

# Smooth Operator

## A user's guide to gimbal rigs



Once upon a time, the only options for a moving shot that wasn't on a dolly and tracks, or maybe a jib arm or crane, was good old handheld (which, while many were expert at it, ran the risk of being wobbly and tiring) or full-blown Steadicam (expensive and needing very specialist skills) – but then along came a whole new range of options: the gimbal rigs. Now they are available in all shapes and sizes. GTC member DoP **Mark Langton** has put together a user's guide to how to go about selecting a setup that will work well for your shoot (with a little bit of help from GTC members who kindly responded to our survey on gimbal ownership and usage).

Every now and then a piece of technology comes along and shakes things up a bit and, in 2013, hot on the heels of video-capable digital single-lens reflex (DSLR) cameras, we witnessed the rise of the gimbal, or to be more precise, the emergence of handheld 3-axis, electronically controlled, brushless motor-driven, camera-stabilising gimbals... we'll stick to just calling them 'gimbals' from hereon in.

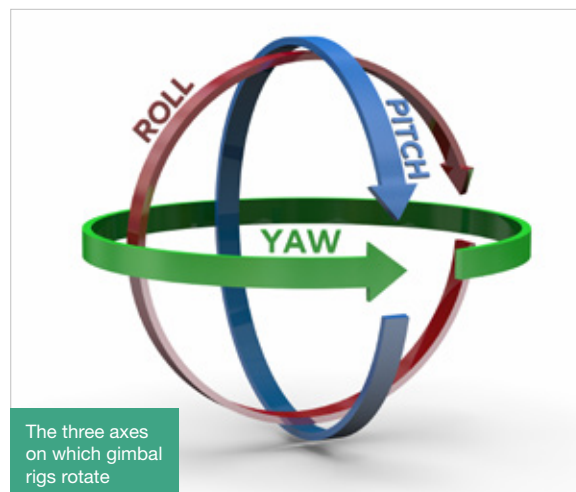
This type of gimbal is a device that keeps the central camera platform level and heading in a chosen direction, irrespective of how the outer parts of the frame are positioned. They are intended to remove all the unwanted movement that detracts from the story being told, resulting in smooth, fluid shots that glide the viewer through the scene.

Gimbals are not a replacement for a Steadicam, dolly and tracks, or a slider; they can emulate these to some extent, but don't quite allow for the same degree of control, especially with very slow moves. However, what gimbals do offer is creative opportunities of their own.

### A brief history

What first caught my eye and fired my imagination back in 2013 was a video with a gimbal operator on rollerblades filming a girl getting into and moving off in a New York taxi – you know the one? Or, to be more specific, the behind-the-scenes video of that sequence ([www.youtube.com/watch?v=pDv2OYKICoc](http://www.youtube.com/watch?v=pDv2OYKICoc)). That video showcased the MōVI M10, the first handheld camera gimbal produced by stabilisation trailblazers Freefly, using technology from their very successful aerial gimbal, the CineStar. The M10 generated a lot of talk within the creative community, as did the original price of US\$14,999.

A year later, Dà-Jiāng Innovations (or DJI as you will know them) debuted their original Ronin gimbal. It had a similar specification to the MōVI M10 but was priced at a more modest US\$2,999. They too released a great video showcasing their device: a 3-minute film shot in one take and incorporating handheld tracking, a vertical cable winch, a handover through an open window and a crane shot – all continuous and seamless ([www.youtube.com/watch?v=b333dB\\_cOvg](http://www.youtube.com/watch?v=b333dB_cOvg)).



Camera folk were quick to realise the potential, Chinese engineering companies were quick to realise a new revenue stream, and the result has been a flood of constantly evolving devices, each one smarter, more ergonomic, and more ingenious than its predecessor.

We shouldn't forget other companies like BeSteady, who were also working hard to perfect similar rigs in 2013, but it's generally considered that Freefly and DJI cornered the gimbal market early on, and to this day they retain the monopoly.

