CIRCLES IN THE AIR

By John Keedwell GBCT UAV Pilot

In 1889 William Friese-Greene filed his patent for what is widely regarded as being the first demonstrable moving image camera, although it was never a commercial success. In 1890 Thomas Alva Edison released the Kinetoscope and Kinetograph, a successful practical film apparatus, along with the 35mm film format invented by his Scottish employee William Kennedy Dickson. Cinema was born.

Opposite: In flight movie - XM2 Pursuit
Below: Drone alone

Some 13 years later, in December 1903, the Wright brothers flew their first powered and sustained flight in Kitty Hawk, North Carolina, after many failed attempts by other inventors, including Edison. Manned flight was born.

These individual and magnificent inventions have shaped our modern world. We can travel the globe in jet aircraft, watch in-flight movies and think nothing of their origins. But when these are combined, in the form of aerial cinematography, we can see the world in incredible ways.

It was, of course, many decades before the elements of flight and cameras were fully combined in any cinematographic form, as cameras were extremely large and the early aircraft were extremely fragile with limited capacity for extra weight. Many other inventions were needed to make it viable, with many tricky technological issues to be overcome, before the combination of flight and cameras became what it is today.

Of course, flying a camera and operating to frame a shot of another moving object are not easy, whether you are operating on the ground or from another aircraft. It needs a great perception of 3D space and speed, plus a lot of experience and skill.

Old school

Before the gyro-stabilised camera rig was invented it was common on a documentary or movie to make a helicopter shot by the operator sitting on the floor secured with a sturdy safety strap, the helicopter door open and suspending the camera from a cord. It can still be a method of getting a shot when a rig isn't available or viable, such as working above a ship from a helicopter.

But the technology has advanced massively in the last 20 years, with the ingenuity of the inventors giving a greater freedom to create moving aerial sequences that were never before possible. One of the greatest challenges with aerial work is the inherent movement of the craft being suspended by a column of air pushing downwards to counter its weight and the effect of gravity. There is always going to be turbulence, and other atmospheric effects will affect the camera platform in unpredictable ways, so this movement will be transmitted to the camera unless it is isolated in some way. Enter the gimbal.

Gimbals

Gimbals were first described by Greek inventor Philo of Byzantium in 280BC, so they are not a new concept. But powered gyro-stabilised gimbals are. And they are an essential part of aerial cinematography. Gimbals have been used on ships for many years to keep the compass level, along with tables and even the clock (or chronometer), as their mechanisms are sensitive to a ship's constant movements.

Yet these were 'passive', gravity balanced systems, which simply keep the platform horizontal. The random movements caused by changes of airflow on an airborne craft need to be 'ironed out' and stabilised automatically, leaving the camera operator to operate the camera from a stable platform.

Gimbals create a platform that is stable in all directions and need to have 6-axis stabilisation, pan/tilt/yaw each in both directions. The most popular for helicopters is the Shotover range to suit different markets, and they are popular because they have a fully-modular system allowing operators to easily utilise multiple camera and lens combinations.

The Helicopter Girls

Formed by Emma Boswell and Katya Nelhams-Wright in 2011, The Helicopter Girls is a specialist provider of drone aerial film services. Operating internationally, the company uses cutting-edge UAV and stabilisation technologies to craft close aerials for film and television.

"Our team really care about the work we do," says Boswell. "We operate the safest, most reliable aircraft and stabilisation systems on the market and are proud to announce a brand new advanced level of super-heavy lift payload capability with our latest aircraft.

"Our crew is built on experience, with expert pilots and aerial camera operators who have thousands of hours experience behind them. We combined with John Marzano at Marzano Films in 2018 to include the additional capability to shoot from helicopters."

Safety is a high priority, and the firm is a congested-area specialist, trusted by London Film Offices, Film London, CAA, NATS, local councils and 1st Option Safety, and carrying £10m in public liability.

"Behind-the-scenes we plan shoots meticulously, working with productions to make sure every aspect goes smoothly, from testing bespoke camera payloads in advance to attaining international permissions and working with location safety," adds Boswell.

