September

Hello Benefactors. Here's what I've been working on in September.

Having successfully blown up my only working gimbal control board in August I had to wait for a replacement to be delivered. I used some of that time to set about creating a custom board so that I could try out some L6234D motor controller chips that I had been able to get hold of. Once a new gimbal board had been delivered to me I was able to put together a test rig in order to use a brushless motor to drive a twist mechanism, which I put together and demonstrated on the September livestream.

I have also been working on the Tempest stroke algorithm, which I outlined in the July dispatches. I have added some parameters that I think were missing, which now make certain motions a lot more possible. This is work that will feed into the random stroker plugin, which I will definitely have to release at some point in October.

I also released an update to the clip ring gear for the T-wist, which has been due for months and months.

Online curiosities

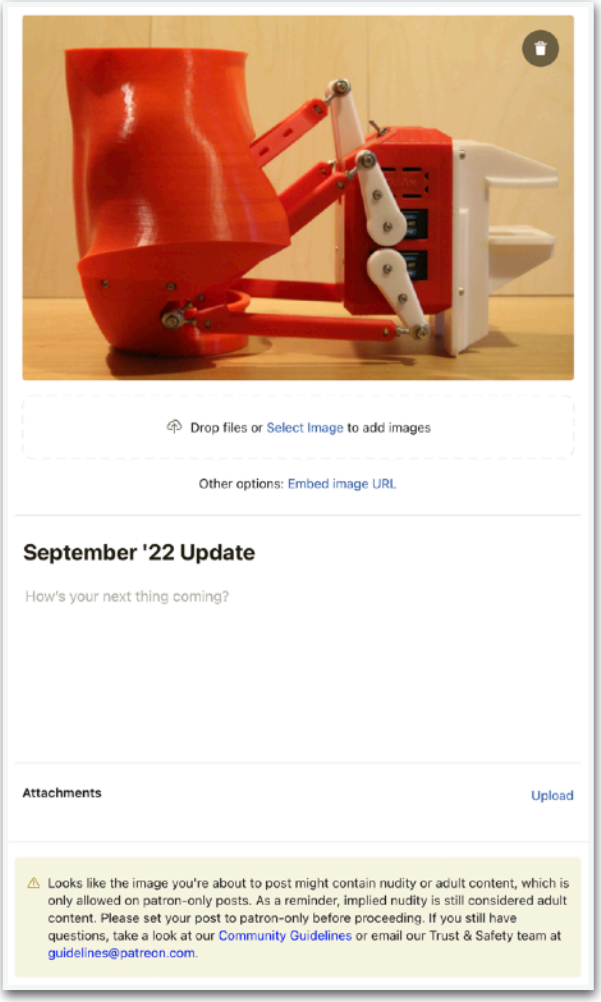
Early this month I mentioned a couple of things that I'd come across whilst handling my various accounts online.

The first thing, which was a bit of a surprise, was that Patreon's nudity filter seemed to take exception to photographs of my contour receiver. I have fallen foul of this before in the past, so I have a pretty good idea now of how such things work with Patreon. Essentially, as long as the images are paywalled they assume the viewer is an adult and they don't mind it being a bit sexually explicit.

The reason that this image was being scrutinised, obviously by some kind of nudity algorithm, was that this was for my monthly update post, which is public.

I could probably have gotten away with posting that image but at the end of the day it isn't worth the hassle. The sad truth is that this is the kind of BS that one has to deal with periodically as a content creator servicing the online adult community. The particular difficulty I have seems to be that most of what I create isn't sensitive at all on the face of it, so it's always comes as a surprise when somebody, somewhere, takes exception to something I've shared.

I found it absolutely astonishing that the algorithm found nudity in the pictures I uploaded. The human body shaped parts of it don't reveal any particularly sensitive areas. I dunno, maybe my design is just that good. At the time I joked that maybe I should have put some pants on it and re-taken the picture.



ARE PATREON'S NUDITY FILTER ALGORITHMS REALLY THIS SENSITIVE? APPARENTLY SO!

DOWNLOAD ANALYTICS FROM MY THINGIVERSE PAGE

Something else I shared in the devstream was an image of the analytics from my Thingiverse page.