Back in the early days of 3-axis, brushless offerings, the options were limited. The first widely available handheld devices really were just re-engineered UAV (drone) gimbals and generally only catered for either very small cameras like the GoPro, or much larger cameras like the Canon C300 or

RED Epic, which, when paired with a decent lens and follow-focus motor soon became uncomfortably heavy. Over the years, a few solutions have been developed to counter the sheer mass of these rigs, such as: modified Easyrigs and Steadicams; gimbal-specific vest rigs resembling a praying mantis produced by a number of manufacturers under the names Ready Rig, FlexiRig, Atlas, Slingshot, etc. – and then there’s Armor Man, a sort of Robocop-like creation. All these rigs provide much needed muscular relief and give the operator far longer ‘flying time’, but a big gimbal setup takes time to put together and balance, especially if you have a second operator looking after framing and focus, meaning you need to add a wireless video sender and lens telemetry system. That’s OK if you’re working on a drama production or music video where there is the time and budget, but for everyday programme making it can seem an extravagance. It’s fair to say a large gimbal rig should be reserved for those jobs where there is adequate setup time, in the same way you would allow for a Steadicam to be built and balanced, or camera tracks to be laid.

Coincidentally, running parallel with gimbal development was the evolution of small-form DSLR and digital single-lens mirrorless (DSLM) cameras. A few years ago, many models surpassed the minimum ‘broadcast spec’ bar of 8-bit 4:2:2, 50Mb/s. DSLMs, in particular, are attractive because of the absence of a reflex mirror, meaning the lens can be mounted much closer to the sensor and therefore accept a wide range of high-end stills and cinema lenses. It’s not hard to see why their acceptance and adoption as B cameras are now commonplace among industry professionals.

Handheld gimbal design was quickly scaled to cater for the popularity of DSLMs in their various configurations – and now we are spoilt for choice (too much choice even?), with an ever-growing range of compact gimbals, all offering a solution to the unavoidable human wobble associated with lightweight cameras. Small and medium-sized gimbals, in particular, are now a part of most camera professionals’ kit due to their compactness and fast setup time.

In fact, the results of a recent survey among GTC members and other camera professionals reveal that 83% of respondents now own one or more gimbals: 31% own a small unit like the DJI Osmo or a GoPro/ smartphone gimbal; 76% own a medium-size DSLM gimbal; and 49% a heavyweight gimbal (see more survey results on page 52).

## Choosing a gimbal

One size doesn’t fit all; there simply isn’t one perfect gimbal that will be good in all situations – because there will always be a tradeoff between size/weight and physical, human operating time. A large gimbal may seem like a good choice because it’s more versatile and can carry a wider range of cameras, but any gimbal owner will tell you that the sheer weight of a fully loaded M10 or Ronin can be punishing on your body, even with a support rig. Your choice will more likely be based upon a few key factors like which camera and lens you intend to use and what shots you’re after. It’s not uncommon for a camera professional to own two or more gimbals that cater for different size and payload ratings. The best way to choose is to ask colleagues their opinions and to try different models out for yourself. What might seem good on paper may actually turn out to be too heavy and cumbersome for your particular needs and you may end up hating it. Worse still, you might have to shell out a chunk of your earnings on chiropractor bills!

We can currently group gimbals into three categories: very small, single-handed units designed for a GoPro, mobile phone, or incorporating a camera head like the DJI Osmo; medium (0.5–4kg payload) gimbals for DSLM-size cameras, which can be single or two-handed operation; and the heavyweight (4–13kg payload) gimbals that definitely require two-handed operation.



The popular Ronin MX will take a 3.6kg payload but more importantly it can accommodate a DSLM with a larger lens.



With a 6.8kg load rating, the M6VI Pro can handle most digital cinema cameras.



Ronin 2: the big daddy boasts a huge 13.6kg payload, with the rig alone weighing 4.2kg. Make sure your gym subs are up to date!

