as I could with my building process, and some decisions has been taken according to this methodology:

- **3D-Printing for the Fuselage:** Molds would be too expensive, as I may need to heavily modify the design after the first flight tests.
- **Foam Core and Vacuum Bagging for the Wings**: If you just need to build one prototype, the quality you can get is similar to full composites molds but much *much* cheaper.

These decisions would make the building process faster but I wanted as well to test some full-scale features found on full-scale sailplanes.

As reported in the previous parts in this series, there is a long-term goal to build a full-scale sailplane. Therefore I decided to design and build a spar joiner system that can be representative of what needs to be done on a full-scale equivalent: there is a specific paragraph on this below.

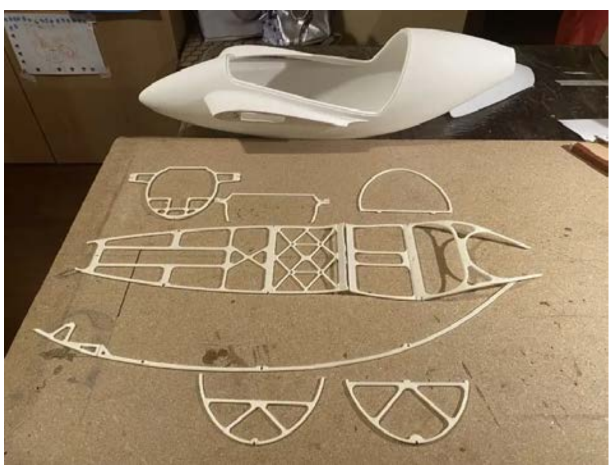
Fuselage Build

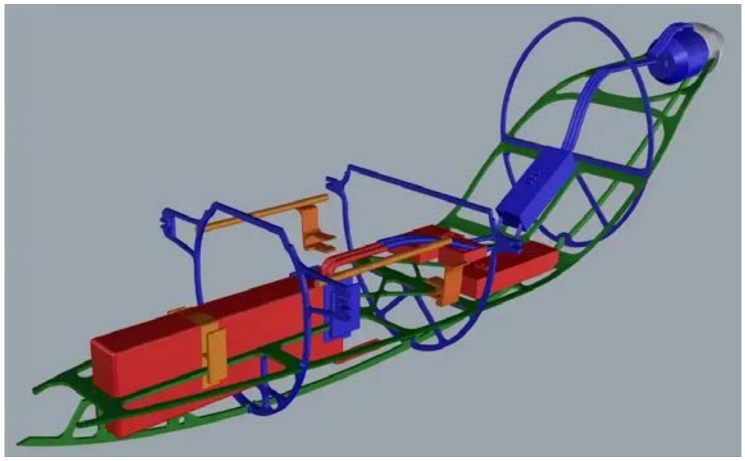
The fuselage was 3D-printed in one single piece, and the selected material was nylon. It's 0.6m long: not something you can print easily at home. Home 3D-printers are based on an FDM (filament deposition) process that is good enough for certain applications. In my specific case I went for SLS (selective laser sintering): this technology produces very strong and durable parts. The cost is not negligible, but way cheaper than molds. I used Shapeways, and there's a link in the *Resources* section below with more information about the process.

Fuselage, as delivered.

The surface quality is very good, and only required some finish sanding and nothing else. The material thickness is just 1mm, to minimize weight. Structural stresses on the fuselage are quite low, and this is again connected to the special wing joiner design.

The internal volume is huge and therefore I designed a structure that facilitates the layout of the electronics and increases the overall stiffness. All these ribs have been printed at home in PLA material, with a thickness of 2mm.





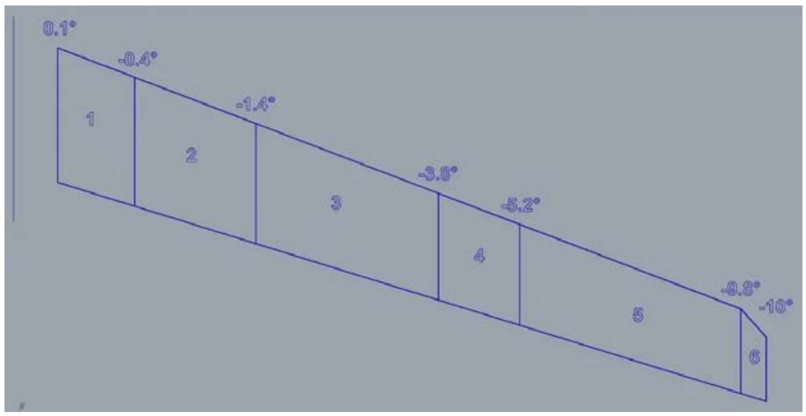

Internal stiffening structure components, as printed and glued inside the fuselage.

In the next two pictures, you can see how this structure simplifies the internal layout:

In orange: battery clips and wing joiner retention clips.

Wing Build

The wing manufacturing is based on the method developed by Professor Mark Drela for the *Supra TD/F3J*. The wing structure is based on a solid foam core, carbon spar caps, and fiberglass skins. Hot-wire cutting all the foam cores was already a challenge. The wing is characterized by a large amount of non-linear twist from the root to the tip. With hot-wire, I can just go for linear twist variation on each foam block: therefore I decided to split the wing in six blocks, according to the twist distribution shown immediately below:



Left: foam cutting was a long job. | Right: blocks per wing, with linearly discretized twist.

If you are interested in the cutting process, see my *Dream 2700 Scale Sailplane Wings Foam Cutting* video link in *Resources*.

After cutting, the six core blocks has been glued and the glider showed its shape for the first time.

The wing spar is made by cutting the wing foam core, gluing the prefabbed carbon spar caps (20mm width, 0.5mm thick) on top and bottom, and wrapping everything with 55g/m² glass at 45°. For further details, see Professor Drela's *Supra 3.4m TD/F3J Sailplane* link in *References*.

Left: Cutting the spar core. | Centre: Wrapping with glass fibers. | Right: Preparing for vacuum bagging with perforated film and breather.

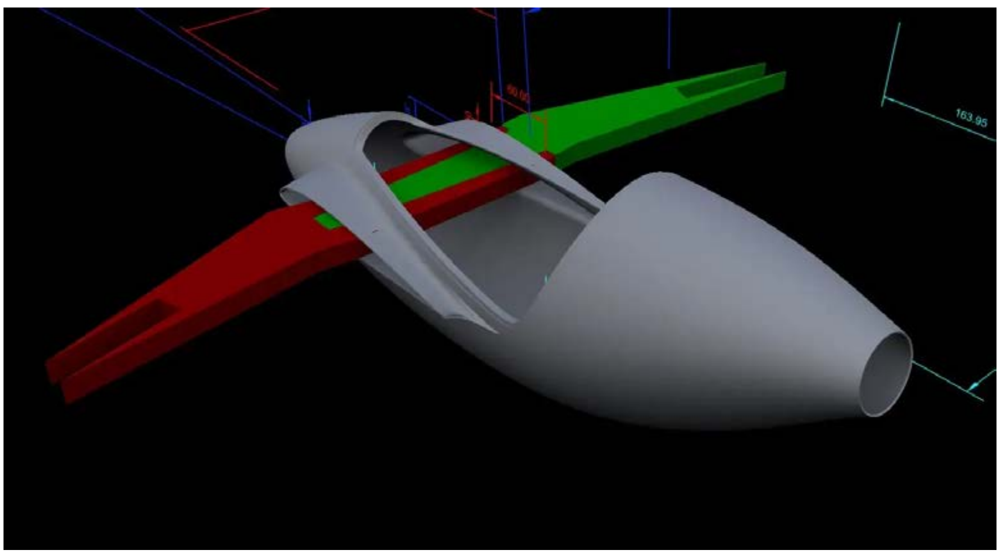

TO USE
STORE
TIPS

Left: Vacuum bagging. | Centre: The two main spars. | Right: The full structure including wing joiners.

At this point, I have the wing spars ready, but this was not the right time to glue them in place with the rest of the wing. Before doing that, I needed to finalize the wing joiner construction. The wing geometry is very complex and requires lots of alignment checks before gluing anything: I had to think twice, and after, think again before gluing!

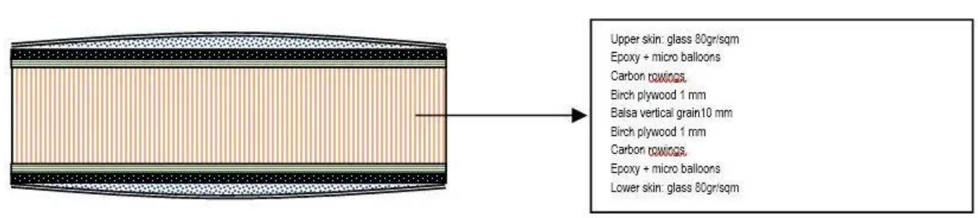
The Challenging Wing Joiner System

As mentioned previously, I wanted to build a wing joiner system which is very similar to the one found in full-scale gliders. The design is well illustrated in the picture below:

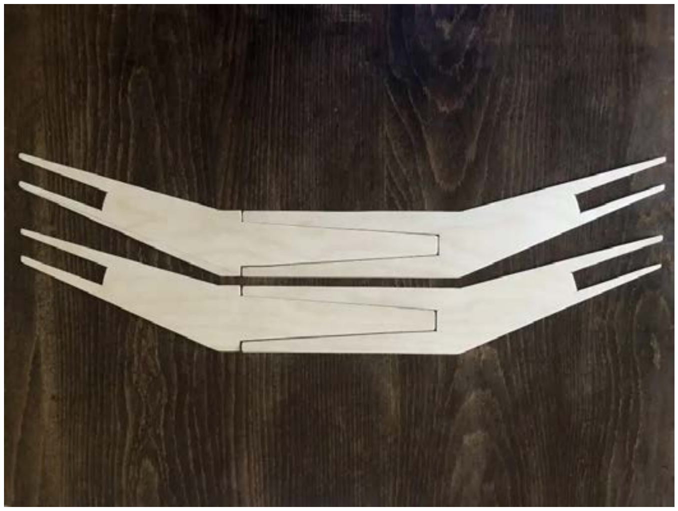


Left and right spars are interconnected using two longitudinal steel rods.

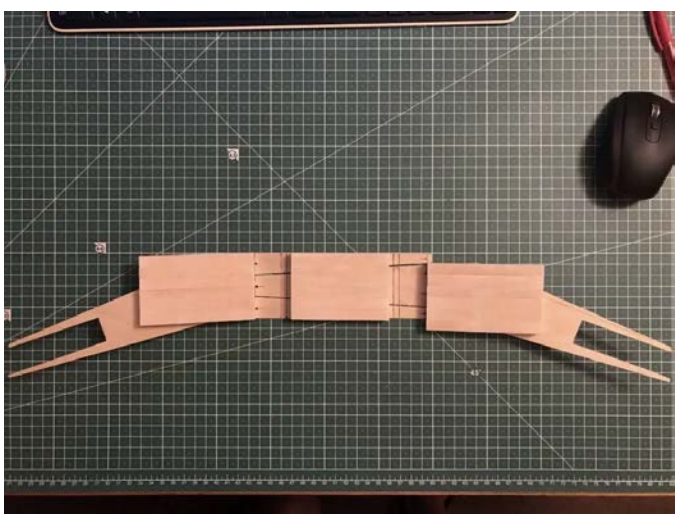
The wing joiner core is made of lightweight balsa with vertical grain, followed by top and bottom layers of birch plywood, and finally covered with carbon rowings for the full length. It is likely structurally oversized, but don’t forget that all the bending and torsional loads are concentrated here.

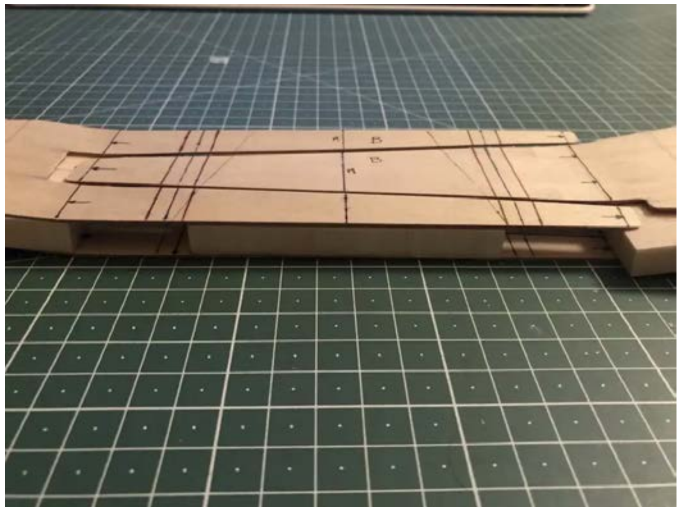


I started cutting the birch plywood spar caps, and prepared a mounting frame to bend them with the right dihedral angle: hot steam was used for bending.



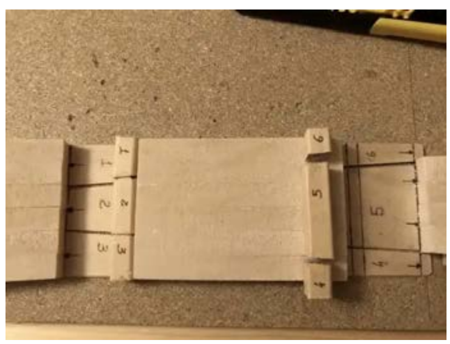
The next step was to glue all the balsa cores:

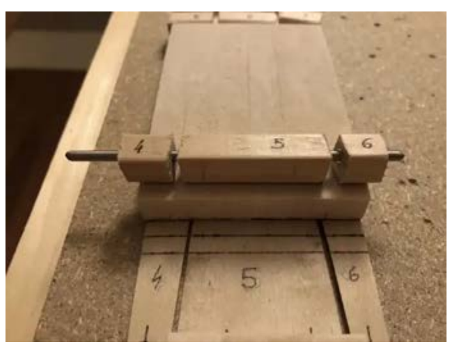




Part of the balsa cores are glued in place. Note the empty space left for the steel rods.

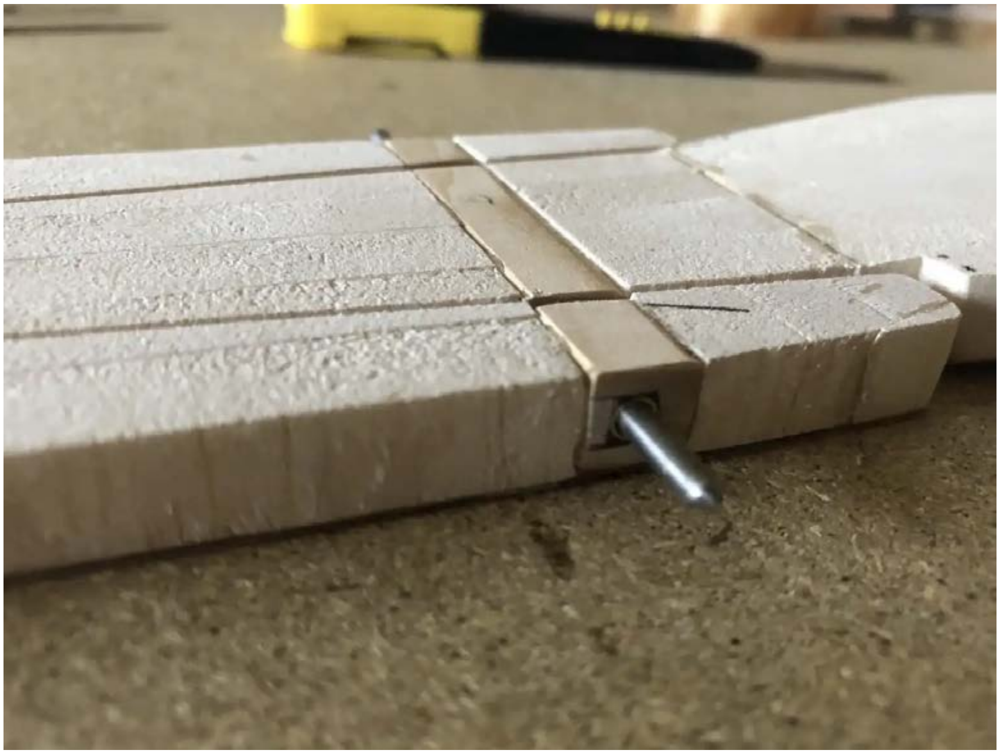
The balsa cores are kept together with the two wing joiners to maintain a perfect alignment. The next step was to prepare the steel rod boxes:



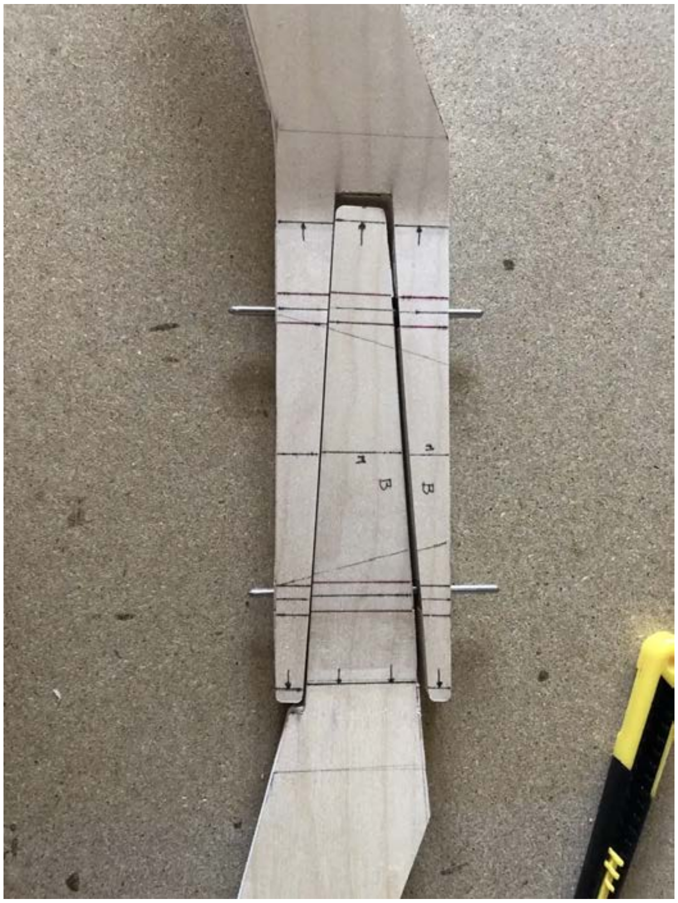


Steel rod boxes are made from hardwood, with a brass tube inside, cut in pieces, and glued in position with the steel rod inserted.