I have always been curious just how many OSR2s and SR6s have been built. Sadly it's just not something I will ever be able to know.

Strangely enough Patreon doesn't actually give me download statistics, so I have to make guesses when it comes to patrons. So for example we could say that if only around 50% of my patrons over the last three years actually built a working machine then there would be in the region of 1,000 OSR2/SR6s in existence.

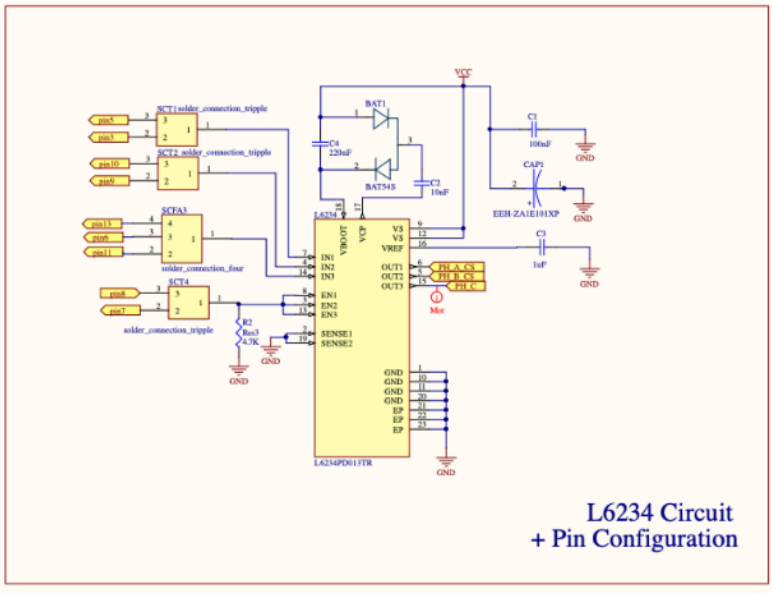
To put that in perspective we can contrast it with Thingiverse, which does offer download statistics. As of 13th September 2022, the OSR2 Beta1 has been downloaded for free 5,126 times. If only 50% of those downloads resulted in a build there are an additional 2,500 OSR2s in the wild!

I find the whole thing quite mind boggling to be honest!

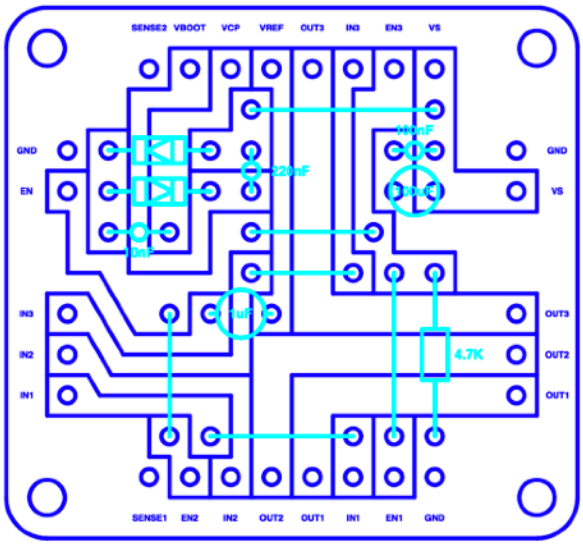
Custom circuit boards

With my only working gimbal controller beyond repair I had to think of a way of putting together a motor controller so that I could keep playing with brushless motors. In particular the GBM4108H-120T that I have been using for tests.

I tried to get hold of some of the L6234D chips used on the BGC3.1 from Mouser, but they are marked as out of stock and not available until March 2023! I was however able to source a couple of them from a seller on eBay. I was also able to find a copy of a diagram showing the associated connections and ancillary components.