[HTTPS://FREEHYSYSTEMS.COM/MOVI](https://freehysystems.com/movi)

[HTTPS://STORE.DJI.COM](https://store.dji.com)

# Gimbal rigs

If you have a larger camera setup like a Sony F5 or FS7, Panasonic EVA1, ARRI Alexa Mini, RED, etc. with cinema lens and an array of peripherals, including wireless video sender and lens control, the choices are few and therefore it's easier to narrow down what will be suitable. You are likely to opt for something from the Ronin or MōVI line-up. The same goes for a lightweight setup, such as a GoPro or smartphone. Although there are many manufacturers of these, they offer relatively few different options because they tend to all be similar in features and functionality. However, with smartphone gimbals, we are beginning to see intelligent functions extend from the phone via Bluetooth, allowing for such features as object or person tracking – in other words, the phone tells the gimbal where to point, a bit like the Active Track function found in most DJI drone gimbals and the new

Osmo Pocket. That leaves the majority of gimbal owners, all 76% of them, in the mid-size gimbal demographic, and it's this category where there is by far the most choice and functional variation between units. It makes sense therefore to devote the majority of the article to this sector.

## Size and payload

Once you have decided which camera combo you want to 'fly', you need to choose a gimbal that can not only take the weight comfortably but can also physically accommodate the overall size of the camera and lens. If, for example, you are using a Sony a7S and a compact, lightweight lens like the Sony 10–18mm, the choice of compatible gimbals is vast since the centre of gravity (CoG) is roughly under the front of the camera body, meaning the camera can sit fairly central on

## Tips

- Since the whole idea of a gimbal relies on good ol' physics, particularly mass and gravity, it's vital that a balanced CoG is achieved before you even turn the gimbal on. It's worth watching the manufacturer's setup videos, as these often have time-saving tips. If your gimbal is badly set up, the motors will be overworking to compensate and your battery life will be considerably reduced. You also increase the risk of the motor 'shuddering' and you may even get wonky, off-axis shots.
- If your camera is too small and light to get a good CoG, or it sits too low and the lens is touching the gimbal's camera plate, try adding a compact quick-release (QR) plate to raise the camera by 1–2cm.
- If you are emulating a crane shot or performing a crabbing/tracking shot, try enabling the 'lock all axis' mode. This keeps the gimbal pointing in one direction regardless of its orientation and makes for a more convincing shot. Any small adjustments can be made using the remote control.



A circular support like the CAME-TV Orbit will provide more grip options and minimise muscular fatigue. It also means you don't need a separate stand.



The Zhiyun Crane V2 can carry up to 1.8kg, but what if your camera combo is too light? This Sony a6300 and 10–18mm lens only weigh 670g, which is great news for your wrists but can be difficult to balance. Adding a quick-release plate raises the CoG sufficiently.

- If you are experiencing hum or vibration, it could be due to loose bolts or screws: check there is no play where the arms meet the motors.
- Consider a circular frame to mount the gimbal to, like the Ronin Grip, MōVI Ring or CAME-TV Orbit: this enables more hand positions, countering fatigue. It also provides more room for mounting a monitor, wireless link, radio mic receiver, etc., and allows you to rest the rig against a wall in between takes.
- Walking shots, especially up and down stairs, often suffer from small vertical movements, as you would expect, being a bipedal human. One solution is to add a Z-axis to your gimbal, such as the Beholder D2S Spring Arm, a dual handgrip with two small shock-absorbing arms, which attaches to the base of the gimbal via a 3/8" thread.



## Follow-focus setups

[HTTPS://STORE.DJI.COM](https://store.dji.com)



The Ronin focus motor integrates with the Ronin-S to provide full manual control.



The PDmovie Live Air 2 kit is completely wireless, making it a good match for gimbals with unlimited 360° rotation on all axes.