After gluing the steel rod boxes, I can fill the remaining space with balsa, and only now I can separate the two wing joiners:



As a last step, I glued the top spar cap in position:

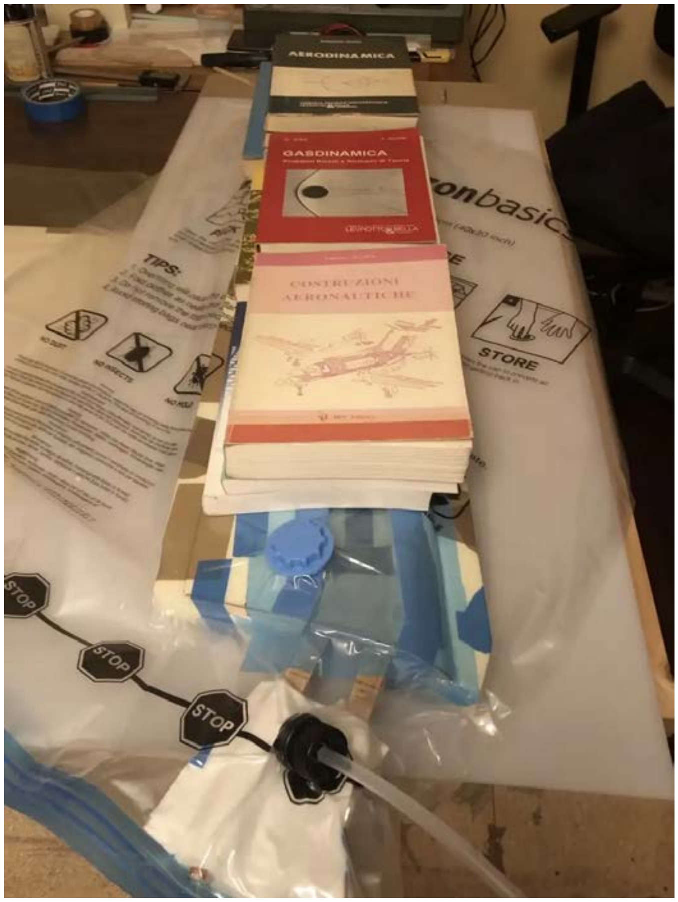


It was a tedious process, but finally things were getting into shape!

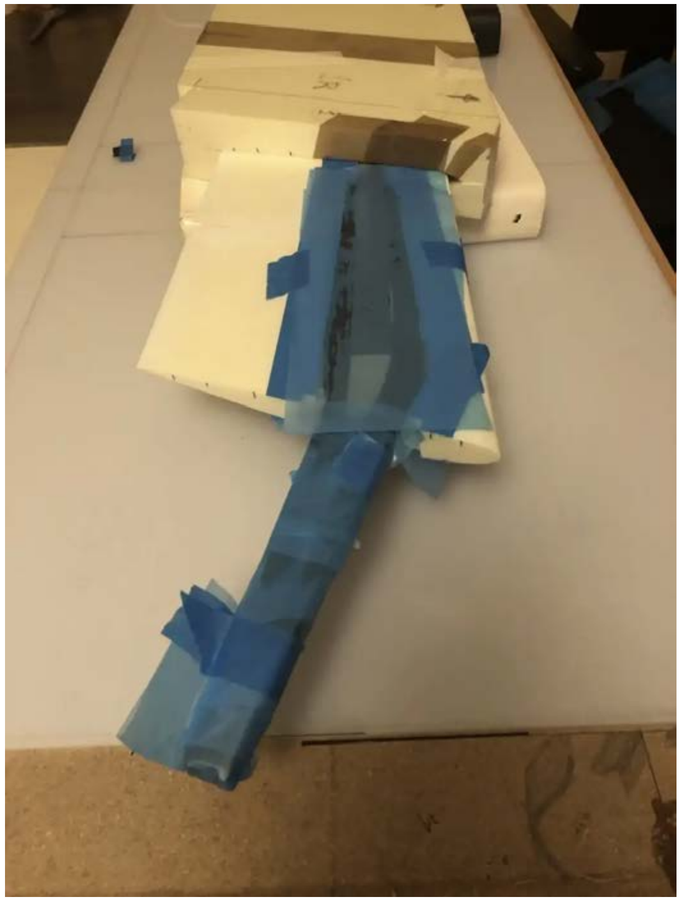
The wing joiner dry-fitted to the fuselage.

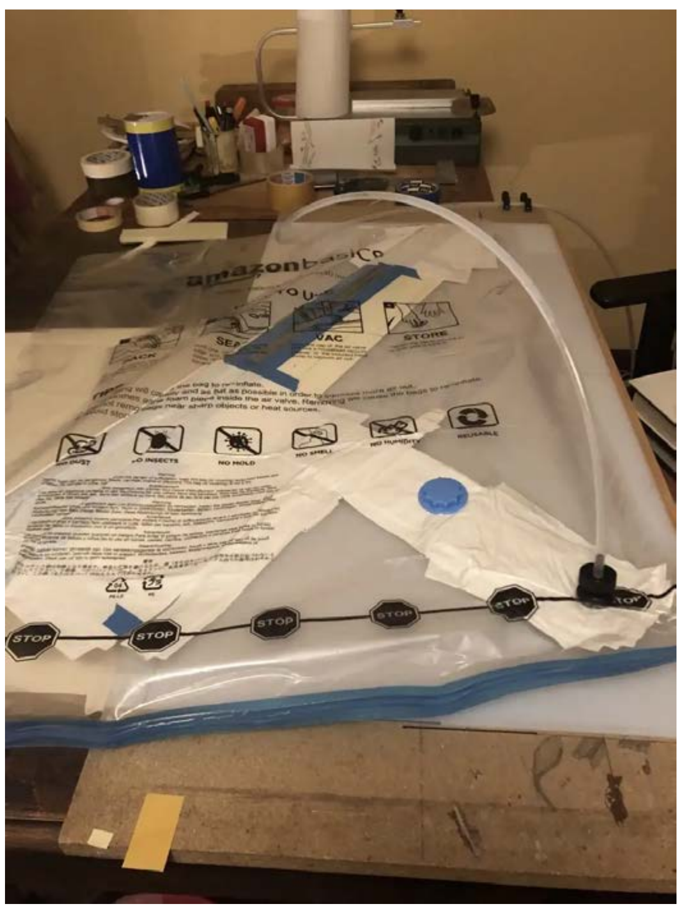
The next challenge was to glue the wing joiners to the spars, making sure everything was correctly aligned. To do that, I used the female foam templates to build a jig and check the alignments: gluing was done in place with slow curing epoxy.

Before gluing the spars to the wing, I added some carbon fiber reinforcement where the spar connects to the wing joiners. The last step was to vacuum bag the wing with the spars.

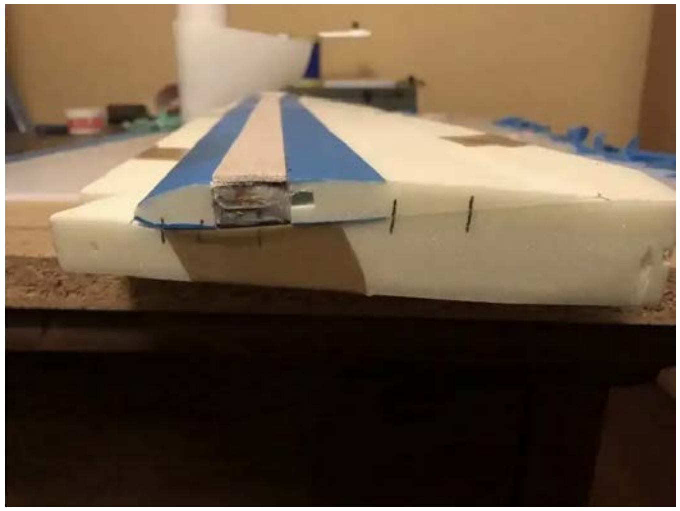


Then it was time to reinforce the wing joiners with some carbon rowings, and vacuum bag for the second time:




VAC
STORE
STOP
STOP
STOP
STOP
STOP

I’m getting closer, I promise! The last step was to level the wing spar recess with balsa and foam, and to sand everything flush:



Note in the left picture the milled slot for the servo cables.

Not a bad for a Christmas gift!

Wing Skins Vacuum Bagging Can (Finally) Start

From this point on, I return to a more conventional process, applying some reinforcements on critical areas and for the integrated flaps and elevon hinges, applying the glass fiber skins (80g/m², diagonal), and vacuum bagging everything. There's nothing special with that process, I just applied a well known tecnique used for F3K gliders. If you want to go more in depth, I suggest *Scratch Built DLG glider: Vacuum Bagging Wing* in *Resources*.

Glass fiber is applied on the mylar sheets, re-enforcements for the leading edge, integral hinges, servo bays, and vacuum bagging.

Being the first time for me with this process, I must say the result was stunning! If you want to see the full process, see the *Molding the Main Wing* video linked below.

Fin and wings after vacuum bagging

This is the first picture of the full sailplane. Note that all parts are still kept together with tape:

Final Assembly

With such a complex shape it is important to stress absolutely correct alignment of all components. The first step was to glue the wingtips (6° anhedral) to the main wing sections (6° dihedral). Wing dihedral alignment on a swept wing is really a headhache. Luckily I still had the foam beds available, and I used them as a template, adding as well a 3D-printed reinforcement jig where the dihedral change is located:

Foam templates and wing in position for glueing with the right dihedral.

The joint was reinforced with carbon fiber cloth at 45° and everything was clamped with a soft foam tool: this provides an almost uniform pressure and a perfect finish, thanks to thin polyethylene sheet.

Soft foam compression tool in action.

The most difficult part was related to the mid-span fins: I wanted them to be removable, for easy transportation, but with a very precise assembly. To do that, I glued two carbon rods inside the fins and 3D-printed the fin fairing. Two cylindrical carbon tubes where glued in position with the fairing, but kept separated from the fin. Now I have a good reference guide to drill two holes in the wing. Final operation was to glue the fairing to the wing, with the right alignment. All those steps took a lot of time, but the result paid off.

Left: The plastic 3D-printed fairing is already glued with the carbon tubes that are going to be glued inside the wing. | Right: Final alignment of the fin while the glue cures.

And finally, the time came for finishing and painting. The wing came out on the heavy side; I didn't want to take any risk on structural loads. On the next prototype I can probably go lighter on both spar and skins. For that reason I decided to go for a very light finish, with just one layer of primer before the final paint. The wing surface is not shiny perfect — I'm not a perfectionist when it comes to painting.

The completed wings ready for servo installation.

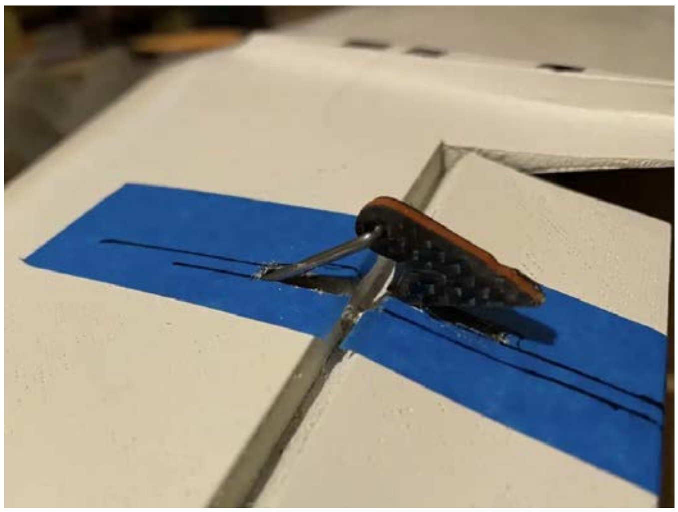
Servo and Electronics Installation

The wing section is very thin (10% thickness), therefore I used thin servos, and I had to prepare a specific support for them since I wanted to make them to be easily dismountable. Guess what — 3D-printing helps (again).

3D-printed servo supports with thread metal inserts.

If you want to see the details of the servo box preparation, see *Servo Mounts* video available linked in *Resources*.

For servo linkages, in that case I took inspiration from F5J standards (see see *Flight Comp* videos for more detail). The control rod is 1.5mm steel, and the control horns were manufactured with a sandwich of 3D-printed core and two carbon layers on both sides.

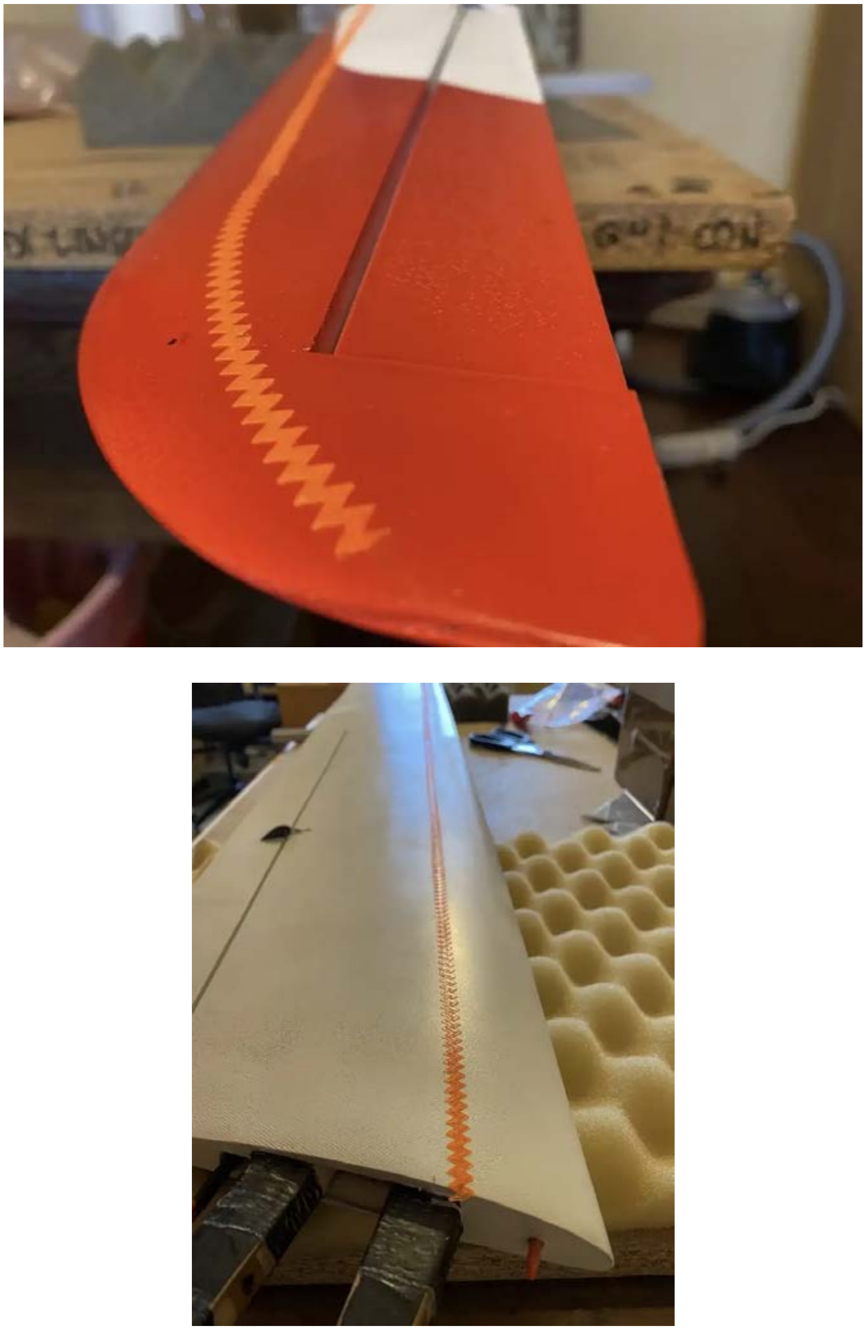


Left: Servo mounted in the wing. | Right: Control rod and horn.

The radio equipment installation was flawless, due to the huge amount of space available in the fuselage pod. If you want to see more details, there's a specific video — *Assembly Process*, below in *Resources* — where I show as well how the wing joiner concept works.

A Final Aerodynamic Touch: Turbulators

The Reynolds number on the wing, at the design speed of circa 11m/s varies from 50,000 to 150,000. This brings a potential risk of flow separation. For that reason I decided to implement turbulators on the upper whole surface of the wing, and on the lower surface of the wingtips: again, the easiest way to get those turbulators was to print them!



3D-printed turbulators applied at 30% of the chord, to avoid laminar separation bubbles.

Final Considerations

It has been a really long journey. It took me way too much time to build this first prototype. I’m sure there was an easier way to do it but the pleasure not only comes from flying, at least for me. Designing and building from scratch makes you feel in close touch with your project. It’s a continous challenge in solving issues as long as you progress. Sometimes you feel very frustrated, being aware that your creature might not even fly, or crash in few seconds.

I must say I was very lucky, since the first flights are already done and the *Dream 2700* flies great, with no particular issues.

In the next, and final chapter, I will provide you with a detailed report of the flight characteristics, and some ideas I want to implement on a second prototype (MVP2, according to the *Agile* methodology) to make it even better!