L6234D CONNECTIONS



2D CUSTOM BOARD DESIGN

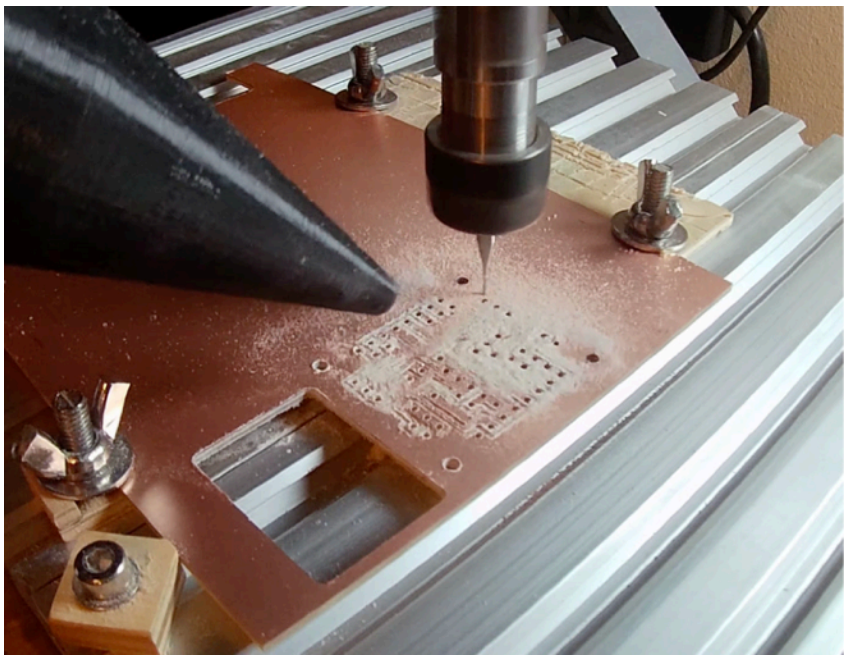
The L6234Ds are integrated, surface-mount packages, so I couldn't exactly plug them into a breadboard. I would have to create a circuit board if I wanted to use them. The fastest way that I know of doing that is to cut out a board from a piece of copper board using a CNC milling machine.

This is something that I have done before many times and it works very well! It just requires a little bit of experience with a 2D CAD program. I use QCAD, though one of these days I should probably pony up and get something more professional like AutoCAD.

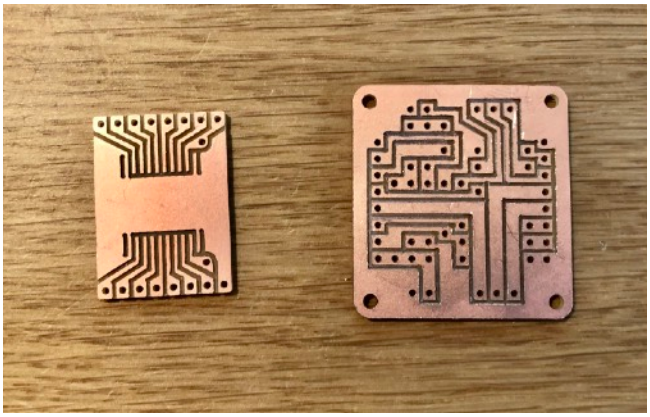
In days gone by I used to use some dodgy homemade software to generate the toolpaths in GCode from the DXF drawings, but these days I just use the excellent suite of manufacturing tools in Fusion360.

Home CNC machines are only a little bit more complex to work with than 3D printers. The basic ones tend to be Arduino-based and have to be driven by a computer over a USB cable. I have found the best way to use them is to set up the driving software (bCNC in my case) on a Raspberry Pi. That way you can mostly just leave them to get on with the job in a different part of the house. They are quite noisy after all!

With a milling machine it's possible to create what is, in effect, a custom copper strip board. You can cut all of the component and mounting holes, cut channels to separate the tracks, and finally cut out the board outline.