[HTTPS://WWW.ZHIYUN-TECH.COM/EN](https://www.zhiyun-tech.com/en)



This motor is designed for the popular Zhiyun Crane 2. The newly released Zhiyun Weebill Lab has its own, much smaller, follow-focus motor.

the gimbal platform. If, however, you use the same a7S with a longer, heavier lens, like the hefty Tamron 24–70mm, plus an EF to E-mount adaptor, the CoG shifts forward, meaning the camera has to sit further back on the gimbal platform. This can become a problem with smaller gimbals as the camera is now too close to the roll motor and can impede movement. The same camera with a Sony 28–135mm lens will offset the camera even more, placing the CoG approximately 8cm in front of the camera – so, the gimbal's physical dimensions are a key factor.

If your camera combo weighs 1.9kg, don't choose a gimbal with a 2kg maximum payload as this allows no 'overhead' in the motors to compensate for extra forces like wind resistance and inertia, or for any add-ons like a small video transmitter or clip-on matte box. Instead, look at gimbals with at least a 2.5–3kg payload as these will give a smoother result.

### Subject

Next, decide on the primary use: what type of shots are you planning? If these are going to be quick, single-handed, wide-angle following shots or circular tracking and majestic sweeps using a DSLM and compact, super-wide lens, then you might opt for something like the lightweight Zhiyun Crane V2 or Crane Plus, because it's up and running in seconds, easy on your arms, packs down flat, and the batteries last all day (actually, most gimbals will go a whole day without a battery change as long as they're balanced correctly).

If you're going to be filming from a moving car or boat, you might want a longer focal length and, whether this is a prime or a Canon EF zoom, it'll most likely be a bit heavier, meaning your camera will sit further back. The Zhiyun Crane V2 may struggle with this setup, so something like a Ronin-S, CAME-TV Prophet or Zhiyun Crane 2 (not to be confused with the Crane V2... I know, I know), or any similar size and strength gimbal will be a better choice in this scenario. (For high-speed tracking where high wind resistance and inertia are likely to seriously affect the gimbal, the Ronin MX, Ronin 2 or MōVI Pro are probably more suitable because they are specifically designed to counter these forces and will perform better in this environment.)

If you are likely to shoot skateboard or doggie-cam point-of-view shots, you will want a gimbal that can be inverted/underslung and not all gimbals can – so, check that all three axes can freely rotate 360°.

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Gimbals should be used where they enhance the shot and add something to the storytelling. Wide, sweeping, establishing shots are fine but you also need to give the editor detail shots, closeups, textures. When everything is constantly moving it can make the editor's job more difficult and give the viewer motion sickness.

If you want the option of attaching your gimbal to a camera crane, you will need it to not only invert but also to have the controller circuitry and battery incorporated into the body of the gimbal frame rather than in the handle. Something like the Ronin M or MX, or the MōVI Pro will be good choices – and they also come with very good, precise remote-control units. In fact, most gimbals with a handlebar-design handgrip will work in this scenario, but most have only a small wireless remote control (about the size of a matchbox), which doesn't offer the same degree of accuracy.

For timelapse sequences, most of the Zhiyun gimbal range have a smartphone app that can control both the gimbal and the camera. This function is currently only available using a Sony or Panasonic camera, and requires an extra cable. The Ronin-S also has a timelapse function and supports a wider range of cameras.

### Camera control

Since we are camera professionals not YouTube vloggers, we want absolute control over what the camera is doing; in particular, we want complete control of the lens. With a large gimbal setup you'd have a second operator looking after iris and focus via a wireless link, but a single operator doesn't have that luxury. Instead, he or she has three options: use a super-wide lens and large f-stop to ensure everything is in acceptable focus; use a follow-focus motor and controller; or (deep breath) rely on the camera's auto-focus function.

## Tech corner

The **IMU** (inertial measurement unit) is a small circuit board that lives underneath the camera plate and incorporates an accelerometer, gyroscope and often a magnetometer, GPS chip, barometer and thermometer – similar to the technology found in smartphones. It measures position, force and angular velocity, and sends the data to the main controller board. Some gimbals use a second IMU on the main chassis, often above the yaw motor to provide additional positioning data.