Resources

- *Le parkour* by Norbert Neumann and Sarah Koch — Our guide will show how to overcome long standing rules and chart a clear path toward a more agile and competitive company, drawing inspiration from the trend sport »Le Parkour«.
- *Agile for Hardware Development* by Dorian Simpson and Gary Hinkle. — For those who are interested, an ebook on the *Agile for Hardware* process.
- *Shapeways Selective Laser Sintering* — “begins as thin layers of polymer powder are dispersed over the build platform. A computer-controlled CO2 laser traces the cross-section of the 3D design on the powder. It then scans each layer, fusing them all together…”
- *Dream 2700 Scale Sailplane Wings Foam Cutting* by the author on YouTube. — “Cutting of the first two sections of my tailless sailplane design. Results are not bad.”
- *Supra 3.4m TD/F3J Sailplane* by Professor Mark Drela as posted on the Charles River Radio Controllers website. — “The Supra wing is a slight modification of the Aegea wing. The sweep has been eliminated, mainly to reduce the flaps-down launch torsional loads by a factor of…”
- *Molding the Main Wing* by the author on YouTube. — “A timelapse of the process I followed to mold my wings. I have to improve the

leading edge finish, as i did already for the second half wing.…"

- ***Servo Mounts*** by the author on YouTube. — "In this video I will show my method for installing servos. I've used tailor-made servo mounts, 3D-printed in PLA…"
- ***Flight Comp*** on YouTube. — "Flight Comp is all about RC sailplanes. We are passionate about what we do and want to share it with you."
- ***Assembly Process*** by the author on YouTube. — "This is the final assembly procedure for my sailplane rc scale model. Everything fits tight and strong, sign of a precise construction…"

*All images by the author. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

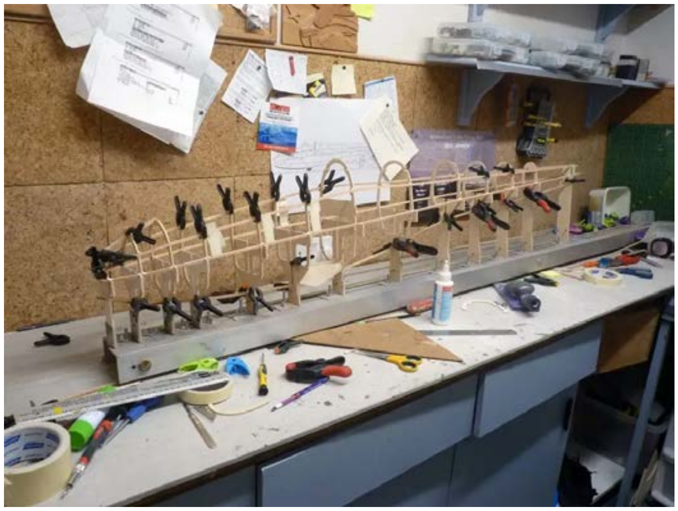
Downsizing the Bergfalke IV

Motley Crew displays the finished Bergfalke IV.

Part I: What do you mean you don't remember the cabriolet version with winglets?

For those of you reading this on your phone (which apparently is well over half of you!) note that you can tap on any photo for a larger, more detailed version. — Ed.

The *Bergfalke IV* is the culmination of the Scheibe's series of the type, making its debut around 1969, being of steel tube structure in the fuselage and traditional wooden flying surfaces. It has long been a favourite of mine, and three *Bergfalke I*'s and three *Bergfalke IV*'s bring us to the current version. As an OAP, I have found my designs becoming smaller over time, which is why this one is scaled to a very convenient 1:4.7-scale.



Left: Basic fuselage construction starts on the ‘Bridson’ jig. | Right: Top decking of the nose comprises off planks of 1.5mm ply.

Left: View of the basic fuselage underside. | Right: Making up the cabriolet hatch.

The hatch, ready for sheeting.

So, full disclosure: I can find plenty of full-size cabriolet conversions for the *Bergfalke III*, but none for the *IV*. I have found one *IV* with winglets. Not to be daunted I carried on with the project, deciding halfway through that this would be an ideal model for electric assist (e-assist) as it would, hopefully, be small enough to easily hand launch on the flat and extremely useful on light days on the slope. As it turns out, these predictions were fully borne out.

Left: View of the rear end and tail feathers. | Right: First stage of the wing construction.

Left: Basic airbrake assembly. | Right: Airbrake installed in the wing.

Given the structure of the full-size version, the fuselage would have to be built on a jig, not a problem as I have the use of my purpose-built 'Bridson' jig, although a simpler method with a wooden base is the more traditional way. The flying surfaces are of spruce, ply & balsa in the normal fashion. The cabriolet hatch is retained with magnets, and full top & bottom airbrakes were designed in.

Left: View of one of the removable winglets. | Centre: Configured for e-assist mode with the prop on. | Right: Pure glider mode with blanking plate fitted.

The nose is made up my usual way, with multiple applications of car body filler. This is then drilled out ready for one of my pal Smallpiece's aluminium housings into which a bearing is placed. The motor shaft is removed and replaced with a longer version coming out the other way: this allows the motor to be screwed to the rear of the front former, thus obviating the need for spinners or cowlings. The final advantage of this system is that the prop can be removed and a blanking plate fitted to restore the model to pure glider status.

The Bergfalke IV airframe, ready for covering.

Scheibe Bergfalke IV	
Scale	1/4.7
Span	3.7m
Length	1.67m
All Up Weight	4.5kg + LiPo
Wing Section	HQ 35/12
Control Functions	Ailerons, Rudder, Elevator, Airbrakes, Tow Release

Turnigy G32 E-Assist System	
Battery	3~4 Cell /11.1~14.8V
RPM	600kv
Max Current	60A
No Load Current	11V/1.3A
Internal Resistance	0.036 ohm
Weight	202g (not including connectors)
Shaft Diameter	5mm
Dimensions	72x42mm
Test Data	14.8v - 13x4 prop - 16.5A - 1680g Thrust 14.8v - 14x10 prop - 46A - 2350g Thrust

Curious to know how it all turned out when the *Bergfalke IV* is placed "into the tender hands of gravity"? Tune in next month for Part II. Until then, thanks very much for reading.

Resources

- *The Williams Anthology* — The collected works of Chris Williams as found in the pages of the New RC Soaring Digest.
- *Turnigy G32 Brushless Outrunner 600kv* from HobbyKing.— "Designed to be a direct swap out for your 32 size glow engine.

> This brushless outrunner will provide more power and with its high efficiency, long run times…”

Where it all started for me — the 1/4-scale version of the Bergfalke IV.

All images by the author. Read the [***next article***] *in this issue, return to the* [***previous article***] *in this issue or go to the* [***table of contents***]*. A PDF version of this article, or the entire issue, is available* [***upon request***]*.*

On The Bench | Youme Batteries

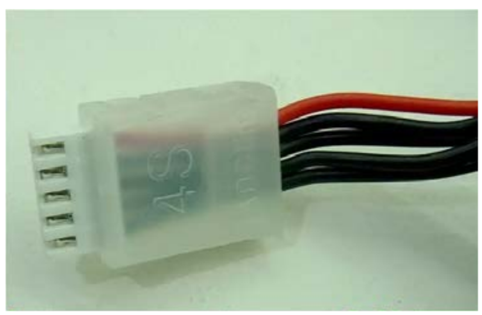
(credit: Youme Batteries)

Your usual Lipo supplier done a bunk? Here's a solid alternative.

Now that the big, Hong Kong-based online hobby retailer (you know which one!) has seemingly left the UK and Europe we have to look elsewhere for our LiPo batteries. I like to buy from UK suppliers whenever I can but the prices they charge for LiPos are often eye-watering. Quality can be a problem too. I bought some batteries from a reliable source a year or so ago that turned out useless. They had internal resistances (IR) starting at 35mΩ, falling very little after three charges. They went back. So my message is take care when buying an unknown brand. Ask around, but if you get no joy buy one and test it out as I have done below before committing a lot of money.

I covered IR in a previous article (link in *Resources* below). However, briefly, a battery is made of metals and chemicals that have electrical resistance, internal to the battery. This takes energy from the current, warms the battery, and drops the voltage. Ideal values are between 1 and 4 milliohms (mΩ). Up to 10 is fine. The value goes down over the first few charge and recharge cycles, or should.

A mate at the club called Mark regularly flies impressive ducted fan models that need efficient batteries. He turned up with some Youme batteries that he had just bought, a name that was new to me. I decided to buy a couple of them to replace some Zippys that turned out to be duds when I dragged them out for my old *WOT Trainer* I wanted to use for buddying. It turned out they were six years old. I got two Youme 4.5Ah 4S batteries from a supplier on eBay for £45 for the two, very much a competitive price.



Left: Typical configuration, as tested. | Right: Balance plug.

They are very solid and well made. I especially liked the balance plug. Surprisingly they are about 15g lighter than the old Zippy batteries and the same size. Mine came with EC5 connectors but I decided not to change them to XT90s until I was sure I wouldn't want to send them back. I soldered on the XT90s once convinced all was well. You will need a very powerful soldering iron. Even my 175W electric gun wouldn't have coped. Some time ago Mark suggested a gas (not gasoline!) powered soldering iron. I bought one and now use nothing else on large gauge wires and big connectors. There is no temperature control so you have to take some care not to keep it running between joints. Wonderful bit of kit.

I measured the IR as delivered, then again after a full charge. I then discharged to storage and did a second full charge. Results below. Being good I then discharged them to storage again after looking at the rotten weather forecast. I will of course check again after a few more charge cycles.

Battery 1

Cell	IR as Delivered	After First Charge	After Second Charge
1	17	11	10
2	13	6	6
3	11	5	5
4	13	7	6
Total			**27**

Battery 2

Cell	IR as Delivered	After First Charge	After Second Charge
1	16	10	9
2	12	6	6
3	9	7	6
4	13	7	7
Total			**28**

So these results indicate batteries that are not equal to the very best Turnigy *nano-tech* ones, which have as low as 1mΩ , but are perfectly good. The batteries were marked with a rating of 60C but that is absurd. At 4.5Ah that means a maximum current of 270A. At that current the 27mΩ would drop the battery by 7.3V. A more normal 50A would give a 1.35V drop so I would rate the batteries as 15C or 20C. I reckon you need resistances of around 2 on average to rate at 60. If Mark had telemetry it would be interesting to see what drop he got from his ducted fan currents. He has now tried the batteries in a propellor-driven large scale model and estimates 10% more speed.

> **ProTip: Recovering Dead LiPos**
>
> Another hint from clubmate Mark: if a LiPo has been allowed to discharge very fully, for example by being left hooked up for a day, a charger might not recognise that it is there and will refuse to charge it. One trick is to make the charger think it's not a LiPo. For example charge it as a NiMH for a while. Once it has some voltage in it the charger might then charge it as a LiPo. No guarantee though and be cautious with the charging and the first flight test.

Following an idea from my mate Keith I wondered if the IR, or at least the differences, are one reason why some batteries last longer than others. Perhaps the ones that last the longest are the ones where all IRs start much the same. A higher value cell would waste more energy and heat up and degrade more so perhaps creating a vicious circle (not cycle!).

The acid test? I'll be buying some more when I need to. Unfortunately at present Youme do not do a full range of sizes. There is no 2.2Ah 3S for example.

Resources

- *Youme Power* — The 'official store' on AliExpress.
- *Electricity for Model Flyers | Part II: Internal Resistance and Why It's Important* by the author. — "You will see the voltage drop. But why? The stuff that the battery is made from has resistance, called 'internal resistance'…"

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Rediscovering Martin Simons

"Libelle piste 04 à Grenoble" (Mahé Le Tiec-Pellin via Wikimedia under CC BY-SA 4.0)

Part VI: Winglets as discussed the noted author's model aircraft books.

While each article in this series stands on its own, some readers may want to read ***the previous parts*** *before continuing with this article. This is material on the subject of winglets from two of Martin Simons' excellent books:* Model Flight *and* Model Aircraft Aerodynamics*. Curator Peter Scott's comments are marked with [] (ie. square brackets) — Ed.*

Model Flight

4.15 Winglets and Tip Sails

Ever since it was realised that the wing tips cause serious increases of drag, efforts have been made to prevent or reduce the wing tip vortices. The first attempts involved fitting large flat plates, vertically, at the tip. This does achieve some reduction in vortex strength, but air pressure changes are communicated from one place to another around whatever obstruction is put in the way. The high pressure region under the wing extends down on the inside of any tip plate, the low pressure zone on the upper surface, is felt at the top of the plate. Air therefore tends to flow around the tip plate, and the vortex, although weakened, does not vanish. At the same time, the air flows over the whole surface of the plate and this creates additional skin friction and form drag, so tending to reduce the total benefit. Tip plates of this simple form have not proved useful in practice.

More recently, various forms of *winglet* and *tip sail* have been developed and these have been applied with success to both full-sized and model aircraft (Figure 4.17). The idea of these devices is not merely to restrict and weaken the vortices, but to extract energy from them and use it to provide a useful additional forward-directed force. The net effect is a reduction of vortex drag, especially at low flight speeds and high angles of attack. Correct placement and design of the winglets is necessary if their benefit is to be realised. Badly placed, they do more harm than good.

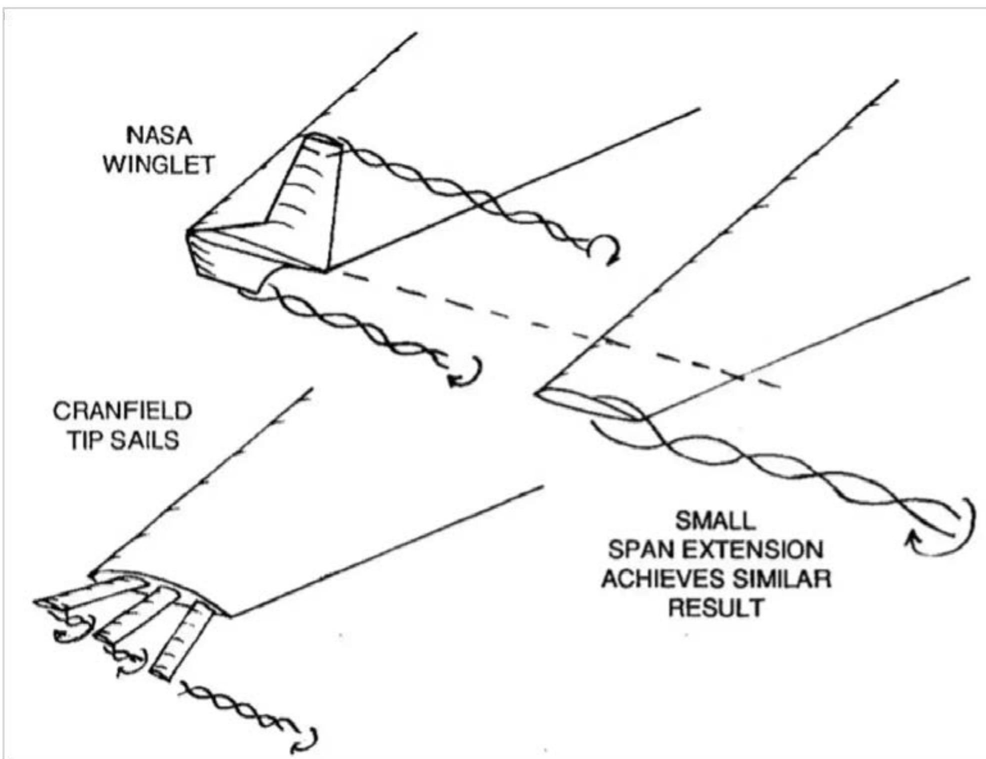


Figure 4.17: Winglets and Tip Sails

Again, the existence of the appendages increases the skin and form drag of the wing, so the full gain is not achieved. What is perhaps more important is that if the wing is extended in span, with a plain tip, it is easy to reduce the vortex drag by increasing the aspect ratio. In terms of structural complications, cost and simplicity of design, this is usually a better method of reducing vortex drag. Winglets find their most promising application when there is a strict limit on the total wing span of an aircraft, as is the case with some classes of model sailplanes in competition. Adding a well designed winglet, extending vertically upwards at the tip, does reduce vortex drag without increasing the total wing span, and so the model remains within the contest rules.

Model Aircraft Aerodynamics

[References to paragraphs and pictures elsewhere in the book have been marked with {} (curly braces)]

6.17 Winglets

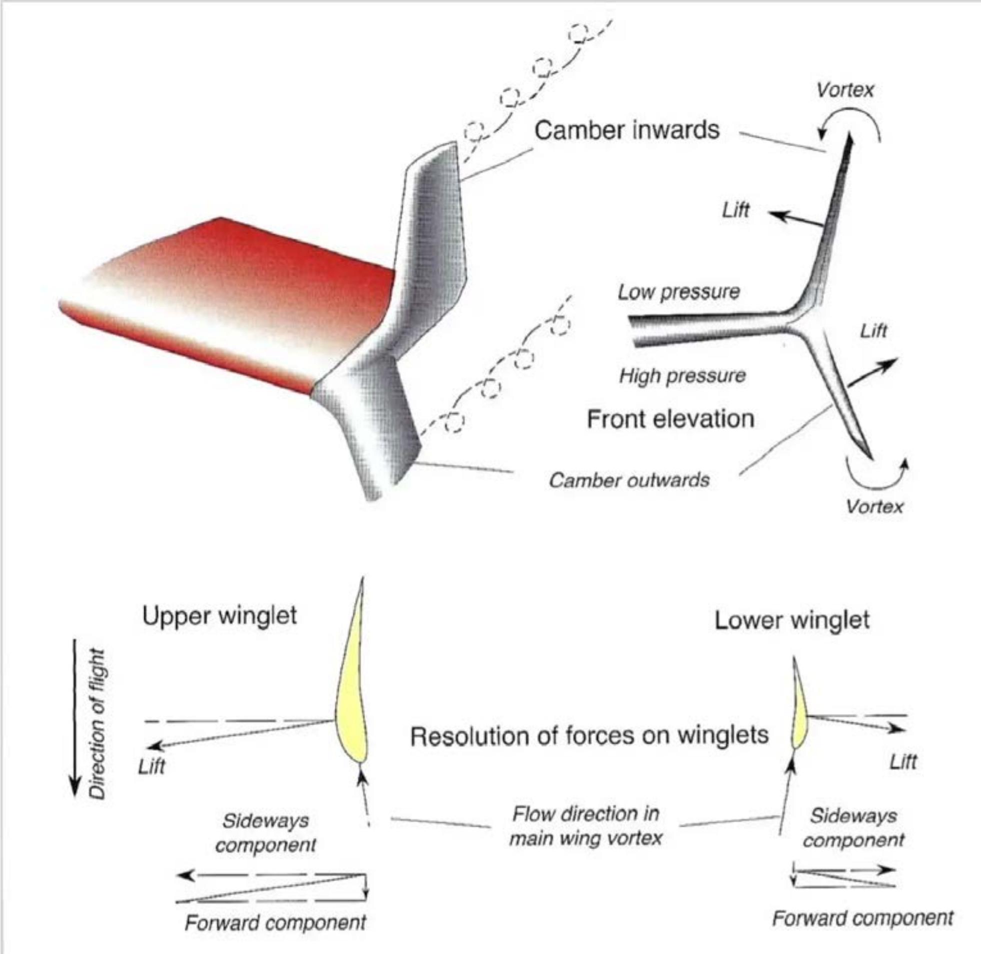


Figure 6.8: The Whitcomb Winglet

Wing tip plates of the kind just described should be distinguished from winglets and tip sails, which are different in principle. A tip plate or body is intended to restrict or prevent the tip vortex. Winglets and tip sails are designed to use the vortex by extracting some of its energy. This not only weakens the vortex but, if the energy can be turned into a force in the right direction, there is a further small gain. Winglets of the type sketched in Figure 6.8 were first developed by R T Whitcomb. {As shown in Figure 5.1,} the vortex airflow round a wingtip is inclined outwards on the underside, upwards just beyond the tip, and inwards above. The precise angle of the flow to the direction of flight changes as the strength of the vortex varies at different angles of attack and flight speed.