CUTTING OUT THE PROTOTYPE BOARDS



THE CUT-OUT CIRCUIT BOARDS

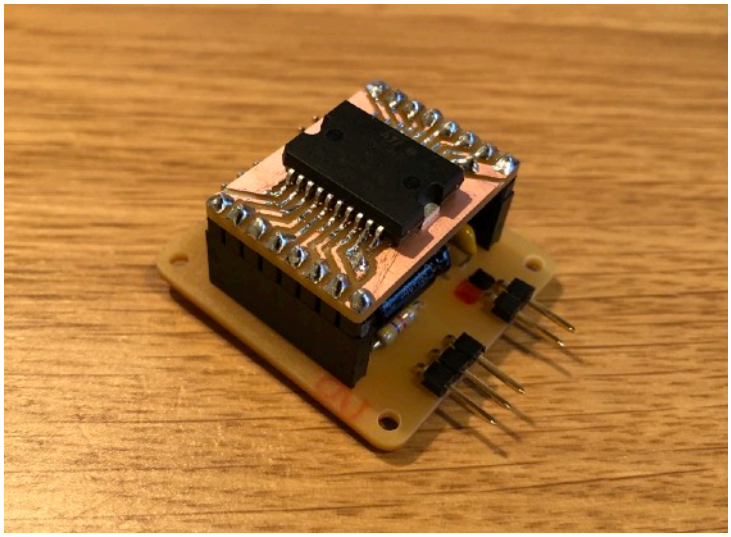
Component pins tend to be located on a pitch of 0.1" apart, like the holes on stripboard, or indeed a breadboard. I have found that using a 0.6mm milling cutter it's possible to create nice solid tracks with the boundaries half that distance (0.05" or 1.27mm) apart.

Done well this kind of board can be a very neat alternative to using strip board to create a circuit. It's certainly a lot more resilient than loose components in a breadboard. Obviously the ideal is a custom printed circuit board, but those can have a much longer lead time as they need to be ordered from a manufacturer.

For the L6234D I actually created two boards: one to hold all of the ancillary components and tidy up the connections, and the other to hold the chip itself. I could then mount the chip to the board, but potentially use it again on a different design in the future.

I plugged this custom arrangement into an Arduino UNO and I was very pleased to find that it performed exactly as intended. That's quite a rare delight with electronics in my experience!

I don't expect that I will ever include machining out circuit boards as a part of one of my build guides. I just included this because I thought it might be of interest to you guys.



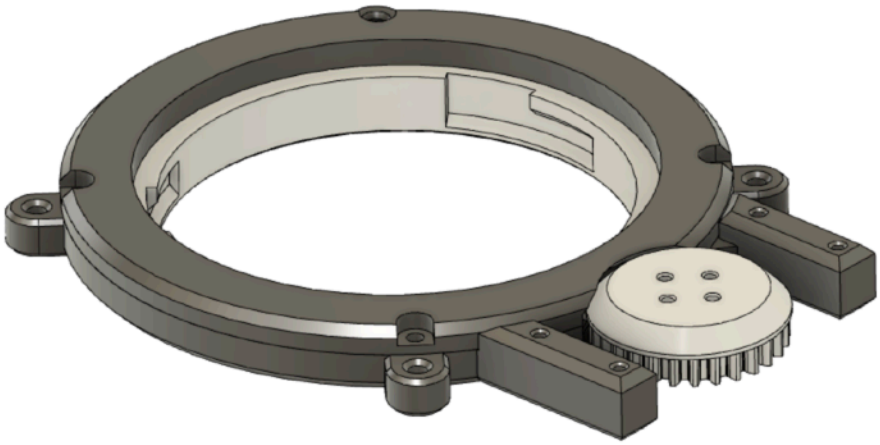
THE L6234D CHIP MOUNTED ON THE CUSTOM BOARDS

At some point I may have to look into custom printed circuit boards. We'll deal with that when we come to it!

Brushless twist motor demo

I've been playing with brushless motors for a while now, so I thought I should put something together to give a demonstration to the community of the enormous potential of this technology.

It seems to me that the first part that I should try to implement this tech on should be the twist mechanism. There are several reasons for this. One is that it's a self-contained mechanism that's separated from the main drive of either device. Another is that T-wist 4 is actually terrifyingly overpowered with a 20kg.cm servo, so actually something with a little less torque would probably work well.