Credits: *1917, Downton Abbey, Bridgerton, 355, Death On The Nile, Maleficent 2, Hobbs & Shaw, Mission: Impossible – Rogue Nation, The Apprentice and Ross Kemp Inside Barlinnie.*

www.thehelicoptergirls.com

Drones

When it comes to drones, a different set of factors needs to be considered. The propellers are controlled by tiny electric motors powered by high-capacity batteries, with the operator/pilot on the ground looking at the image via a downlink. Many technologies need to work seamlessly together or the drone becomes unstable. A good GPS system, excellent gyro-stabilised gimbals, light airframe, good communications to and from the drone, a battery system that gives good flight time and warns of low power, and the potential to carry heavier cameras and lens combinations are all vital.

Limitations

Drone and helicopters can in some ways overlap and do a similar job, yet each has its own set of limits. For example, a helicopter cannot fly from a street scene and in through the window of a building.

The take-off position is always logged by the drone, and it will fly back and automatically land if the radio signal is lost. However, when launched from a moving boat, the take-off position is not really ideal for an auto-landing! This means flying-in and landing manually, often with a 'hand catch' by an assistant, can become necessary. Having a pilot with manual flying experience is one of the top tips from Emma Boswell of UK-based drone specialist The Helicopter Girls.

Whilst they are certainly versatile, drones cannot carry a camera to high altitudes above ground – 120m/400ft is the normal flight ceiling. Nor can they travel out of sight of the operator around the back of a building or mountain, as radio control will be lost. For drones, the flying restrictions often mean skyscraper shots are not normally possible.

These days drones are capable of 80kg payloads or more, but that then brings them into another category of flying weight, and some more restrictions by the authorities. It is all about picking the tool for the job.

Experience

Directors buy experience in their technicians, and that can't be faked when it comes to aerial DPs and operators.

"I fly with systems I have personally built, so if we have an issue I can land the helicopter, fiddle around and know what is the likely issue and, more often than not, fix it literally in the field," says UK aerial cinematographer John Marzano.

And The Helicopter Girls concur. "You need to know the camera rig/or helicopter inside out, and ideally you have built it yourself," says Boswell. "My business partner, Katya builds our drones and we know every wire and connection on each machine. If it goes wrong, we can most likely fix it on the set."

Getting started

Helicopters are expensive to buy and maintain, so for any one with aerial filming ambitions, it not just a case of buying one for £2m and strapping a £600K Shotover camera rig to it.

"The helicopter side is very difficult," says Jeremy Braben of Helicopter Film Services. "Understandably, the hardest part is hands-on training of new people, yet we need to do that, and have greater diversity coming up through the ranks. There are very few female operators in the business – we have one new trainee for example – but that needs to improve. We need more people show a passion, whoever they are, as there are very few who want to commit to a specialism.

Helicopter Film Services
Jeremy Braben Associate BSC GBCT has been a cameraman and DP for over 34 years. He started in news and current affairs, before moving into documentary, music videos and drama, and then specialising almost exclusively in aerial cinematography since 1990.
Braben founded Helicopter Film Services in 1993, which now operates from an 8,000sq/ft hangar HQ near London for productions shooting worldwide. In the USA the company works with partners, Wolfe Air Aviation, based in California.
"Offering both drone and helicopter filming services gives us the unique ability to give the customer an unbiased view on which is the best equipment for the job," says Braben. "We have some of the best drone equipment available – from a small Mavic for recce's, through to DJI Inspire Pros up to 20kg, 42kg and even 80kg Ultra Heavy-lift drones capable of carrying the ARRI Alexa 65 or even film cameras on motion pictures.
"We are now one of only two companies in the world who own and operate the NSI Vectorvision periscope and nose camera for the Lear Jet. We operate a specially-modified Lear 35A capable of speeds of 400mph, which is famous for its role in shooting commercials with the legendary Concorde for British Airways."
Key equipment includes the Cerberus 3-camera, Typhon 6-camera and 360 Aerial arrays, and LIDAR integrated large format VFX system for the Shotover K1.
Credits: *The Crown, Black Widow, Wonder Woman 1984, The Midnight Sky, Fast & Furious Presents Hobbs & Shaw, Downton Abbey, Avengers: Endgame and Darkest Hour.*
www.helicopterfilm.tv

"But don't expect to be an aerial DP straight away. Come in as an assistant, learn the kit inside out, and then, when we work on jobs, the trainee can take on some of the easier shots. That way they build up solid experience."