The **controller board** is the brain of the system. Early units were built around an 8-bit CPU; modern gimbal controllers use 32-bit architecture. It processes feedback from various sensors and sends precise instructions to the three motors that stabilise the camera platform to keep it horizontally level and pointing in the correct direction.

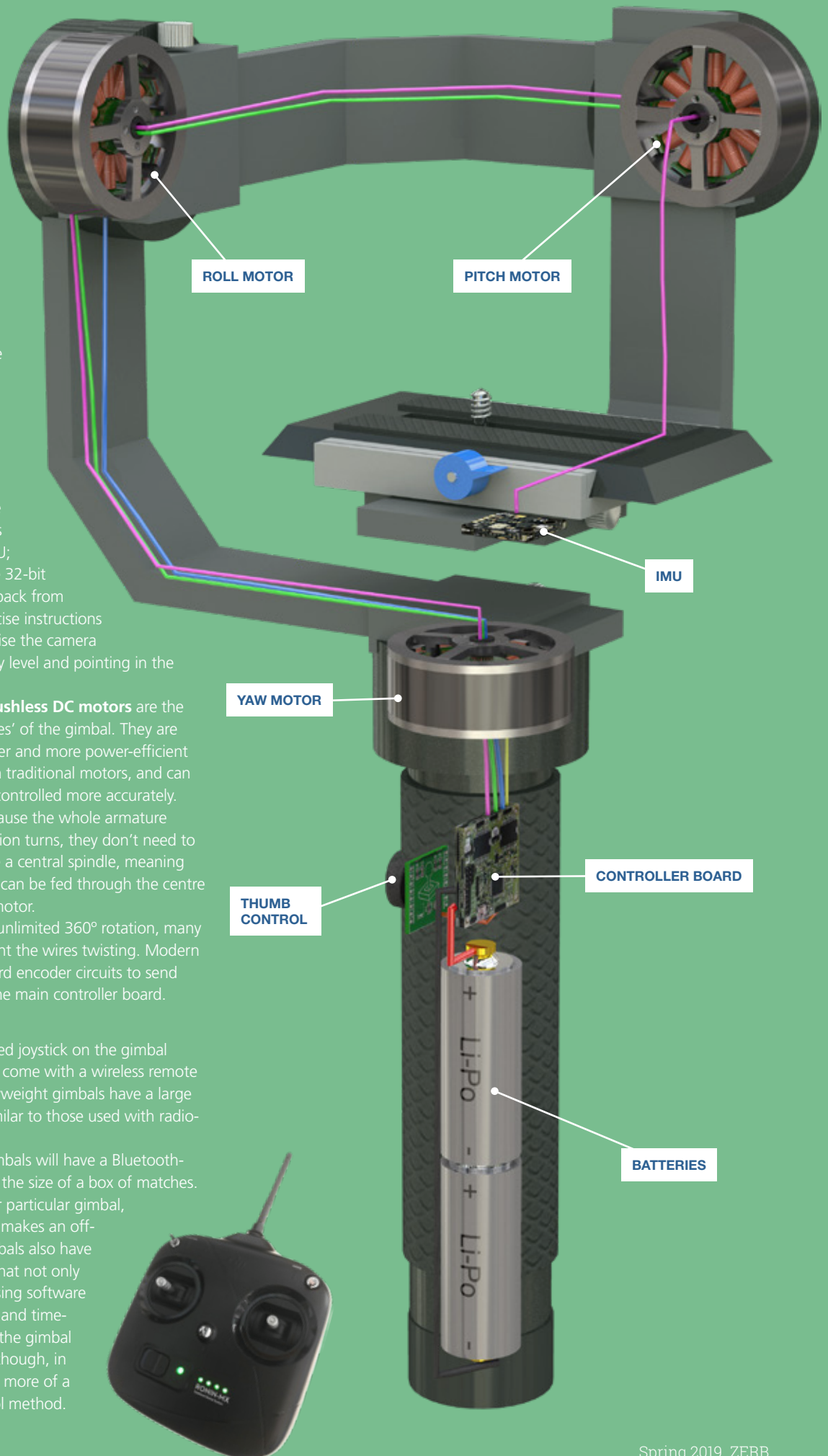
The **brushless DC motors** are the ‘muscles’ of the gimbal. They are quieter and more power-efficient than traditional motors, and can be controlled more accurately. Because the whole armature section turns, they don’t need to have a central spindle, meaning wires can be fed through the centre of the motor.