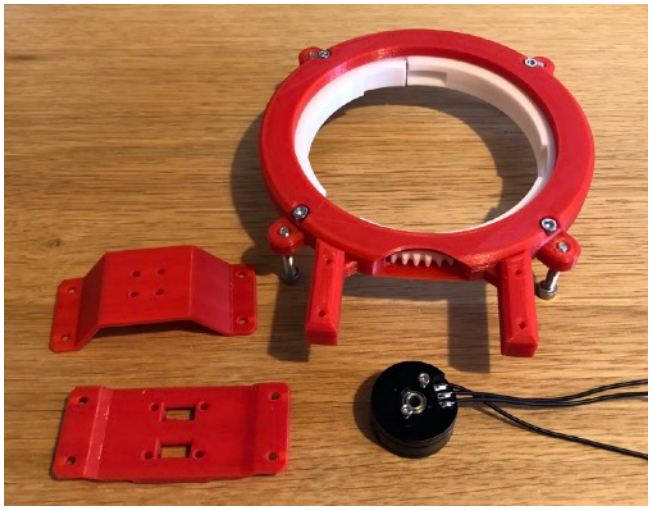
EARLY CAD DESIGN OF THE TEST RIG

A 2204-260KV BRUSHLESS GIMBAL MOTOR

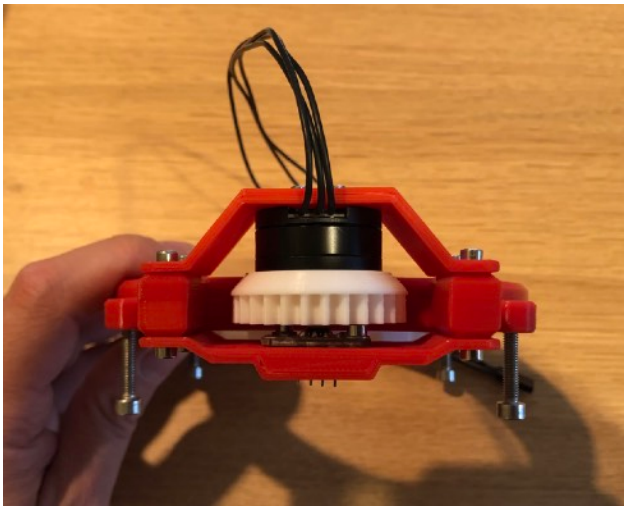
Ideally what we want is a motor that can run on the same power bus as the servos, ie a motor that takes 5-6 volts. We also want the motor to be the conceptual equivalent of a "generic red" servo, in that they are inexpensive, easily available and the same form factor.

What I have identified for this purpose is the 2204-260KV brushless motor. They seem to fit the bill, so they might be a good starting point for my first homebuild brushless motor design. That is at least until people start screaming at me that they can't get hold of them.

The other components that I used for this rig are the AS5600 magnetic encoder, and the BGC3.1 (or BGC3.0) gimbal control board, which I have mentioned before.