An aircraft such as a commercial jet transport operates most of its time at one steady speed. It is possible to design a set of winglets that project into the vortex flow at such angles that they can, like small wings, extract some 'lift' force. If the winglets are set correctly this force will have a forward-acting component that can appear in the general force diagram for the whole airplane as an addition to the thrust. The bulk of the winglets lift will, however, be directed laterally and this will not only tend to bend the winglets themselves but will increase the bending loads on the wing main structure. Since the winglets generate lift, each tip will have its vortex. Compared with a main wing lacking winglets some saving in total drag does result at the designed cruising speed.

Winglets, as shown in the diagram (Figure 6.8) are cambered and twisted to meet the flow at each point at the most effective angle of attack. They are quite complicated to design and construct and are most efficient over a narrow range of flight speeds. If winglets are used it is most necessary to design them carefully and test them extensively before final adoption. They are not merely crude appendages stuck on the end of the wing. For them to work as intended, a great deal of work has to be done.

6.18 The Commercial Equation

If an existing airplane is fitted with winglets, the increased bending loads compel some strengthening of the mainplane, adding weight, and there is a reduction in load carrying capacity. This may be compensated by the increased efficiency so that some fuel is saved. Clearly, whether the aircraft should or should not have winglets is finally determined not by aerodynamic considerations alone but by commercial factors such as the cost of the materials, the investment in design hours and wind tunnel testing time, and the price of fuel. That the winglets do work as their inventors claim is not doubted, but this does not imply they should necessarily be fitted to every commercial airplane nor to flying models.

6.19 Tip Sails

At about the same time as the Whitcomb winglets were being developed, J J Spillman at Cranfield was working on tip sails of the kind shown in Figure 6.9. These were inspired by the wing tip feathers of some large soaring birds, which are spread, fingerlike, to form a series of separate wing extensions with slots between.

Essentially, the Cranfield tip sails are intended to work in the same way as Whitcomb winglets, but there may be three, four or five sails, arranged radially and *en echelon* round the tip. Each sail is adjusted to extract lift from the flow in its neighbourhood and, as with the winglet, some of this force is directed forwards, the rest adds bending load to the wing. The results are comparable and the same economic considerations apply. As before, an increase in aspect ratio has the same effect.

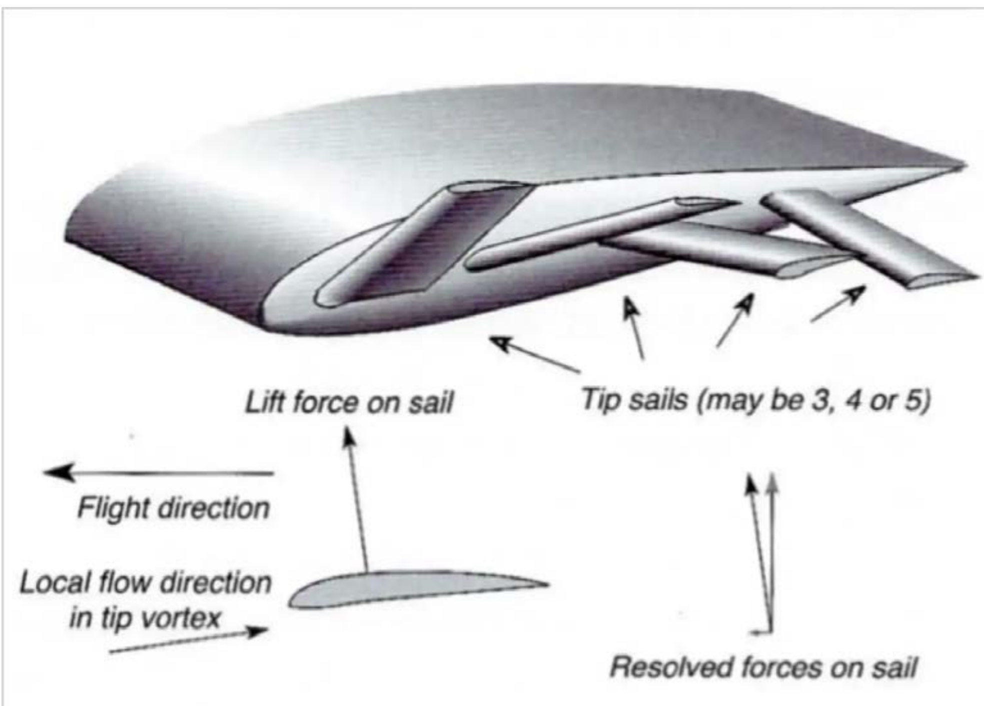


Figure 6.9: Spillman (Cranfield) Tip Sails

6.20 NASA Tip Sails

Even more reminiscent of the bird wing, the NASA tip modification suggested in Figure 6.10 is intended to spread the tip vortex and reduce its strength, and this, too, reduces the vortex drag. Additional loads, as usual, must be borne by the mainplane structure and the slender tip ‘feathers’ are prone to flutter.

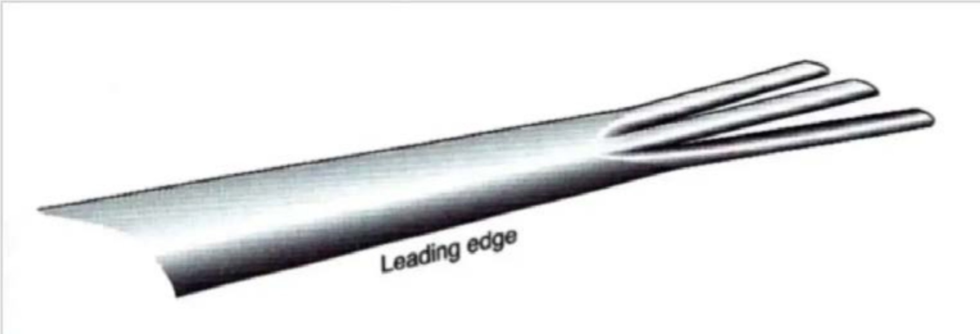


Figure 6.10: NASA Wing Tip Sails

6.21 Disadvantages of Winglets

Winglets are intended to reduce vortex drag that is most important for flight at relatively high angles of attack. They are usually set so that they will be most effective at one speed. Airliners cruise for long periods at steady airspeeds close to the best L/D trim. The winglets will be set to give their best effect in this situation. At any other speed they will work less effectively because the main tip vortex itself changes, requiring the winglet to be set at another angle. The winglets also contribute parasitic drag. At high speeds in particular they will be a handicap because as airspeed rises vortex drag becomes less and less significant, while all forms of parasitic and form drag increase greatly {(Fig 4.10)}. For example, if the winglet is set at -7 degrees at its root (Fig 6.11), it will be fixed at this angle also when the aircraft is flying at an entirely different angle of attack.

Full-sized sailplanes now in production are usually built with winglets and many older aircraft are modified to permit winglets to be attached. The calculations required are extensive and must be supported by practical tests in flight. The gains are measurable but relatively small. Sailplanes need to fly fast between thermals as well as slowly for soaring, The idea of making winglets adjustable to different angles in flight has been mooted but, at the time of writing, has not been attempted in practice. Winglets do, as a rule, improve aileron control and stability in circling. This, rather than any gain in performance, may justify their use.

It has been shown {in Chapter 5} that the most effective method of reducing vortex drag is by increasing the aspect ratio, i.e. increasing the wing span for a given total area. It follows that whatever the gain from using winglets, a similar improvement could always be achieved by an increase in aspect ratio. This could be done by fitting a simple wing extension. Such a span extension would, of course, increase the bending loads on the mainplane and would add weight, so the question is again decided by economics rather than aerodynamics. Nonetheless, whereas winglets require considerable research and, usually, wind tunnel testing to ensure they are of the most favourable shape and set at the best angle, to lengthen the wing is comparatively simple. Moreover, stretching a wing in this way is guaranteed to reduce vortex drag at all airspeeds. A longer wing is more prone to flutter problems and slower in roll than a short wing, but adding winglets to a short wing also increases the danger of flutter and the additional mass at the tip creates more rolling inertia. Even so, as the ETA demonstrates {(6.1)}, however high the aspect ratio, a winglet at the tip may help a little.

6.22 Winglets and Tip Sails for Models

As far as model aircraft are concerned, very few tests have been performed with winglets or tip sails. They are unlikely to produce benefits unless they are properly adjusted and very few modellers have access to wind tunnels for the necessary testing purposes. If there is no restriction on the wingspan of the model, it is safer to increase aspect ratio than to use winglets unless these have been correctly designed. There are, however, occasions when the wingspan is restricted by contest rules, or where an increase of aspect ratio (with a reduction in mean wing chord) might take the wing down to a low Reynolds number and so lose efficiency. In such cases winglets, especially of the Whitcomb type, offer some prospect of worthwhile gains.

The two-metre sailplane class is a case in point. In 1980 tests of a model in this category were reported by Chuck Anderson (in *Model Aviation,* May 1980, pp. 525). On a wing with 25.4 cm chord, of rectangular planform, aspect ratio 7.87, winglets as shown in Figure 6.11 were fitted. These seemed to improve the performance while remaining within the two-metre restriction. After twenty years the model concerned, and others of similar design, remained in use and flew competitively in their class. These winglets also had some less desirable effects on lateral stability and control. Such additions to the tips are rather vulnerable to damage, especially in ground loops or landings that end with the model upside down. For small freeflight models and even for F1A (A2) sailplanes, {as mentioned above (6.4)}, wing taper is not generally desirable but the addition of winglets or sails to a rectangular wing may prove worthwhile. The Reynolds number of the mainplane would be unaffected and the tip vortex, providing the winglets were well designed, would be reduced. Anderson's two-metre sailplane, very wisely, was made with the angle of the winglets adjustable so that by repeated test flying, the best setting could be discovered.

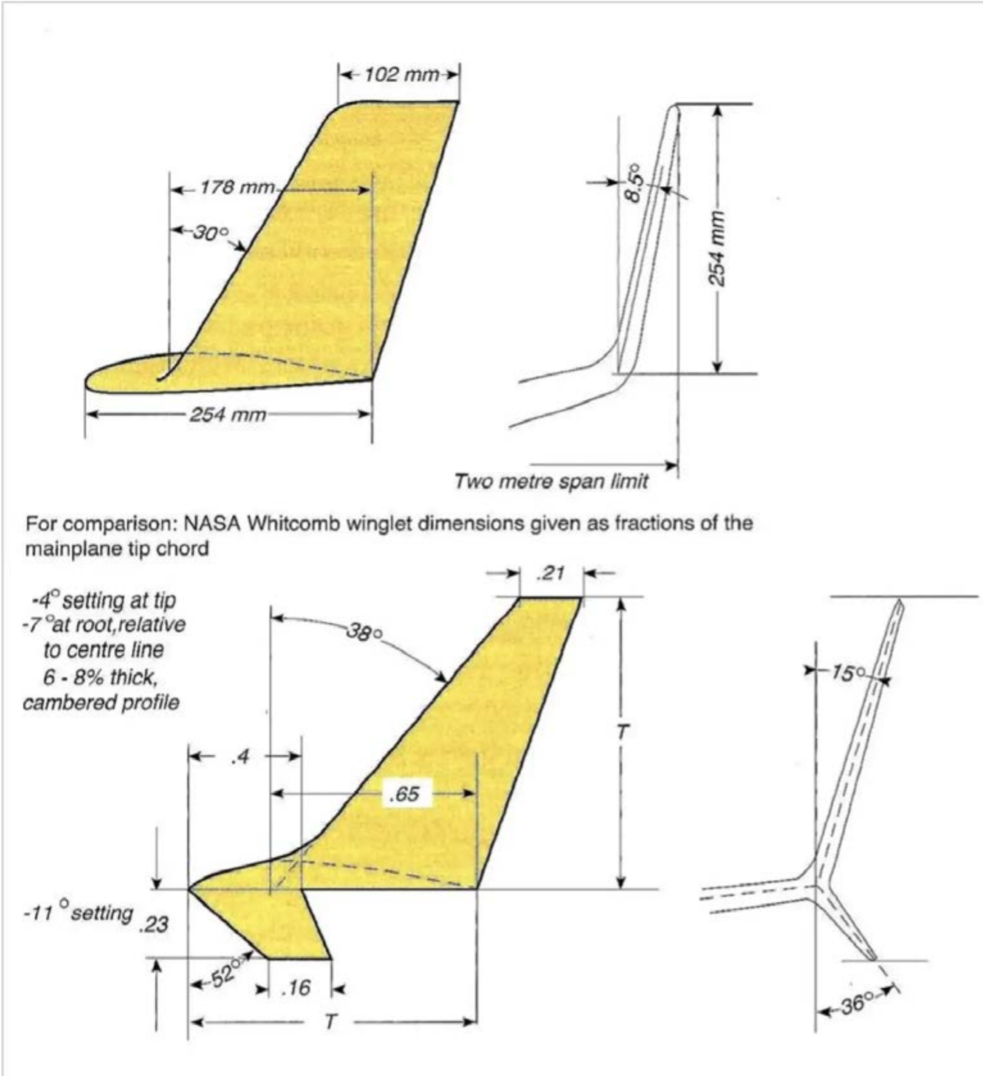


Figure 6.11: Winglets on a Two Metre Sailplane (Chuck Anderson)

Noel Falconer used a refined winglet design on tailless sailplanes and electric powered models. Apart from saving drag, which is rather more severe on a sweptback wing, the winglets also serve as fins, providing very necessary lateral stability on the tailless aircraft.

Resources

- *Rediscovering Martin Simons* — The complete set of previously published articles from this series.
- *Peter Scott* — The contact page on the curator’s personal website.

Note that the following are simply examples (from AbeBooks) of where you can obtain copies the books referenced in this series of articles. A quick search will reveal many alternatives including possibly your local secondhand bookstore:

Bigger Is Not Always Better

I have pint, quart and gallon containers of wood glue and I transferred some to smaller bottles. Twist open tops are much easier to use than the push pull tops on most wood glues.

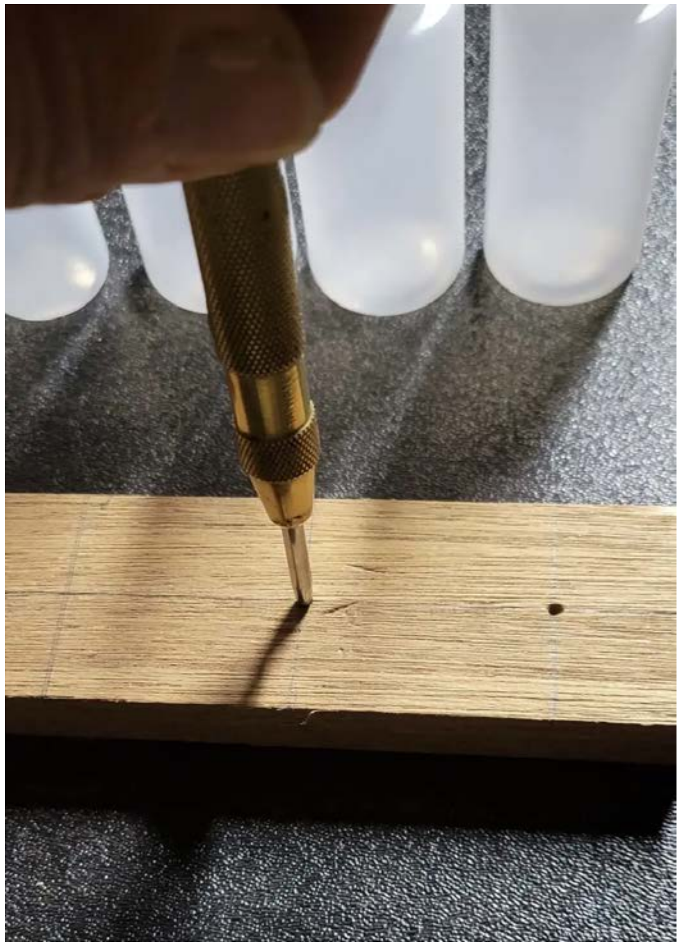
The rumors have been greatly exaggerated.

I use many types of solvents in the shop. For years I just got out the cans when I needed to use one.

A few years back I finally got smart and started using squeeze bottles. I never use that much of any one solvent at a time, so it just made sense to fill up the small bottles instead. I've made a couple of different racks to hold them and this is the latest. I took a scrap piece of wood and set out the bottles I wanted to use.

I then marked where they would go.

Then I punched the centers and used the appropriate bits and drilled about three quarters of the way in.



You can just set it on your bench like this…

…or mount it somewhere like I did here.

To mark the bottles, you will need to use a marker that the solvents won't erase. A black 'industrial' Sharpie works well.

Here's a previous rack I made. They were out of these particular bottles the last time I went to order. I actually like the new ones better, since they have various sizes. Twist off tops are much better than these snap-on ones.

Even if you only use a couple of different solvents, having smaller bottles is really much more convenient. Finding them is easy: just put `squeeze bottles` in your Amazon search. Look for the ones that suit your needs. Avoid any with small tips that can clog. In *Resources*, I have provided the link to the ones I bought.