To achieve unlimited 360° rotation, many gimbals use slip rings to prevent the wires twisting. Modern brushless motors have on-board encoder circuits to send precise position feedback to the main controller board.

### Remote control

In addition to a thumb-operated joystick on the gimbal itself, most modern units now come with a wireless remote control as standard. The heavyweight gimbals have a large digital proportional control similar to those used with radio-controlled model aircraft, etc.

Most small and medium gimbals will have a Bluetooth-enabled remote control about the size of a box of matches. If you didn’t get one with your particular gimbal, chances are the manufacturer makes an off-the-shelf controller. Some gimbals also have an optional smartphone app that not only provides a quick way of accessing software settings like mode, calibration and time-lapse, it also allows control of the gimbal movements via Bluetooth – although, in my experience, this function is more of a gimmick than a reliable control method.



Now, some of you may have just spat your cornflakes out in disbelief at the last option – and until two years ago I would have been equally horrified at the mention of ‘auto-focus’ (that’s just for consumer cameras and smartphones, right?). Well, predictably, cameras get smarter with every new incarnation and the focusing technology inside modern Sony A-series and Canon C-series cameras, in particular, is quite amazing. Sony uses Hybrid AF, which combines contrast-detection and phase-detection, and Canon uses Dual Pixel CMOS AF phase-detection to accurately lock-on and track moving targets in real-time without ‘hunting’ or ‘twitching’. Both systems also employ face-detection algorithms to track people with impressive accuracy and the new Sony a6500 even has eye tracking. It should be noted though that auto-focus works best with native lenses, i.e. a Sony camera with a Sony E-mount lens, or a Canon camera with a Canon EF mount lens. Using, say, a Canon EF lens on a Sony a7S via a Metabones adaptor will not be as responsive, and may result in the lens ‘hunting’ for focus.

Now, this may all sound like yet another nail in our coffin: just as streaming services are killing broadcast TV, are intelligent cameras killing the camera professional’s craft? Well, not exactly. For a start, rather than provoking a spiralling decline in production values, the likes of Netflix and Amazon Prime are actually pushing the quality back up with their hefty investment in programme making – they are the new broadcasters and need experienced, highly skilled cameramen

and women to create their content. Similarly, new technology is there to help us make better, more creative imagery. Fly-by-wire auto-focus gimbal shots are reliable enough to allow the single operator to achieve impressive results at longer focal lengths, and generally enhance the storytelling where previously you’d have needed a Steadicam or jib. You don’t need to know how the underlying technology works, you just need to know what it’s capable of and how it can simplify your job – and, let’s face it, when you’re shooting 4K (and very soon 8K) without a focus puller, you need all the help you can get.

Our survey revealed that 55% of gimbal owners regularly use auto-focus, and half of those rated the auto-focus function 7 or 8 out of 10 in terms of reliability (for perspective, 7% rated it 9/10, but no one gave it 10/10, and 14% rated it 1/10 or ‘terrible’ – so there is obviously still some margin for improvement). In other words, it’s not idiot-proof but if you take the time to find out its limitations (for example, low-light is a nightmare for auto-focus), this can be a very handy and effective, time-saving tool.