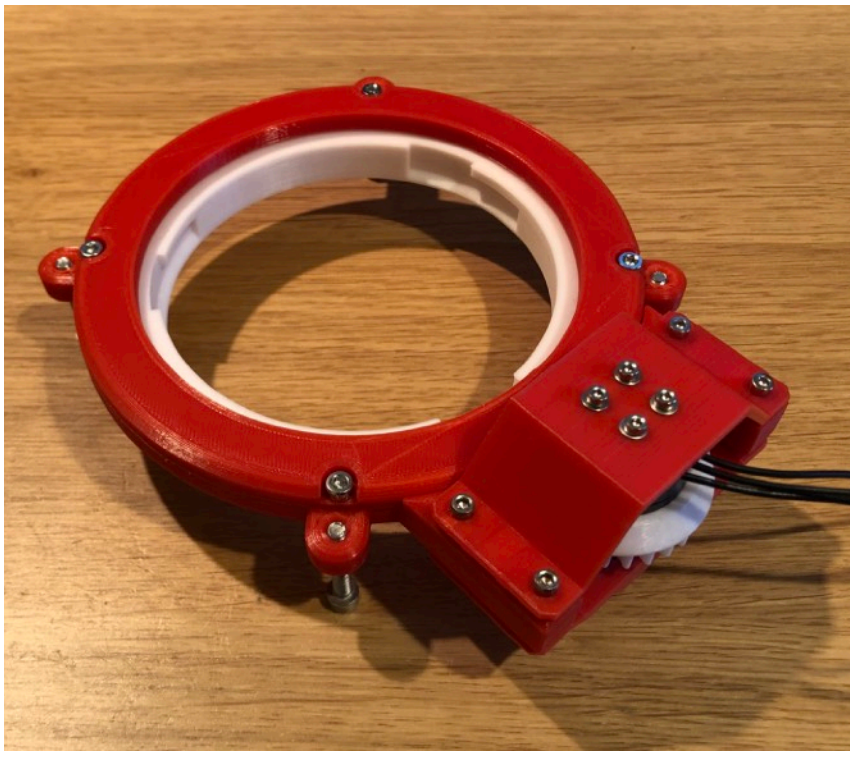
ASSEMBLING THE MOTOR INTO THE TEST RIG



MOTOR, GEAR AND ENCODER ALL INSTALLED IN THE RIG

The rig that I built was designed around the geometry of the Twist module, which will be pretty familiar to anyone who has built one. I was able to use a clip gear ring that I had left over from when I developed the T-wist 4, but the rest was specially designed for the task.

The drive gear, which I mounted directly to the face of the gimbal motor, was based on the same gear geometry as I have used on T-wist 2-4, ie a 28-tooth spur gear. I had to modify it so that it could be screw-mounted on the motor, and also so that it could hold the 5mm cube neodymium magnet used by the magnetic encoder. This, the AS5600, was mounted below the gear so that it had direct access to the magnet.