Thanks for reading, best of luck with your projects and please let me know if there is a particular tip you would like to see!

Resources

- *Belinlen Plastic Squeeze Bottles with Twist Cap* — These “squeeze bottles can be used…for cookie decorating, food coloring, royal icing, condiments, syrups, dressings, oils, vinegars, and sauces…”.
- *Tom’s Tips* — The complete compendium as presented on the pages of the *New RC Soaring Digest*.

All images by the author. Read the next article in this issue, return to the previous article in this issue or go to the table of contents. A PDF version of this article, or the entire issue, is available upon request.

Soaring the Sky Podcast

E129: Soaring and Simulation | Getting the Most Out of Your Simulator Experience

Our eighth instalment of this ongoing series where we select and present episodes from Chuck Fulton's highly regarded soaring podcast. See Resources, *below, for links where you can find* Soaring the Sky, *or simply click the green play button below to start listening. — Ed.*

For this edition of the podcast Scott Manley joins Chuck to talk about how simulation can be used as a powerful tool to learn and also have some fun while on the ground. Scott has been an educator and flight instructor for years. Recently he has been teaching students online all over the globe using *Condor,* the soaring simulator. He has so much to share about how glider guiders can get the most out of simulators and have fun while doing it. The podcast also reached out to the soaring community to find out how it uses *Condor*. Some left comments on social media and some recorded responses on the *Soaring the Sky* website. Chuck shares these in this episode as well.

Sergio the Soaring Master has a new and interesting segment today and this one is titled *The Days Script*. Enjoy Chuck's show!

Resources

- ***Condor*** — "simulates the complete gliding experience on your computer. With it you can learn to fly gliders and progress up to a high level of competition skill. The core of the simulator is the state of the art physics model and advanced weather model aimed at soaring flight."
- ***Simulation-Based Glider Flight Education*** — Guest Scott Manley's website: "the information and resources you need to self-manage the flight training and aeronautical knowledge development … the key to this efficiency is the use of glider flight simulation … "
- ***E047: Condor Soaring Flight Simulator with Chris Wedgwood*** — Want still more *Condor* content? Check out this episode of the *Soaring the Sky Podcast* which was featured in the November 2022 issue of the *New RC Soaring Digest*.
- ***Soaring the Sky*** — "an aviation podcast all about the adventures of flying sailplanes. Join host Chuck Fulton as he talks with other aviators around the globe". You can also find Chuck's podcast on Instagram, Facebook and Twitter

Subscribe to the Soaring the Sky *podcast on these preferred distribution services*:

Science for Model Flyers

“With H2FLY and our aircraft HY4, we have proven that we can make hydrogen fly. And hydrogen’s potential for the future of air mobility is enormous”. For many, flight with hydrogen-generated energy remains the holy grail of aviation. (credit: H2FLY, link in Resources)

Part III: Energy

Although not a mandatory prerequisite, you may want to read the first two parts of this series before proceeding with this next instalment. These are The Periodic Table *and* Forces and Inertia *respectively — Ed.*

The word energy is derived from the ancient Greek word ἐνέργεια (pronounced energeia), meaning activity. It was probably used first by Aristotle around the fourth century BC.

The energy that exists in the universe now is the same as it was just after the Big Bang. It is just arranged differently. Energy can neither be created nor destroyed, just changed from one form to another. That is a fundamental law of physics. It is part of the science of thermodynamics, which literally means ‘heat movement’, though a more general term would be energy movement.

Why does that matter to you as a flyer? You and your models are all part of energy movement. Every breath you take, every time you launch a glider, every material you use when building, every solder joint you make and every time you charge your batteries you are part of energy movement. The outcome has a name. It is called entropy.

Entropy is a measure of complexity. At the start, all of the energy in the universe was concentrated in one place. It was structured very simply. It had zero entropy. As the universe expanded and matter formed the energy became spread out into many different forms. Its complexity increased — let's call it chaos. Its entropy increased. Its temperature fell.

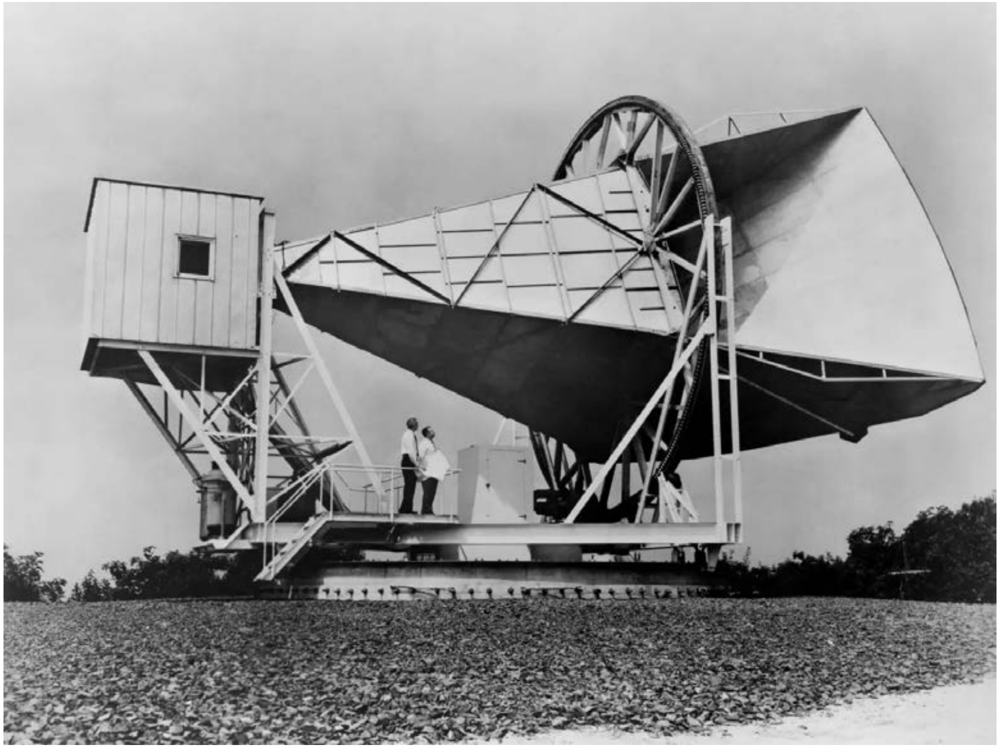
In the end energy will probably be evenly spread out and entropy will be maximum. The temperature everywhere will be about six degrees kelvin (6 K), which is 6°C above absolute zero. Much of the universe is nearly there now. It is called cosmic background radiation and was first measured at 3 K by Penzias and Wilson in 1964. One of the greatest examples of serendipity is described in Penzias' history below. At the very end, when energy is spread evenly, there will be no temperature differences to cause energy to flow so nothing can happen any more.

As T. S. Eliot wrote in his poem *The Hollow Men:* "This is the way the world ends | Not with a bang but a whimper".

> **Arno Penzias (1933 —)**
>
> Arno Penzias was born in Munich, Germany, the son of Justine (née Eisenreich) and Karl Penzias, who ran a leather business. At age six, he and his brother Gunther were among the Jewish children evacuated to Britain as part of the Kindertransport rescue. Later, his parents also fled Nazi Germany, and the family settled in the Garment District of New York City in 1940. In 1946, Penzias became a naturalised US citizen.

Penzias went on to work at Bell Labs in New Jersey, where, with Robert Wilson, he worked on ultra-sensitive cryogenic microwave receivers, intended for radio astronomy observations. In 1964, on building their most sensitive huge horn aerial and receiver *[Picture 1]* they heard background radio noise that they could not explain. It was far less energetic than the radiation given off by the Milky Way *[our galaxy]* and it was isoptropic *[equal from all directions]*, so they assumed their instrument was subject to interference by earth-bound sources. The horn proved to be full of bat and pigeon droppings, which Penzias described as “white dielectric material”. Removing it made no difference. Having eliminated all sources of interference, Penzias contacted Robert Dicke, who suggested it might be the background radiation predicted by some cosmological theories. The pair agreed with Dicke to publish side-by-side letters in the Astrophysical Journal, with Penzias and Wilson describing their observations and Dicke suggesting the interpretation as the cosmic microwave background radiation (CMB), the radio remnant of the Big Bang. This allowed astronomers to confirm the Big Bang, and to correct many of their previous assumptions about it.

With Wilson he won the 1978 Nobel Prize in Physics for their discovery.



Picture 1: Horn Antenna in Holmdel, New Jersey. “In 1964, radio astronomers Robert Wilson and Arno Penzias discovered the cosmic microwave background radiation with it, for which they were awarded the 1978 Nobel prize in physics.” (credit: NASA via Wikimedia)

> **Robert Wilson (1936 —)**
>
> Robert Woodrow Wilson was born on January 10, 1936, in Houston, Texas. He studied as an undergraduate at Rice University, also in Houston, and then earned a PhD in physics at California Institute of Technology. He worked at Bell Laboratories until 1994, when he was named a senior scientist at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts.
>
> Wilson was one of the twenty American recipients of the Nobel Prize in Physics to sign a letter addressed to President George W Bush in May 2008, urging him to “reverse the damage done to basic science research in the Fiscal Year 2008 Omnibus Appropriations Bill” by requesting additional emergency funding for various national science institutions. He was elected to the American Philosophical Society in 2009.

Okay, you'll be dead long before the end of the universe, so you ask again why does it matter? No whimper for you, thanks. And of course we cannot yet be sure how the universe will end, nor even if it will. Some think it will expand for ever. Some think it will collapse back to a point. Now that would be some thermal! More fun than the "Restaurant At The End Of The Universe" from *The Hitchhiker's Guide To The Galaxy*. Some even think it is formed from digital data (`1` and `0`), like a large hologram, where each `1` or `0` represents the existence or not of something as yet undecided. As the universe gets bigger there is a greater number of the `1` and `0` states so it becomes more complicated. If that was true its state just before the big bang would be a single `1`.

It is also worth noting that mass and energy are the same thing. When you add energy to something its mass rises, normally just a smidgeon. That is described in Einstein's famous equation $E = mc^2$. E is energy in joules, m is mass in kilograms and c is the velocity of light in metres per second (m/s). The value of c is very large (3×10^8 m/s) so a tiny change in mass involves a vast amount of energy. This is what generates heat in stars and in our nuclear reactors and weapons. When you charge a 2.2Ah 3S battery from flat its mass goes up by about 10^{-12}kg. Better shift it back a tiny bit to keep the centre of gravity right.

One oddity. Entropy must increase in any energy conversion. Chaos must increase. How then can highly organised things be created where entropy clearly falls, for example a human being or indeed a model glider, both created by structuring atoms from chaotic nature? The answer is that the creation process must produce more chaos than the loss of chaos in the created, organised thing. This is why whenever we make something we make muck, including greenhouse gases and other waste materials, and we increase entropy. And that includes processes that recycle materials, so the human race must learn to make and use less if it is to survive this century, at least until we produce all our energy from the sun or nuclear fusion as sources and learn how to recycle our muck properly. If we don't then the earth will carry on in a rather more watery, acidic and warm state, but we humans won’t. Perhaps Thomas Malthus will prove right (see *Resources*). Maybe it’s what happened to Mars. They have found evidence of past water and life there, which might give us an idea of how the earth could end up.

Have you played bricks with a small child? You sit on the floor and pile the bricks into a tower. The child then knocks the tower down and demands that you pile it up again, for ever. This is an excellent model of entropy and of course the joys of parenthood. The pile of bricks is ordered and has low entropy. Knock them over and chaos and entropy increases. Rebuild and entropy drops again, though your muscle activity increases it even more somewhere else. Entropy is one way to see the direction of time. Record the tower game on video and see if there is a way you can play it backwards. If not you can imagine it. The bricks jump up from the jumble on the floor into an ordered state. So you can tell which way time flows by seeing whether entropy falls or rises.

A free swinging pendulum is an extreme example. It causes very little increase in entropy on each swing. Put another way the swing only becomes slightly less each time due to energy being lost into the surrounding air. You would have to watch a recording for a long time to see whether it, and time, ran forward or backward.

Types of Energy

Potential	Gravitational and electrical
Kinetic	Linear and rotational
Chemical	Chemical bonds and changes in batteries
Heat	Internal combustion engines
Electrical	Other than chemical
Magnetic	Motors and servos
Elastic Potential	Bungee and rubber motors
Light and Other EM Waves	Navigation lights and radio signals
Sound	
Surface Energy	Surface tension (for example)
Nuclear	
Ionisation	

Table 1 (credit: ScienceStruck)

An impressive list I am sure you'll agree. What's more impressive is that all but the last two are at work in our models. What about sound? Sound is, especially if you have a sound system to imitate engines and other noises of a scale model. And what about the hiss and whistle from a glider when it pulls out level from a fast dive? Surface tension is, if you are trying to take off from smooth water or you wick glues into narrow gaps by capillary action.

Efficiency

Every time energy changes from one form to another some is wasted, meaning not becoming the energy you want. For example when our muscles convert the chemical energy in our blood sugars into work, such as lifting something, about 80% of the energy is turned into heat in the muscles. Only 20% is used for the lift. The heat is not necessarily waste as our 'warm-blooded' mammalian body needs our body temperature to be kept up. That is why we shiver when we are cold. It is making our muscles generate heat.

So if we lift something only a fifth of the energy is turned into the energy we intended. I use that to estimate the power I generate when cycling. I can't justify the cost of power-reading pedals. We describe this as an efficiency of 20%, and give it the Greek letter eta (η). So:

- Efficiency (η) = useful energy / total energy used
- It is always less than 1 (see *Perpetual Motion* below)
- We then multiply it by 100 to turn it into a percentage.

Here are some typical efficiencies as a percentage:

Petrol (Gas) Engine	25%
Automotive Diesel Engine	45% which is why you get lower fuel consumption
Gas Turbine Using Kerosene	60%
Electricity Generation	35% depending on process used
Electricity Supply System (UK)	77% though varies a lot world wide (97% to 29% in 2014)
Human Muscle	20% though varies a lot with fitness
Electric Motor	90%
Filament Lamp Bulb	10% and could be much less
Fluorescent Lamp Bulb	60%
Light Emitting Diode	90%
Loudspeaker	5% approximately
Lightweight Road Bicycle	95% but remember muscle losses
Electric Convector Heater	Nearly 100% but note losses in generation and supply
Gas Condensing Boiler (Furnace)	95%
Oil Condensing	90%

The above are typical values I gleaned from a variety of data sources. As a rule of thumb for heat engines the hotter the energy starts out, and the cooler it finishes, the more efficient the engine. That's also why condensing boilers are much more efficient because the flue gas is cooler. The engineer Sadi Carnot wrote the defining equation for what he called an 'Ideal Engine' meaning a 'perfect' one:

`Efficiency = (high temperature — low temperature ) / high temperature`

Temperatures are in kelvin (K), where absolute zero is zero K (-273 ºC) and each degree is the same size as a celsius one. For water, boiling point is roughly 373 K and freezing point 273 K.

Let's look at a theoretical petrol engine example:

- `low temperature` = 300 K (exhaust) which is 27 celsius or 'pretty warm' in fahrenheit
- `high temperature` = 1100 K (cylinder)
- `Efficiency = (1100—300) / 1100 = 0.73` (or 73%)

Wouldn't that be wonderful? Sadly, practical engines are very much less efficient. However the principle of getting the greatest difference in temperatures applies. The very high combustion temperatures in gas turbines are one reason for their greater efficiencies.

Logically you can see why this is true from kinetic theory. This tells us that heat energy is stored in the kinetic energy of the particles. They stop at absolute zero so all energy will have been extracted. An engine that emits gas at zero kelvin will be 100% efficient.

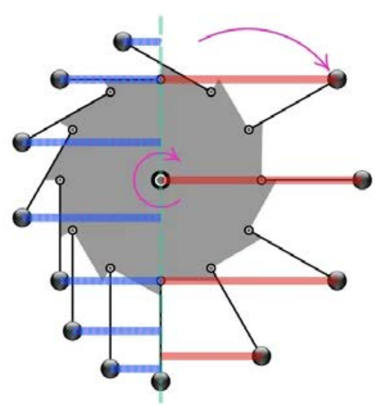
I am still puzzled why model turbines use up the fuel so quickly though — much quicker than a glow or petrol engine producing similar power. Anyone know why?

> **Sadi Carnot (1796 — 1832)**
>
> Nicolas Léonard Sadi Carnot was born in Paris into a family that was distinguished in both science and politics. He was the first son of Lazare Carnot, who chose his third given name Sadi after the Persian poet Sadi of Shiraz. Lazare was an eminent mathematician, military engineer, and leader of the French Revolutionary Army.

> After education at the Ecole Polytechnique in Paris he joined the French Army as a military scientist and physicist and was later described as the "father of thermodynamics." He published only one book, *Reflections on the Motive Power of Fire* (Paris, 1824), in which he expressed the first successful theory of the maximum efficiency of heat engines and founded the new discipline of thermodynamics. Carnot's work attracted little attention during his lifetime, but it was later used by Rudolf Clausius and Lord Kelvin to formalise the second law of thermodynamics and define the concept of entropy. Based on purely theoretical study, such as improving the performance of the steam engine, Carnot's intellect laid the groundwork for modern heat engines, such as car and gas turbine engines. Carnot retired from the army in 1828. He was locked up in a private asylum in 1832, suffering from "mania" and "general delirum", and he died of cholera shortly after, aged 36, at the hospital in Ivry-sur-Seine.

Perpetual Motion

So what about perpetual motion machines? Picture 2 looks as though it ought to work. The weights on the right have long moment arms so should turn the wheel with more weights from the left falling over to replace them. However note that are many more weights on the left.



Picture 2: "The Overbalanced Wheel, annotated with distances of the weights from the centreline showing that the torques on both sides even out on average." (credit: Wikimedia)

Some look very convincing but none of them work. You can buy models on AliExpress that you can use as a talking point, but make a point of looking for the power lead, which is the giveaway but not shown in Picture 3.

Picture 3: 'Kinetic Art' Not shown, the power cord. (credit: AliExpress)

The closest we get to perpetual motion is the current that continuously flows in superconducting wire loops that have no electrical resistance. Examples are MRI body scanners and the large hadron collider. However these wires must be cooled to a few degrees above absolute zero by liquid helium. However well insulated they are, energy is used to keep them cold. It's one reason why we shouldn't waste precious and limited helium on balloons and silly voices.