In case you were wondering where Panasonic are in all this: they are still playing catch-up with their hugely successful, gimbal-friendly GH5 and GH5S cameras, which are sadly lacking in terms of auto-focus performance. A firmware release in late 2018 addressed this shortcoming to some extent but they still haven’t nailed it. These cameras are better suited to a manual lens setup.

## Design improvements so far

Gimbal designers are constantly looking to make their products better. Some of the more popular features or modifications that exist, but you may not be aware of, are:

- Wiring hidden inside the chassis. The first wave of handheld gimbals were covered in a mass of wires just waiting to get snagged on something. Today everything is neatly hidden behind a CNC-machined alloy exoskeleton.
- Encoders incorporated into most gimbal motors provide greater accuracy.
- Slip rings in the motors allow cables unlimited rotation.
- A repositioned roll motor allows the rear screen of the camera to be viewed without obstruction, as seen on the Ronin-S, Pilotfly H2, Tilta G2X, Nebula 5100 and Zhiyun Weebill Lab.
- The Ronin MX and MōVI Pro have a second battery to power the camera and accessories via a socket on the camera platform.
- An integrated focus control wheel, as found on the Zhiyun Crane 2 and Ronin-S, directly controls an optional follow-focus motor.
- Controls and power integrated into the main frame allow use as a hot head on a crane, etc. This is fairly standard on large gimbals but few medium-size gimbals will do this: the CAME-TV Prophet, Prodigy, Optimus and Argo, and the Filmpower Nebula 5300 are among them.
- Many gimbals with unlimited 360° movement can perform ‘barrel roll’ shots.
- Smartphone apps that accompany DJI, Zhiyun, MōVI and other gimbals allow access to additional functions like tuning, remote control and timelapse. The MōVI Pro app also provides real-time data like battery status so that the camera assistant knows when to change them.
- The app can also be used on some gimbals to switch between ‘car mode’ and ‘walking mode’, applying compensation for the extra forces the gimbal will encounter.

## Future enhancements

- Intelligent tracking: we have already seen this in smartphone gimbals and drone gimbals with integrated cameras. We will soon be seeing it appear in mid-size, handheld gimbals as well. The gimbal and camera will communicate with each other at a deeper level, making shallow depth-of-field shots more accurate and reliable.
- The Zhiyun Crane Plus already has an auto-tracking feature but it requires a smartphone to be mounted on the cold shoe of the DSLM camera – not an ideal setup.
- The Tarot Flamingo has an optional camera module that attaches to the gimbal’s camera plate to provide optical tracking ability.
- A fully integrated, zero-latency video link would be a welcome addition, rather than the clumsy, phone-battery-sapping Wi-Fi option we currently have. This could be sent to a lightweight monitor or to a head-worn display.



This add-on camera module from Tarot-ZYX, which actively tracks the subject and controls the gimbal, is a glimpse of what’s to come. Expect to see more integration with artificial intelligence (AI) technology in the next wave of gimbals.

## Is it all too much?

Can too much gimbal be a bad thing? Well, yes, is the popular opinion. Remember back circa 2011 when the Canon 5D MkII was arguably at its height of popularity? Viewers were subjected to what can only be described as a pandemic of ultra-shallow depth-of-field shots: a combination of wide-open super-fast f1.4 lens, full-frame sensor and an over-zealous operator wanting to make everything look 'cinematic' – but which often translated into interviewees having sharp eyebrows and out-of-focus eyeballs. Fortunately, we seem to have grown out of that and the majority of broadcast TV and professional web-based material has returned to a more comfortable amount of visual aesthetic.

In certain circles, the gimbal 'look' has similarly become 'a thing', which, on the surface sounds a bit worrying to us camera folk as we like to pride ourselves on our craft and our creative individuality and looking 'samey' isn't generally a good thing. But digging a bit deeper, it transpires it's more about how often they are used, especially when a more controlled shot would better suit the narrative.