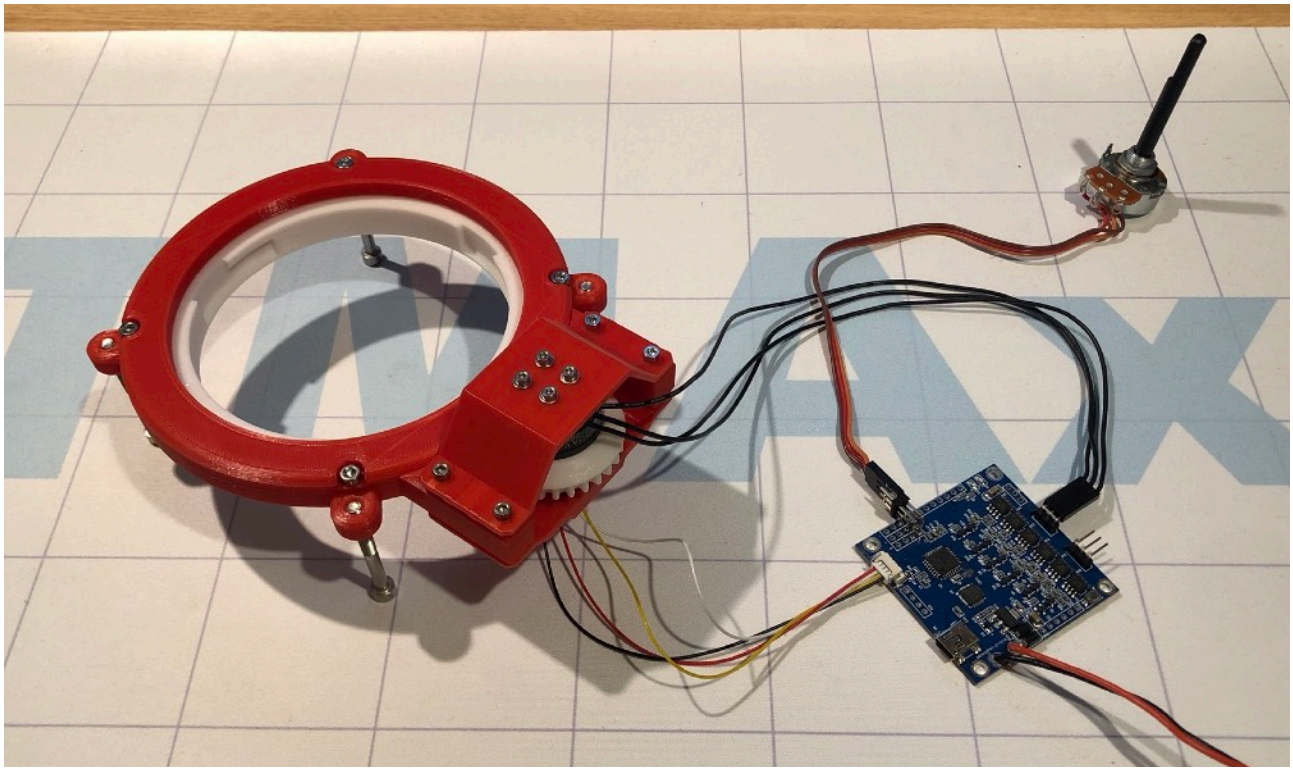
THE TEST RIG FULLY ASSEMBLED

Connecting up the motor and the encoder to the BGC3.1 board is a little bit more involved than hooking up a servo, but not much more. The AS5600 goes on the I2C bus, which does require some soldering of pins and/or wires to make the connection. I used a cable into the 4-pin mini micro JST connector on the board to do this, but it's also possible to connect to SCL & SDA using the 0.1" pins.

For the sake of the demonstration I wired up a potentiometer to the board to serve as an input.

The programming was also reasonably easy to do because the SimpleFOC library provides a comprehensive, easy to use set of tools to take advantage of.

Those of you who have seen the livestream will have seen the rig in operation. I was very pleased that I was able to demonstrate just how quiet these motors can be.



FROM THE SEPTEMBER LIVESTREAM: THE WHOLE TEST RIG FULLY WIRED UP

What I think I will aim toward in the near future is a system a lot like this built into an integrated twist receiver in the style of T-wist4. Call it a virtual servo, which would plug in to the OSR2/SR6's power bus in the same way as a regular servo would. The 5-6v power and ground lines are already there. All that would be needed would be a servo signal line attached to one of the interrupt pins on the BGC3.0/3.1. That way the twist position could be commanded using a servo signal from the Romeo/ESP32, rather than the potentiometer.

One thing that was clear to me was that the strength of the motor was insufficient to turn a full fleshlight with this gear ratio. If I can then, I will use something like 1/3 to 1/4 of the number of teeth on the drive gear. This will trade speed for torque, but that should be okay.

Improving the Tempest Stroke

Back in July I explained how the stroke algorithm that I came up with worked. The idea was to be able to parameterise each axis, so that complex multidimensional stroke patterns could be described by a simple set of numbers. This could then be used for "random stroker" applications, ie apps that procedurally generate stroke patterns for the user to enjoy.

$$-\cos\left(\theta + \frac{\pi p}{2} + c\sin\left(\theta + \frac{\pi p}{2}\right)\right)$$

The stroke waveform is defined by the **start** point (which is also the end point), the **mid** point, the **phase** (*p*) and the eccentricity (*c*). Soritesparadox has done a lot of really cool work with this. You can check out his work here.

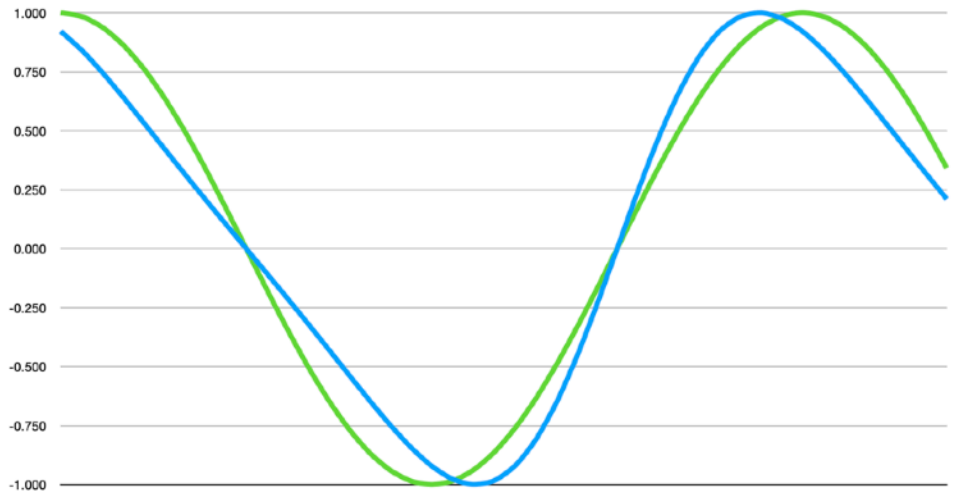
I have noticed that this equation isn't quite comprehensive because it does not allow for certain kinds of movement, for example: fast down, slow up, or vice versa. I am therefore going to propose is an additional term added to the equation.