Chemical Energy

Even though electrical energy conversions tend to be the most efficient, energy is wasted when we charge our batteries. About 60% to 70% of the energy we put in gets stored as a chemical change. Generating and transmitting electricity have losses as we saw earlier. The charger itself also wastes energy. If a mains charger is used you might only get 6% to 20% of the energy it uses back out of the battery. However some mobile phone and laptop charging systems can achieve much better than that. There is a link in *Resources* with additional details.

What is certain is that despite their inefficiencies the total pollution and wastage of rechargeables is less than single-use batteries.

Gravitational Potential Energy

This is the energy of height. You have just manually towed your glider to its ceiling and you release it. It has the energy you gave it by pulling it to a height. This is called gravitational potential energy. It is weight times height or mgh. What is g? It is what you multiply mass in kg by to get weight in N. Near the earth it is about 10. If using imperial units it is 32 as 1 lb weighs 32 poundals force. And yes, there is a unit of energy in the fps (foot pound second) imperial system. It's called the foot-poundal (ft-pdl) and is 0.042 joules or 0.0004 British Thermal Units or 0.00001 food Calories. I like to promote the cubit as a really traditional length unit to the imperial diehards at the field. If it's good enough for Noah it's good enough for me.

To get the model up in the air you worked against its weight and lifted it by a vertical distance. This is called doing work. Work done is force times distance. The weight acts straight down so it is vertical distance that counts. As it is energy it is measured in joules. One joule is the work done when a force of one newton is moved by one metre. Or you lift an apple from the ground under the tree and pop it in your pocket followed promptly by "get out of my orchard!"

So the glider now has potential energy equal to its weight multiplied by its change in altitude. A 2kg glider, which weighs about 20 newton, if lifted 100m, will have 2000 joules (J) of potential energy. If there are no thermals nor slope lift that's all the energy the glider will ever have in this flight. How will it be used? As the glider slips through the air it experiences drag. That is a force. Remember work (energy) is force times distance. The less drag there is the further it can go for its 2000J. Suppose the drag is 10% of its weight. It can go 10m forward for every 1m it drops vertically. Wait a minute that's glide angle! Yes the glide angle is the result of potential energy being used to do work against drag. You can now see why less drag gives a better glide angle. That's why the sleek, polished glass ship with hidden control linkages can have a glide angle up to forty. Any advance on forty for a model?

In the above case when dropping 100m the glider should move forwards by 1000m. I can feel a silly idea coming on. Perhaps I should use the distance travelled from a certain height, which is recorded by my FrSky GPS telemetry, to check whether that is true. Just need a dead-air day. Mind you, with the extra atmospheric energy of global warming, dead calm days are an increasing rarity. As I have said before it's a race between climate change and the CAA/FAA to destroy our hobby.

Kinetic Energy and Aerobatics

Kinetic energy is the energy of movement. Numerically it is half the mass times the speed squared ($\frac{1}{2}mv^2$). Now let's do some glider aerobatics. This is very different from duration flying with minimum sink. Let's think of a simple inside loop. You will already have some speed but not enough for a loop. Put your nose down and dive. You gain speed and kinetic energy by converting it from potential energy. When you judge the speed to be enough pull your nose up to complete a loop. If not enough then think quickly enough to try a stall turn instead before you reach zero speed followed promptly by "that's what I intended to do".

For pure gliders, aerobatics is always about having enough height and potential energy to complete the manoeuvre, then regaining height from slope or thermal lift ready for the next.

My New Challenge

I have invented a new game — sorry, challenge. At least I think it is new, so let me know if it isn't. You get your glider up to the maximum allowed height for your field, say 122m. When your telemetry tells you that you are there you push the nose down vertically and gain speed. Then do a loop. Then another vertical drop and another loop. The challenge is how many loops you can do in the 122m. In dead air I can do seven with a *Bixler 1.1*. It is trimmed to instability as my mate Keith always tells me when he flies it. In a thermal I have managed thirteen.

I decided to try it with a smoother ship with a folding prop — my foamie 2.4m *Phoenix* — and managed thirteen in dead air. The wings on my ASW flex too alarmingly to try it with that.

What energy changes are going on here? You lose potential energy (height) and turn it into enough speed, or kinetic energy, to do the loop. The perfect technique is to gain just enough kinetic energy to carry you over the top then to dive just enough to gain speed for the next loop. There will of course be a loss of energy due to drag which is why the top of your first loop is below your starting height. Give it a try but please don't blame me if the final loop is into negative altitude.

Next time in *Science for Model Flyers* I talk about aerials! Until then, thanks for reading and let me know if you have any questions.

Resources

- *H2FLY* — "We unlock the era of sustainable air travel by developing the first qualified hydrogen-electric powertrain for aviation…"
- *Thomas Robert Malthus* — "an English cleric, scholar and influential economist in the fields of political economy and demography…"
- *ScienceStruck* — Types of energy.
- *Battery Chargers and Energy Efficiency* by the Natural Resources Defense Council 2003 — "Portable products, such as laptop computers, cordless power tools and cell phones, are powered by batteries that require energy…"
- *Peter Scott* — The contact page on the author's personal website.

Also by the Author

- *Electricity for Model Flyers* — The author's complete, highly regarded series presented on the pages of the *New RC Soaring Digest*.

- *Cellmeter 8* — “What’s on offer for this economical battery meter and servo tester? Quite a bit, actually…”
- *The Fine Art of Planking* — “The time-tested method for moulding strips of wood into an organic, monocoque structure…”

Italicized biographies are based on excerpts from Wikipedia. *Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**.* *A PDF version of this article, or the entire issue, is available **upon request**.*

Stamps That Tell a Story

The Namibian N$1.60 (upper left) shows a Zögling primary glider, while the N$1.80 (bottom centre) depicts a Schleicher ASW-24 sailplane high above the Bitterwasser gliding field which is also shown on the First Day of Issue envelope (upper right) and described in this article.

The Bitterwasser Lodge and Flying Center

The Philatelic Services in Namibia issued two postage stamps to honor the sport of gliding and soaring in their country. The N$1.60 shows a Zögling primary glider, while the N$1.80 depicts a Schleicher ASW-24 sailplane high above the Bitterwasser gliding field which is the subject of this month's article. They were first issued on April 13, 1999 in Karibibi, Namibia. Bittenwasser is also depicted in the first day cover and gives a flavour of the site. All were designed by Dennis A. Bagnall of Cape Town, Republic of South Africa.

According to information supplied by Namibia Post, gliding was introduced in 1928 in what was then called German South West Africa. The first gliding club was formed in Swakopmund in May 1935. More clubs followed in the years to come, especially after Wolf Hirth's visit and write-ups.

The Bitterwasser area is ideal for soaring due to the exceptional good weather conditions from November through to March. It has been one of the leading soaring centres on the African continent since the early 1960s.

Many world records have been set in the Namibian skies, and many more will follow during the coming years. Each year, pilots come to visit the area, to enjoy the almost perfect flying weather conditions, and to attempt new records.

Left: One of Wolf Hirth's write-ups of the area after visiting. | Centre: Aerial view of the Bitterwasser site. | Right: The palm tree Hans Disma planted to mark his 1000km flight. Click any image for a more detailed look.

The amazing flying conditions above Bitterwasser are shown by the row of palm trees which mark the taxyway between the 'pan' and the hangar. Each tree was planted to mark a record or a 1000km flight. This is the reason why the farm is also commonly called the *Diamond Farm*.

Hans Disma from Holland was one of the glider pilots who visited the farm regularly and flew his first 1000km flight in December 1992 in a *Discus B*. He too planted a palm tree which is is known as *Disma's Palm* and shown above.

The original owner, Peter Kayssler, sold the property in 1994 to a group of European investors and glider pilots. Wanting to ensure that soaring could continue there, they established the *Bitterwasser Lodge and Flying Centre* (see *Resources* for link). The former farm with its huge circular dry lake, almost three kilometres in diameter, is now a private air field. Several gliders and a tow plane are available for hire.

Each year the current owners load containers in September to ship sailplanes south for the soaring season. Due to circumstances, one of the regular ASW-24s could not make the trip, so Gerhard Waibel, designer of the Schleicher ASW sailplane series, was asked if he would loan his personal ASW-24E *VW* sailplane for a soaring vacation in Namibia. He agreed, and the ship joined others in the container to go to 'new' territory.

Gerhard Waibel's ASW-24E 'VW', on top of the Wasserkuppe, just before leaving for Namibia.

Dr. Angelika Machinek, an aspiring pilot from Germany, was the lucky person to fly *VW*. Her report on her holiday makes fascinating reading. She described the take-off from the dry salt lake bed at Bitterwasser Airport which was always into the wind from where ever it blew. At 1000m, with great visibility and endless desert, it was difficult to know exactly where she was.

Maps were important and the GPS was even better. The terrain was hard to recognise. She followed dried river beds, dried lake beds, high sand dunes, some roads and hardly any trees or villages. It was a good feeling to have an engine in the sailplane, just in case.

Several feminine world records were flown by her in *VW* in the December 1996/January 1997 soaring season.

Namibia Post had contacted Heidi Snyman, a local glider pilot and promoter of the sport, for suggestions on a new postage stamp series. She submitted several photos of sailplanes, including one of the ASW-24E, with the request to honour the sport and let the rest of the world know about the gliding and soaring opportunities in Namibia. It was her hope that pilots from around the world would then come and visit her home country.

Her suggestion was accepted and photos and reference material were given to Dennis A. Bagnall, an artist (and a power plane pilot) from the Republic of South Africa. With the help of *Jane's All the World's Aircraft*, he designed the postage stamps and the First Day of Issue envelope.

Isn't it time for you to go to Namibia to fly sailplanes the winter here in the north? One can rent one of their sailplanes, or you can ship your owe. For additional information contact the *Bitterwasser Lodge and Flying Centre* using their website.

Writing this article brought many challenges, mainly because I was not at all familiar with the gliding potential in the south-western part of Africa. Much explaining and educating was done by Christoph

Sigwart, one of the co-owners of Bitterwasser Lodge; Hans Disma, who had flown from this field, supplied several photos; Heidi Snyman, who had suggested the subject to Namibia Post; and last but not least Dr. Angelika Machinek, who flew *VW* over Bitterwasser, and Gerhard Waibel who loaned it to her for an unforgettable vacation.

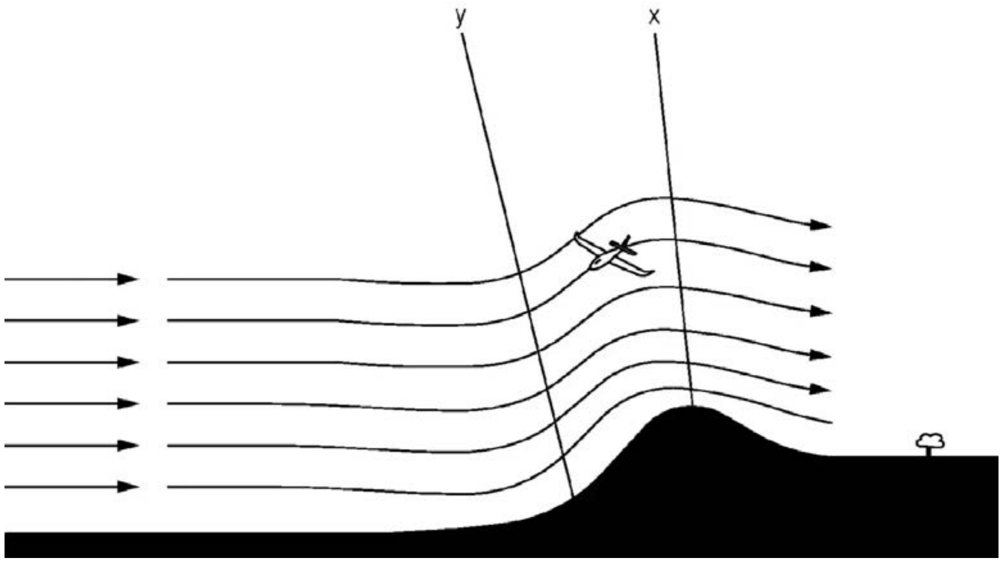
Resources

- ***Bitterwasser Lodge and Flying Center*** — "You will find exceptionally good conditions. The weather here is exceptionally good and it is not for nothing that Bitterwasser is considered the 'best gliding site of the world'. However, flying in Namibia is very different from flying in Central Europe…"
- ***Stamps That Tell a Story: The Series*** — Catch up on your missing instalments of this excellent and informative series of articles presented previously in the New RCSD.

This article first appeared in the November, 2002 issue of Gliding *magazine. Simine Short is an aviation researcher and historian. She has written more than 150 articles on the history of motorless flight and is published in several countries around the world as well as the United States. She is also the editor of the* Bungee Cord*, the quarterly publication of the Vintage Sailplane Association.*

*Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

Glider Patents



US 2019/0107453 A1: Identification and Use of Air Lift for Heavier Than Air Aerial Vehicles

This is the seventh in our series of glider-related selections from the files of the US Patent and Trademark *office (see* Resources, *below). They are presented purely for the interest and entertainment of our readers. They are not edited in any way, other than to intersperse the drawings throughout the text. Disclaimers: a) Inclusion of a given patent in this series does not constitute an expression of any opinion about the patent itself. b) This document has no legal standing whatsoever; for that, please refer to the original document on the USPTO website. — Ed.*

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(54) IDENTIFICATION AND USE OF AIR LIFT FOR HEAVIER THAN AIR AERIAL VEHICLES

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(21) Appl. No.: **15/871,391**

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Abstract

Systems and methods are disclosed for automatically detecting better lift and using the lift to stay aloft longer, provide recommendation to the aerial vehicle’s pilot or fully controlling the flight of the aerial vehicle. The disclosed techniques pertain to aerial vehicles such as airplanes or model airplanes, gliders or model gliders, sailplanes or model sailplanes, hang-gliders, paragliders, speedflying, parafoils etc. The invention uses sensors located on the aerial vehicle to gauge air lift (updraft, thermal, ridge lift etc.) to extend the time the aerial vehicle may be kept aloft. The data flowing from the sensors is fed into a computer, that may provide recommendations to the pilot or to the autopilot (Computer) of the best path to take, to find better lift and to stay aloft.

Related Application

[0001] This application is related to and claims priority from U.S. provisional application Ser. №62/568,506, filed on Oct. 5, 2017 and entitled “A Method to Better Identify Air Lift and Better Use This Air Lift for Heavier Than the Air, Aerial Vehicles.” The foregoing application is incorporated herein in its entirety for all that it teaches and discloses without exclusion of any portion thereof.

Technical Field

[0002] The present disclosure is related to aerial vehicles, and, more particularly is related to identification and use of lift during the flight of such vehicles.

Background

[0003] Currently available technical apparatus to identify lift in the air is a commercially available apparatus called “Variometer”, also known as Vertical Speed Indicator — VSI. Lift is caused by air mass streaming up, lifting the Aerial Vehicles flying within it. Variometer is an ‘air pressure change’ sensor, changes which are caused by change of altitude or by air lift streaming up (Sometimes call “Updraft” — air streaming up, such as thermal). This apparatus then provides a visual and/or audible indication to the pilot, on the type of the change (lift=up or lower=down) and the rate of gaining or losing height (meters per second, etc.). Such Variometer or VSI is installed in almost every commercial Arial Vehicle, in any Glider and the vast majority of the hang-gliders & paragliding pilots buy a Variometer instrument and use it during flight, as it is a great tool to identify lift and help pilots stay aloft more time than without it.

[0004] A Variometer can indicate lift or lower, but cannot provide information about where a stronger lift is. It just indicates that it senses lift or lower. It is common method by unpowered aerial vehicle pilots to start turning when the variometer indicate lift, to stay within the lift and not cross it, flying as storks do — in a circular or helical path, within lift (such as a thermal). As used herein, the term “unpowered” encompasses a craft flying without power, whether or not the craft has power available to it.

[0005] Experienced unpowered aerial vehicle pilots can sometimes identify the direction to the lift core for thermals by sensing it in their seats, e.g., by sensing the movement of the aerial vehicle. Because of this, experienced unpowered aerial vehicle pilots generally stay aloft longer time than novice pilots, who have not learned to feel the lift. There are currently no known technical solutions to point the pilot to the highest lift (such as the thermal core or peak ridge lift etc.), or even stay in the lift and not to lose it, so most pilots have shorter flights, because losing lift will result losing height and will imply a shorter flight.

[0006] The basic lift sensing elements is a variometer sensor (AKA Vertical Speed Indicator). It is a commercially available device. It is noted to make the point that the Variometer Sensor is composed of 2 main parts: A simple air pressure sensor and an analog or digital, mechanical or electronic “calculating” device that report the air pressure change rate over time (lift or lower) in the data it gets from the pressure sensor. Since a Variometer sensor is much more expensive than a simple pressure sensor and since the Aerial Vehicle is equipped with an on-board computer, air pressure change over time may be calculated by this computer, so a simple air pressure may be used anywhere a Variometer sensor is mentioned in this paper, to lower the cost of the solution.

[0007] Before proceeding to the remainder of this disclosure, it should be appreciated that the disclosure may address some of the shortcomings listed or implicit in this Background section. However, any such benefit is not a limitation on the scope of the disclosed principles, or of the attached claims, except to the extent expressly noted in the claims.