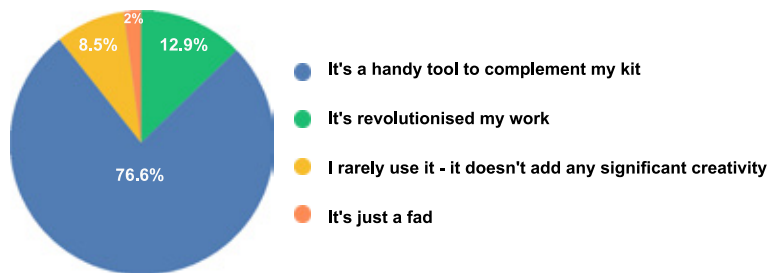
I spoke to freelance editor David Sweeney to get an objective opinion: "You can spot them straight away," he confides, "the obligatory gimbal shots, especially the super-wide, left-to-right arc around the subject – everyone does them. Gimbals give a nice bit of movement to an otherwise dull, static shot, but some people don't know when to stop. They shoot everything on it! Not every shot needs to be wide and sweeping; I sometimes get to the point where I'm desperately looking for a closeup... or any shot done on a tripod."

The general consensus from Dave and other industry professionals is that gimbals should be used where they enhance the shot and add something to the storytelling. Wide, sweeping, establishing shots are fine (I do them all the time) but you also need to give the editor detail shots, closeups, textures. When everything is constantly moving it can make the editor's job more difficult and give the viewer motion sickness.

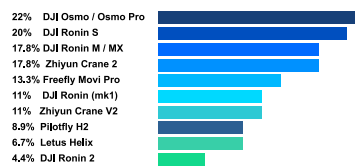
It appears from the feedback I've received that, with the exception of carefully set-up pieces-to-camera, the majority of you use a gimbal as a B camera or C camera for most of your jobs to provide fluid segues, travelling shots from moving vehicles, or to convey the overall grandeur of a scene, thereby

## Our survey results

### Are gimbals a good thing?

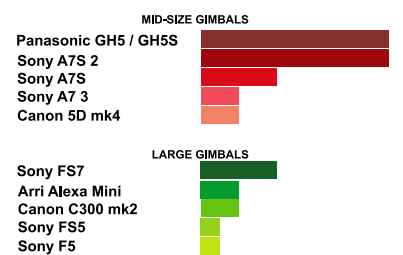


### Top 10 most popular gimbals



Additionally, at least 14% own a GoPro or smartphone gimbal too.

### Most popular cameras used with gimbals



We should also acknowledge the following cameras as they are also in regular use: Panasonic EVA1, Fuji X-T3, Canon EOS-R, Sony Venice, Sony A7R3, Sony A6300.

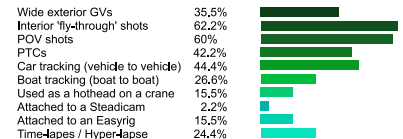
### Do you ever use the camera's Auto Focus function?



### How accurate do you find it?



### How do you use your gimbal?



leaving the larger A camera for the interviews, detailed closeups and long-lens, arty stuff. In other words, it doesn't dominate the shoot unnecessarily. This, in many people's opinion is a good balance.

As you can see, this is a vast subject with many variables and we've only really scratched the surface. But the underlying technology is very exciting and I don't believe these tech companies are looking to devalue our jobs in any way; they want to sell us newer, shinier gimbals, so they are incorporating features they think we'll find useful in our work. A complaint I hear often is that you need to be an IT expert just to operate a camera proficiently these days, which of course is more or less the case; it should be a welcome relief, therefore, when a piece of tech comes along that requires nothing more than an on/off switch and a directional joystick to produce great results. It should leave more space for your right hemisphere to get on with the creativity.



## Fact File

GTC member **Mark Langton** has 26 years' experience in broadcast television, with many primetime credits under his belt, including *Tomorrow's World*, *Bang Goes the Theory* and *Top Gear*.

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