$$-\cos\left(\theta+\frac{\pi p}{2}+c\sin\left(\theta+\frac{\pi p}{2}+\frac{\pi h}{2}\right)\right)$$

For want of a better name I will called it "eccentric phase" (*h*)

And yes it really needs a better name!

This term has the effect of shifting the rate of time inside the eccentric term, with the effect of shifting the peaks asymmetrically. Slow down, fast up. Or vice versa.



GREEN: BASIC SINE WAVE
BLUE: A STROKE WITH C = 0.4, H = 1

Truth be told though I'm not completely happy with this little addition. It might look tidy in the graph above, but there are certain combinations of parameters that make some very weird and unintuitive shapes. It also causes the starting peak to move off the starting time, which may need to be compensated for.

I'm going to have to give it some more thought.

Improving the Clip Ring Gear

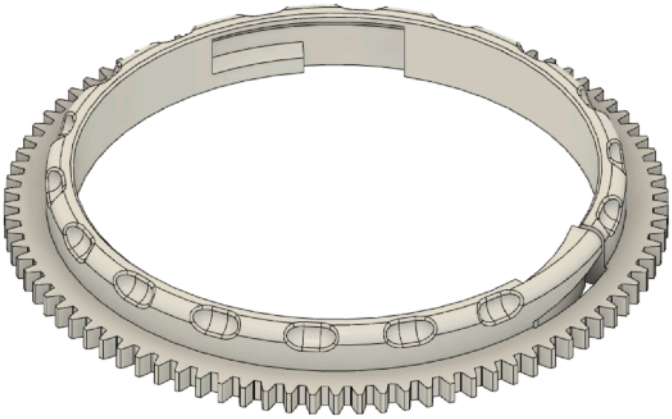
One of the hazards of possessing a creative mind is that sometimes it just won't do what it's told. This month I set myself the task of getting out the Virt-a-Mate plugin and instead my brain started mucking about with new strokes, brushless motors, and goodness knows what else!

As you will have noticed at the end of the month I issued an update to the clip ring gear for the T-wist. It is true that this has been due for months and months, but this is also a bit of positive spin on the story. In truth it was mostly down to a misbehaving brain going off on a bunch of tangents and running out of month.

Now don't get me wrong, a lot of my innovations would never have come into existence if it wasn't for the occasional brain tangent or five. Sometimes though it's just a complete pain in the ass. Patrons are only interested in raw ideas to a certain extent, and at the end of the day I have to deliver content!

The new clip ring was a relatively straightforward redesign task in Fusion360. The smoother grip ring wasn't my idea, it had been an unofficial mod for some time (originally by a user called Inferno I think) but I thought it was time to make it official.

As for the clip. I was pretty confident that if I re-designed the clip with an interference fit, ie the clip in its natural state would actually be inside the fleshlight, then the clip would be exerting a lot more force at the point of contact when the case was installed. This worked out very well, but it did require quite a lot of juggling of parameters to achieve a shape that I was happy with.



THE IMPROVED CLIP RING GEAR

This spontaneous hardware release aside, this leaves me no alternative but to knuckle down and get my Virt-a-Mate plugin into a releasable state in October!

Finally...

I'd like to say a big thanks to you guys for the support you give me. I'm actually enjoying sharing this glimpse into my creative process with you, so I hope that it's interesting to see and read. I would like to invite you guys to engage more on the discord server, especially if you see something I've posted and you have any questions or suggestions. I'm also definitely open to organising livestreams and hangouts on there too if there's anything particular you'd like to see more of. Let me know.

Thanks again!
Tempest