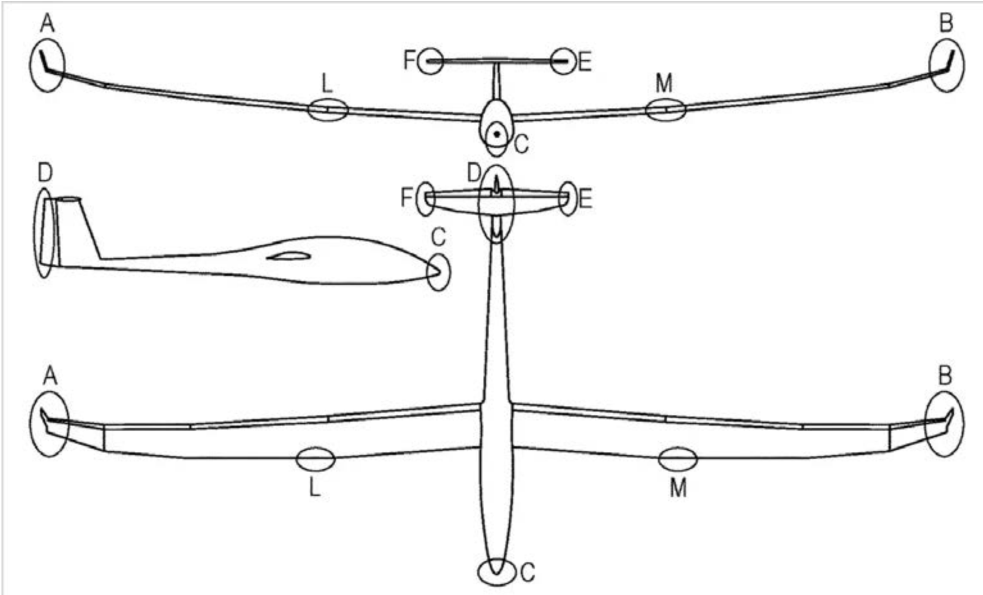

Fig. 1

[0008] Additionally, the discussion of technology in this Background section is reflective of the inventors' own observations, considerations, and thoughts, and is in no way intended to be, to accurately catalog, or to comprehensively summarize any prior art reference or practice. As such, the inventors expressly disclaim this section as admitted or assumed prior art. Moreover, the identification or implication herein of one or more desirable courses of action reflects the inventors' own observations and ideas, and should not be assumed to indicate an art-recognized desirability.

Summary

[0009] As noted above, the innovations described herein pertain to heavier than air aircraft, which may be powered or unpowered, manned or un-manned. Examples include airplanes or model airplanes, gliders or model gliders (with or without motor), sailplane or model sailplanes (both with or without motor), hang-gliders, paragliders (with or without motor), speedflying craft, parafoils and other crafts. Aerial vehicles of these types may be hereinafter referred to as "aerial vehicles" or "heavier than the air" aerial vehicles. More particularly, the present invention is in the technical field of better identifying (compared to other methods available today) air lift and better use that lift, to gain more height. The optional motor and propeller is defined here, to be activated, when low lift conditions are present. This invention covers not only recommendation to an on board human pilot, but also proposes a fully autonomous aerial vehicles (Manned or un-manned) that uses this invention to stay aloft.

Brief Description of the Several Views of the Drawings

[0010] While the appended claims set forth the features of the present techniques with particularity, these techniques, together with their objects and advantages, may be best understood from the following detailed description taken in conjunction with the accompanying drawings of which:

[0011] FIG. **1** is a schematic diagram showing basic sensors location in an implementation of one or more embodiments of the disclosed principles;

[0012] FIG. **2** is a schematic diagram showing extended sensor locations for improved lift map generation, wherein the additional sensors are located on foldable extending rods or wires to create a wider and more detailed lift map;

[0013] FIG. **3** is an example diagram showing one side of the aerial vehicle entering lift, e.g., a thermal, as an example of how lift is detected, the lift map is created and the recommendation to the pilot or autopilot is produced, wherein at this stage, no action need be taken, the system just gauges and checks that it actually is a thermal detected, meaning the pressure is getting lower;

[0014] FIG. **4** is an example diagram showing the aerial vehicle as it passes the lift center in an example of how lift is detected, the lift map is created and the recommendation to the pilot or autopilot is produced, wherein, in the illustrated scenario, the aerial vehicle should turn right to stay within the thermal;

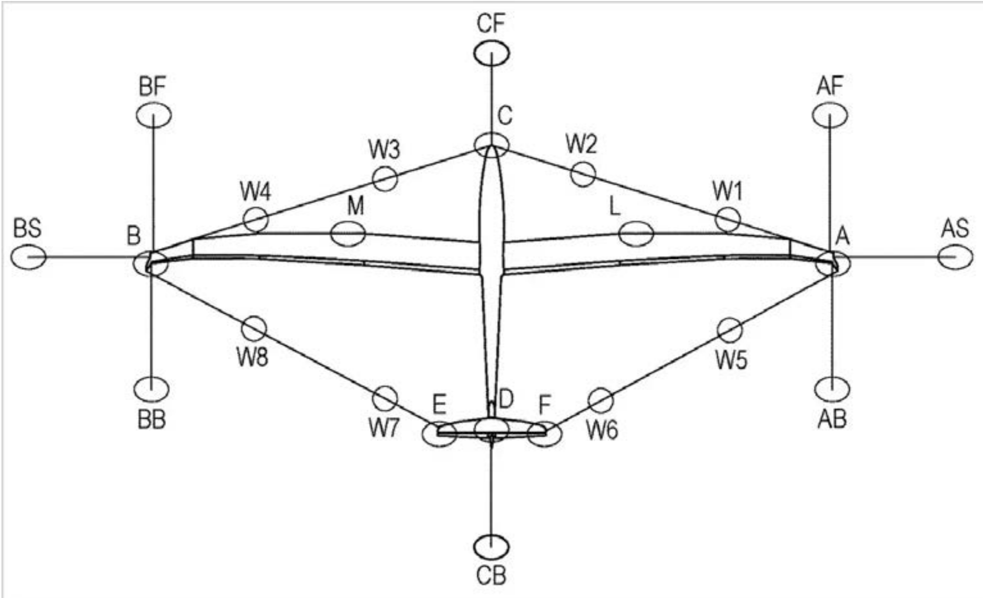

Fig. 2

[0015] FIG. **5** is a schematic diagram showing the aerial vehicle spinning within lift (e.g., thermal), gaining height, tracing an optimal circle the aerial vehicle traces based on the recommendation delivered to the pilot or commands sourced from autopilot; and

[0016] FIG. **6** is a ridge lift diagram showing ridge lift areas created when wind impacts a ridge from the left and is diverted upward, following the ridge outline.

Detailed Description

[0017] Before presenting a detailed discussion of embodiments of the disclosed principles, some basic lift theory and an overview of certain embodiments is given to aid the reader in understanding the later discussion. As an initial matter, unpowered aerial vehicles stay aloft by using air lift, such as thermal lift or ridge lift. A thermal, which is the most common lift source in unpowered flights, is a column of air that streams upward because it is hotter than surrounding air, and the upper air layers are even cooler. A thermal typically has a round or similar to round cross section, with a diameter ranging from a few meters up to a few kilometers.

[0018] A hurricane is an example of a very strong thermal. Thermal outer boundaries have slightly lower air pressure and slightly higher temperature than the surrounding air, so there is some slight lift there. The core of the thermal (the center of the column) has the lowest local air pressure and the highest temperature in the thermal, and this part of the thermal has the strongest lift. As such, this part streams upward fastest, compared to the outer portion of the thermal. In other words, the lift is strongest and hottest in the center of a thermal. Ideally, the aerial vehicle pilot or the autopilot is able to identify a thermal and spin in this thermal in a helical path, just like certain birds do, closest to the thermal center. FIG. **5** is an example of thermaling in the highest lift location possible. It is obviously impossible to spin in the thermal core, as this is a point location, but it is possible to spin as close to the core as possible, with a smallest possible turn radius.

[0019] Ridge lift (shown in FIG. **6**) is created by wind, impacting a discontinuity such as a ridge, and being diverted upward, streaming with the curve of the obstruction, creating a vector of air that moving up, i.e., a lift source. In general, the strongest lift can be found just above the highest point of the ridge, and gets weaker in both directions, with the boundaries of lines X and Y. As opposed to thermal lift, ridge lift is composed of air that is not hotter than its surrounding air. Indeed, the air in ridge lift is sometimes even cooler than its surrounding air, e.g., if it is wind arriving from the sea, hitting a shore ridge.

[0020] This fact can be used to identify the type of lift and how to locate the maximum lift, by tracking the highest peak of the ridge. When the aerial vehicle crosses lift, it can gauge if it is ridge lift, identify the strongest lift within the lines X and Y in FIG. **6**, and maneuver to stay in the strongest lift (with prediction on the ridge line path). This can greatly help the pilot and autopilot. Information derived from geographical data bases can be used to geographically understand the ridge structure, and to use it in predicting where the ridge goes, to find the best lift.

[0021] The present aids in locating regions of air lift, predicting its future motion, and optionally modifying calculations and predictions based on sensors readings. In an embodiment, the system operates to gain height and stay aloft for as long as possible. Lift and the direction to the best lift location may be identified by using multiple variometers and/or accelerator sensors, with the help of a temperature sensor.

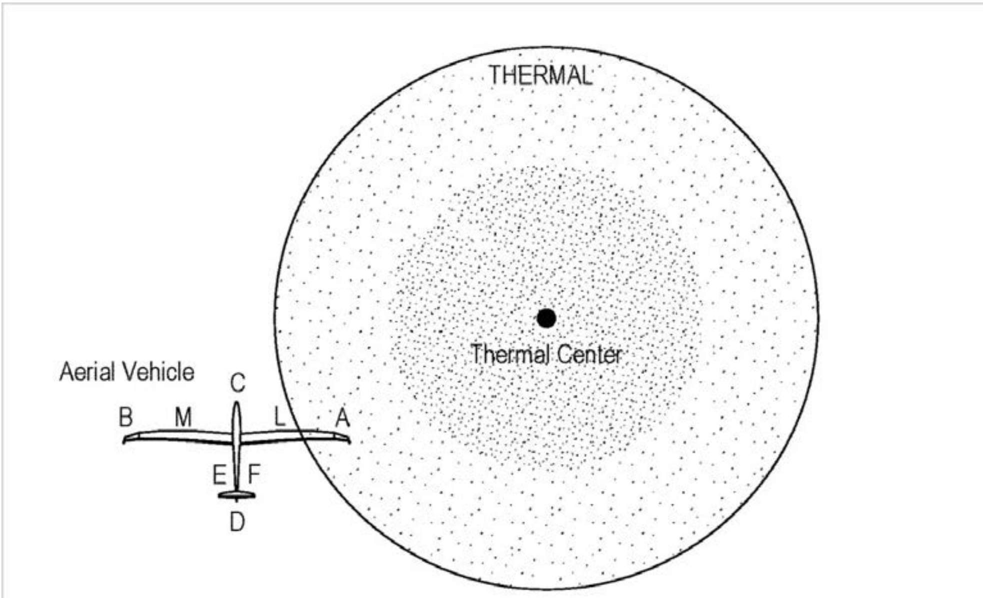

Fig. 3

[0022] The use of a variometer and/or vertical accelerator sensor (in the Z axis, sensing upward or downward motion) in various locations allows better Z axis motion detection, such that motion created by air lift can be sensed in various part of the aerial vehicles. In an embodiment, these variometer and/or accelerometer sensors are located in the wings tips. In the case of unpowered aerial vehicles, the only way to gain height is by using air lift — air that streams upward. As noted above, there are several sources of lift, e.g., thermal lift, mountain or ridge lift, “weather front” lift, “cloud waves” lift etc. All of these types of lift are supported within the invention. Powered aerial vehicles may also implement this invention in order to lower flight cost, conserve fuel, lower engine use and provide a generally quieter flight.

[0023] Implementation may include installing a variometer sensor and/or accelerator sensor on each of the glider's wing tips, e.g., 2 variometer sensors and/or 2 accelerometer sensors. This minimum solution (a sensor on each wing tip) may provide data on entering lift (such as it is done today, with a single variometer located in the center of aerial vehicles), but with the benefit of a wider detection area, as well as directionality as to where the lift is detected, (i.e., to the left or right of the vehicle) to direct the pilot or autopilot to turn into the lift. This solution is best optimized for parafoils, paragliders or speedflying type aerial vehicle, as these 2 points are located far enough from each other to the sides, so lift resolution will be sufficient. An alternative entails installing a sensor such as described in FIGS. **1** and **2**, wherein sensors are located on the aerial vehicle skin and also off the glider as described in FIG. **2**. Sensor data may be used to artificially compose a lift map that may then be shown on the pilot screen, to be used by the pilot as guidance, or it may be used by the autopilot to automatically drive the aerial vehicle to the best lift detected. This information can also be transmitted to other neighboring pilots or unmanned aerial vehicles in the area, or may be stored in a database for use in learning about the area weather, over days, weeks, months, seasons and years to obtain statistical lift data.

[0024] A temperature sensor may be placed in every location a variometer and/or accelerometer is located, to check the air stream temperature. This may be used to identify if the air streaming up is a thermal (air that is usually hotter than the surrounding air) or ridge lift, where the air streaming up is usually the same temperature as the surrounding air, or cooler than the surrounding air. This temperature data can be used by the autopilot to select an appropriate lift algorithm, e.g., a thermal algorithm or a ridge algorithm. The thermal algorithm identifies the center of a thermal column, whereas the ridge algorithm identifies a path of lift along the ridge.

[0025] Additional sensor locations on the aerial vehicle skin may be used to gain a finer reading of the air pressure around the aerial vehicle. This embodiment can be seen in FIG. **1**, specifically locations

A, B, C, D, E, F, L and M. Moreover, to gain a better resolution of the lift map, one or more variometer sensors may be installed outside the outline of the aerial vehicle, on wires connecting the aerial vehicle nose to each of the wing tips and wires connecting the aerial vehicle rear point to each of the wing tips. Sensors may also be placed on foldable extending rods (such as long pipes, extending to the front, back and sides of the aerial vehicle etc.) to gauge air pressure far forward, far backward and to the sides, to get a wider and more detailed air lift map of the air surrounding the aerial vehicle.

[0026] An example of such an implementation may be seen in FIG. **2**. These extenders may be foldable, to reduce drag while they are not used, such as during take-off, landing and so on. The sensors' outputs (data produced by sensors) are routed to an on-board computer. The computer gathers all sensors data and calculates and draws a virtual current air lift map around the aerial vehicle. This may be done continuously (e.g., numerous times per second) to gauge changes and make an informed decision based on it. The computer calculates the lift rate per sensor, and determines if the aerial vehicle is moving into the lift center (strongest lift), if it is straight ahead, or to the right or to the left of aerial vehicle nose, and provide directional recommendation to the pilot to fly to the strongest lift direction or fly the aerial vehicle to the better lift, in an auto-pilot operation.

[0027] The aerial vehicle may have a global positioning sensor such as GPS to define its current location and a barometric air pressure sensor on board to determine altitude. Since each variometer/accelerometer sensor is located at a fixed location relative to the aerial vehicle, known to the computer, the computer has the location of each sensor in space at any moment. Given this, an instantaneous detailed lift map may be calculated by the on-board computer and can be continuously updated, to cover a larger area that the aerial vehicle was traveling through in a particular flight.

[0028] Artificial intelligence can be employed in this process to process all past information for the current location, and provide a best estimate of the motion of the lift direction, over time, to help and guide the pilot or autopilot. Corrections may than be applied, in real time, to compare the best estimate with current conditions and make a correction for the next point to fly to. The current lift map can be based on current sensor and GPS data and in addition, processed historical information in this area, to fine tune the next path to fly to, i.e., the next point of best lift.

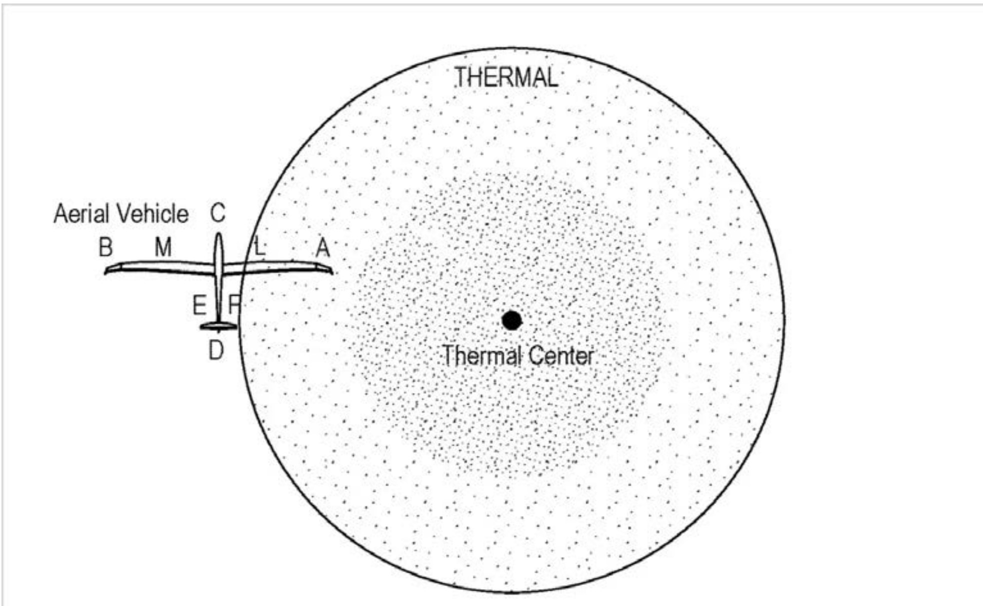

Fig. 4

[0029] In the case of manned flight, the lift map may be processed to provide the pilot with a reliable indication, e.g., via a visual on a special screen and/or an audio signal, emitting different signals to indicate when and in which direction to turn and in what bank, to find better lift. When the autopilot is controlling the aerial vehicle, the decision is made by the computer, and the direction to fly is executed by the autopilot (the computer). If the current start point is quiet air (e.g., substantially no lift), a single sensor indicating lower air pressure (going up) and/or wing tip movement (indicated by the relevant accelerometer sensor) and optionally the air temperature is a bit higher than the other aerial vehicle surrounding air, is a sign that a first thermal may be sensed.

[0030] It may take a few continuous lift maps and more sensors indicating they are also in a lower pressure area, to identify if it is real lift or just a small air bubble streaming up. If lift is starting to be sensed in neighboring sensors, continuously for several seconds, the computer determines that actual lift has been detected and its direction is identified. The pilot or autopilot now will be informed on the direction to this lift, thus directing them, including the angle of bank, to the best lift.

[0031] In a significant embodiment, reliable lift data is provided to the pilot or autopilot. If it is a pilot, he or she will have the option to activate the optional “autopilot” mode of the on-board computer, which will automatically fly into the strongest lift, based on the multiple variometer structure and/or the multiple accelerometer structure, the base for this patent application. If the aerial vehicle flies in an area with several sources of lift (such as a dense thermic field) that were identified by the computer, the pilot or autopilot are directed to the center of the strongest lift, the one with the core which has the strongest lift — such as the strongest thermal.

[0032] Lift maps may be shared with other aerial vehicles in the area over wireless communication channels, for the other aerial vehicle’s computer to evaluate. Computers that get such lift data from a neighboring aerial vehicle computer, may decide to recommend to its pilot to join the neighboring aerial vehicle in its lift, as it may be more promising than the lift map it is in. This is the same action an autopilot may take, making a decision to leave current lift and join the better lift, in accordance with the lift map it just received. Joining neighboring aerial vehicle in its lift will be based on the clear “right of way” rules, used in air traffic.

[0033] Lift maps can be continuously sent to a base station that stores the data, for farther processing, such as to provide lift statistics over the time of day, date, location, season etc., for use by pilots while planning flights. Artificial Intelligence may be used to extract data from the historical lift maps.

[0034] Unpowered aerial vehicles, using this invention, may employ solar panels, mounted on the wings and optionally on the fuselage, to power aerial vehicle on-board electronics, charge a battery (to continue powering the on-board electronics when sun is hidden, such as by clouds or mountain shadows) and in some cases to power an optional motor and propeller. Unpowered aerial vehicle that rely on meteorological conditions may be forced to land if unable to find adequate lift. To overcome this unreliability issue and to elevate reliability in performing its task (if a task is assigned to it), this invention also defines a flight formation of a swarm or group of unpowered aerial vehicles with a task assigned to each of the aerial vehicles. If one of the vehicles needs to land, its assignment will be reassigned to other, neighboring aerial vehicles or, if needed, a new such aerial vehicle will be launched, to replace the aerial vehicle that was forced to land.

[0035] FIG. **1** describes sensors locations. All variometer sensors should be placed as to gauge static pressure, hidden from the dynamic pressure created by air flow on the skin of the aerial vehicle. Variometer, accelerometers and temperature sensors may be placed in the locations shown in FIG. **1**, namely locations A, B, C, D E, F, L and M. This will ensure a detailed lift map. However, the minimum number of sensors, to allow using this implementation, is 2, e.g., one sensor at the tip of each wing. This may include one variometer, one accelerometer and one temperature sensor on each wing tip, in locations A and B.

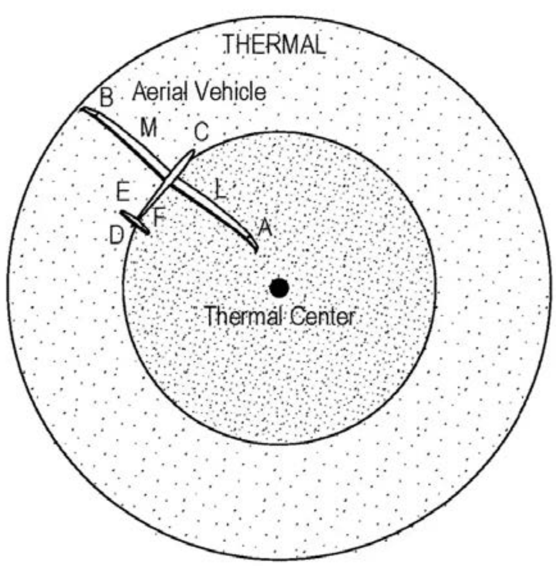

Fig. 5

[0036] FIG. **2** shows all sensors as in FIG. **1**, with additional sensors, located outside of the body of the aerial vehicle, on wires or extending rods, further away from the vehicle skin. This provides data for a better and wider lift sensing abilities, for a detailed and wider lift map. This will be especially beneficial on days when thermals are less dense and more scattered; having a larger area for sensing lift contributes to better lift identification and may thus provide additional flight time. The ability to locate lift with sensors located on the extended rods is even better, but depends on the length of the rods and the gains provided by the additional data may be at least partially offset by the aerodynamic drag these rods create.

[0037] In both FIG. **1** and FIG. **2**, accelerator sensors may be placed in locations A and B and optionally at points C and D, to sense the lifting of the wings, nose and tail, upon entering the boundaries of a lift location. As FIG. 3 shows, when part of the wing enters a thermal (such as the right wing, location A), this wing is lifted. This lift can be identified by the variometer sensor, but also by the accelerator sensor, to show the real lift rate, not only the lower air pressure. This will provide a better, finer measurement for the computer, to provide a more informed decision for the pilot or autopilot to turn into lift.

[0038] In both FIG. **1** and FIG. **2**, temperature sensors may be placed in locations A and B and optionally at points C and D, to sense the air temperature at the wing tips and optionally, the nose and tail, when entering the boundaries of a hot air (thermal). As FIG. **3** shows, when part of the wing enters a thermal (such as the right wing, location A), this wing tip is inside of a thermal, while the other wing tip and all the rest of sensor measure surrounding are temperature. This is a clear indication that wing tip A is in thermal lift and not ridge lift.

[0039] FIG. **3** shows a thermal (the dark circle on the right side of the picture, where a darker color signals a stronger lift), and an aerial vehicle with part of its right wing in the thermal. In this case, a variometer sensor in location A report lowered air pressure and the accelerator sensor reports that the wing is moving upward. If no other sensor reports similar changes, the computer makes a note that the tip of the right wing is within lift. Also, while traveling forward, variometer sensor A reports a lower pressure and the accelerator sensor reports the right wing tip accelerating upward, and the temperature sensor reports increasing air temperature. This occurs as the 3 sensors in location A are traveling within the thermal, getting closer to its center, where air pressure is lower and lift is higher and temperature is getting higher. This information, collected in a few consecutive lift maps, can be used to calculate the lift center location, and point the pilot or autopilot into it.

[0040] While the aerial vehicle continues flying forward, sensor group L in FIG. **4** will enter the thermal, and will report to the computer data indicating that sensor group L is within a thermal. Now the lift map will be based on 2 sensors (A and L), and over time, the lift map image within the computer will be more detailed and accurate.

[0041] FIG. **3** is an extreme example, where only one sensor (sensors in wing tip A in this example) enters the thermal, then the second variometer sensor enters, as in FIG. **4**, and the computer has a relatively small amount of data to make a decision, but this may be enough. It can draw an educated lift map and tentatively identify the lift center for the pilot/autopilot. If the gilder crosses the thermal closer to the center, more sensors will feel (and report) the lift, each in its location. Here, the computer has much more information, the lift map will be more detailed and more reliable, and hence the recommendation to the pilot/autopilot will be more reliable.

[0042] The sensors in FIG. **3** will sense pressure getting lower while the aerial vehicle crossing, until the point where its' right wing tip is aligned with the center of the thermal. Once the aerial vehicle passes this point, such as in FIG. **4**, the air pressure sensed in sensors A and L will start increasing, meaning the sensors feel lower lift. This is an important point, as now the gilder computer has found the maximum lift, so its right-wing points to the thermal center and now lift is getting lower, and it should now recommend to the pilot/autopilot to start turning to the right, in order to stay in the thermal (lift), and not just cross it and exit the lift area.

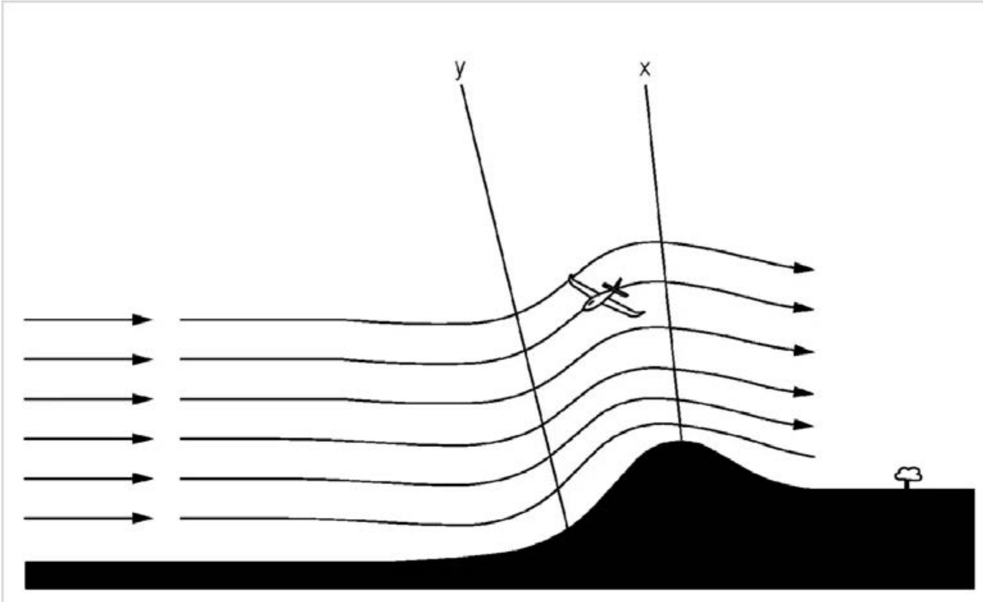

Fig. 6

[0043] If more sensor groups enter into a thermal (such as sensor groups F, D, C, E etc. in FIG. **4**), the computer will generate a lift map that will be much more detailed and accurate. This is achieved by the glider algorithm, to turn right, in this example. This section explains the algorithm using the right wing entering the thermal as an example, but it is the same process for a thermal if the left side enters the thermal. In the odd case where the glider enters the thermal centered and head on, upon passing the thermal (where air pressure starts rising), it may turn to the right or to the left; wherever it senses a slightly higher lift.

[0044] Optimally, when the computer has generated a few consecutive lift maps, showing a reliable and stable air pressure increase, meaning the lift is getting lower, this is the point that the computer recommends that the pilot/autopilot starts turning sharp into the lift, to stay in the thermal. If pilot does not react, the aerial vehicle will exit the lift. In this case, since the lift map is stored in the on-board computer memory, the computer continues recommending that the pilot return to the previous thermal area, while also searching for new lift.

[0045] An optimal flight path to gain the best lift and height in a current thermal is shown in FIG. **5**. The computer shows the direction to: 1. have all its on-board sensors within the thermal, so all vehicles' wing surfaces are creating lift, for best height gaining and 2. spin closest to the thermal center, where lift is strongest, turning in the smallest radius which the aerial vehicle is able to accomplish and the pilot (if it is a manned flight) to able to withstand. This should create a path as shown in FIG. 5 and gain maximum height from a current thermal.

[0046] The aerial vehicle computer may share the collection of the latest lift maps with other aerial vehicles' computers (using wireless communication), to allow the other aerial vehicles' computers to evaluate, and perhaps provide recommendations to their pilots on promising lift locations.

[0047] Lift maps may be shared with base station or a computing cloud, to be stored and processed. Data from this big collection are statistics on typical thermals created at specific location in a specific period of the year (They are also known as "house thermals" in the unpowered aerial vehicle community). This data may be processed by artificial intelligence means, to provide the best estimation on the next lift location. This data will be fed into the aerial vehicle computer of novice pilots, to help them stay aloft more time, getting recommendation for the history of thermal, on top of current invention recommendation.

[0048] Lift generated by wind hitting a ridge, creating air lift, can be tracked via a similar method, i.e., using variometer sensors and/or accelerometer sensors on the wing tips in the aerial vehicle, where the aerial vehicle will identify lift, recommend to the pilot to turn into the lift, identify if it is not a round thermal, but ridge lift, search for the highest lift path on all sensors and recommend the pilot/autopilot to stay in this path. Ridge lift is generally in a straight line, but this line is tracking geographical changes, such as a valley, ridge turn etc.

[0049] The discussion is mainly for unpowered aerial vehicles, but it is perfectly relevant to powered aerial vehicle as well, i.e., to gain height while conserving fuel, allowing engines to idle or be stopped, and to provide generally quieter and cheaper operation. It will be appreciated that various systems and processes have been disclosed herein. However, in view of the many possible embodiments to which the principles of the present disclosure may be applied, it should be recognized that the embodiments described herein with respect to the drawing figures are meant to be illustrative only and should not be taken as limiting the scope of the claims. Therefore, the techniques as described herein contemplate all such embodiments as may come within the scope of the following claims and equivalents thereof.

Claims

1. A method comprising using two variometer/pressure sensors in an aerial vehicle, located on opposite wing tips, to compare lift on the aerial vehicle's wing tips and find a direction to a lift field based on differential air lift read by the sensors.
2. The method of claim 1 further comprising using more than 2 variometer/pressure sensors on aerial vehicle, locating them on the aerial vehicle in predetermined areas, to generate a more detailed lift map around the aerial vehicle showing lift strength in sensor locations.
3. The method of claim **2** including the use of further additional variometer/pressure sensors in aerial vehicles located on the end of extender rods.
4. The method of claim **3** wherein the extender rods are foldable, and extend to the front, back and sides of the aerial vehicle wings, to provide a wider and more detailed lift map around the aerial vehicle.
5. The method of claim **3** further including using temperature sensors, paired with the variometer/pressure sensors to get more

information on the lift type and nature.

6. The method of claim **5**, wherein using temperature sensors, paired with the variometer/pressure sensors to get more information on the lift type and nature further comprises identifying the lift as thermal lift or ridge lift based on the sensed temperature.
7. A method comprising: using an accelerometer sensor, paired with a variometer/pressure sensor and temperature sensor, to obtain information on the dynamic nature of lift by calculating 2.sup.nd and 3.sup.rd derivatives of the acceleration; and refining an algorithm of a lift map using the information on the dynamic nature of the lift.
8. The method of any of claims **3**, **4**, **5** and **6** wherein the aerial vehicle is an unpowered aerial vehicle.
9. The method of any of claims **3**, **4**, **5** and **6** wherein the aerial vehicle is a powered aerial vehicle.
10. The method according to either of claims **6** and **7** used within a fully in-air autonomous autopilot to run in an on-board computer and/or remote computer to keep the aerial vehicle aloft.
11. The method according to claim **10**, wherein the aerial vehicle further comprises a “swarm” of powered or unpowered aerial vehicles for predefined task or flight.
12. The method according to claim **11**, wherein the swarm is managed from a ground control station.
13. The method according to claim **11**, wherein the swarm is managed by one or more members of the swarm.

Resources

- *US Patent and Trademark Office* (USPTO) — The USPTO provides an oustanding search engine which enables digging through (seemingly) every patent in their office. Proceed with caution — you could easily spend **days** of your time digging through their utterly fascinating files.
- *US 2019/0107453 A1* — A PDF of the original patent as downloaded from the USPTO website, on which this article is

based.

Thanks to Editorial Assistant

for her invaluable assisstance in preparing this article. *Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

The Trailing Edge

A perfect end to a perfect Swiss day. (credit: Alexandre Mittaz)

Make 'em laugh, if you can, and get them to the gift shop.

The Ed's terse but surprisingly accurate brief for this column is where we start each month. The social folks want to call it a 'wrap up' — okay, sure, whatever — but really it's just an opportunity to find a funny story in ordinary things, if we can.

Despite The Ed calling this *The Summer Issue* (which we have addressed through Alexandre's Mittaz's seriously beautiful photo above — more on that in a moment) it really is hard winter up here at the home office. The most solid evidence is the family of gray partridges which alighted outside the 'wasp window' which we told you about back in the August 2022 issue when it really *was* summer.

The gray partridge must share some DNA with the more familiar domesticated chicken. The kind we eat, sadly. They certainly fly about as much or, more accurately, about as little. We spotted them as they made a STOL-like, controlled crash onto the snow-covered lawn outside the office. They promptly scattered into the cotoneaster hedge where they hid for a while in case someone had spotted their unceremonious arrival. We had, and lay in wait.

Shortly thereafter the gorgeous, rotund, pullet-proportioned not-so-little birds then spent the next couple of hours doing what can best be described as just, well, strolling around. That's where we made the chicken connection: possible evidence of an ancient mating pair succumbing to the temptations offered by Stone Age two-leggeds gathered around a beautifully warm campfire when it was bloody cold everywhere else. And the rest, as they say, is history. Or rather, pre-history.

We've been told watching barnyard chickens is the terrestrial equivalent of watching fish in an aquarium. If the partridges are anything to go by it really is, we must say. We found watching their super low energy lifestyle almost hypnotic. See if you agree.

Oh, yes, and it looks like the jig's up about this *The Summer Issue* theatre. That white stuff ain't sand.

About That Picture

We're delighted to welcome back our friend Alexandre Mittaz who sent in the absolutely wonderful photo taken back in late October of 2022 near Semsales, Switzerland, which is in the Gruyère region. Alexandre takes the story from here:

"The plane is a 2m *Magic Superlight* RES glider. It weights about 345 grams making for very low wing loading. That day it was floating in the sky in the very light conditions. It was pleasant and almost like meditating." Perfectly put, Alexandre and we couldn't agree more. Thanks so much for finishing up this issue in such a perfect way.

Exit through the Gift Shop

Mission accomplished. This month's spectacular cover photo was taken by Greg Perrins and is used here with his kind permission. Greg captured the AeroSPARX Grob G–109B motorglider performing its airborne pyrotechnics display at Weston Park Air Show in June of 2017. We think this photo simultaneously evokes both the notions of 'summer' for this, *The Summer Issue* and 'New Year' rather beautifully. Order yours today.

All items in the Shop are made especially for you as soon as you place an order, which is why they are fairly priced and it takes us a bit longer to deliver them to you. Making products on demand instead of in bulk helps reduce overproduction and waste. Everybody wins.

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Make Sure You Don't Miss the New Issue

You really don't want to miss the February, 2023 issue of the New RC Soaring Digest when it's out — we always have some exciting things in the works. Make sure you connect with us on *Facebook*, *Instagram*, *Twitter*, *LinkedIn* and *Post News* or simply subscribe to our *Groups.io* mailing list. Please share the New RCSD with your friends — we would love to have them as readers, too.

That's it for this month…now get out there and fly!

Resources

- *Magic Superlight* — This is just one listing we were able to find — on the HyperFlight website — but there may be other options out there. This will at least give you a thread to pull.
- *La Gruyère* — Okay, that's on our list of 'must see/must fly' places someday. Looks absolutely beautiful.

Read the previous article or go to the table of contents. A PDF version of this article, or the entire issue, is available upon request.