XM2 Pursuit has a large R&D department and trains people from the ground up. The company's Aaron Corera, originally a university engineering graduate, loved the idea of the business, and knocked on the door to offer his services. He started sweeping the floor, and then learnt huge amounts by watching the technicians prep the gear and go off to shoot. There is no substitute for practical knowledge and experience.

Buying a commercially-produced drone is another route in to the business of aerial cinematography, and whilst it is less expensive than a helicopter, there is still considerable cost for the heavy-lift drones needed today, and owning one does not mean you will be automatically flooded with work. You will need to train, get to know the gear inside out, and obtain your pilot's licence for the class and weight of drone you use.

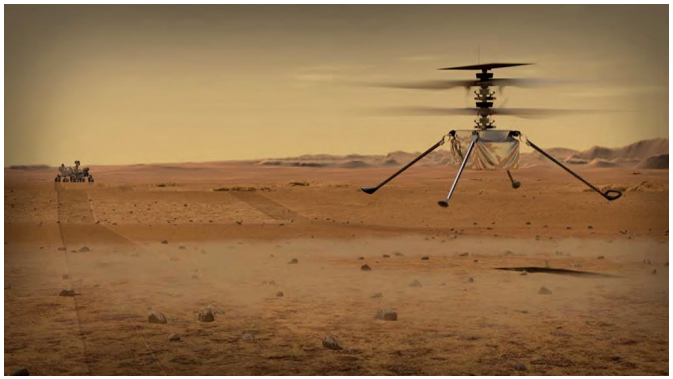
Marzano Films
Marzano Films is a UK-based aerial filming company offering its services to productions worldwide. The company was started in 2014 by John Marzano Associate BSC GBCT, a highly-respected aerial and drone filming director. In 2018, the company teamed-up with The Helicopter Girls and started a collaboration that has shown extraordinary success on some of Hollywood's biggest movie productions including *Fast & Furious Presents Hobbs & Shaw* and Disney's *Artemis Fowl*.
Marzano and his team take great pride in providing a complete package of first-class aerial and drone equipment and highly-experienced and dedicated crew for productions, UK and worldwide. Some of the company's aerial camera capabilities include the Cineflex Elite, the award-winning Mini Eclipse and Shotover camera systems.
"Our safety record is exemplary, and we have never had a client who has been anything less than delighted with not only the comprehensive and hassle-free service, but also the great imagery we have captured," he says. "Thanks to our partnership with The Helicopter Girls, we also have a range of superb drones which can be underslung or overslung to capture the action from below or above."
With well over 100 Oscar and BAFTA Award-winning films and many television dramas, documentaries and commercials credits, the depth of knowledge and experience the team can provide is hard to rival.
Credits: *No Time To Die, 1917, Black Panther, Captain America: The First Avenger, Star Wars: The Rise of Skywalker, Fast & Furious Presents Hobbs & Shaw, Spectre and The Martian.*
www.marzanofilms.com

What qualities make for great aerial cinematography?
It is important to involve the pilot and operator in discussions about the shots during pre-production meetings, technical recce's, and even script readthroughs. They are integral to the process in achieving what the director wants, and great shots need proper planning.

Understanding what the camera and lens can and can't achieve is essential, as is safety. Good pilots know how to push the envelope to a point where it is still safe to get the shot. "Great aerial work is a combination of skill and bravado, tempered by experience," says Marzano.

Ideally full-service providers are best, where they have the knowledge to advise a production as to whether a drone or helicopter is needed, and who can also sort out unforeseen location issues that production might not necessarily have thought about.

Opposite: John Marzano at work
Opposite, lower: Alexa Manta rig
This page: Ingenuity on Mars
Photo: NASA



Getting the shot
Of course, as with all camera movement, sometimes new technology needs to be developed to do certain shots from the air. Stephen Oh CEO of XM2 Pursuit, says, "We have a special Research & Development department where we constantly look at new ways to do new things. We don't wait for the problem to appear, we look at certain possibilities a director may want and devise a rig to get the shot."

Luc Poullain of Aering Media was required to shoot a low shot for background plates whilst filming over a river for *The Legend Of Tarzan* (dir. David Yates, DP Henry Braham BSC) in 2015. However, the downdraught of the helicopter would mean spray getting on to the camera lens, and disturbance of the water. So, he devised a 40m-long cable and added a 'Rocket' on the end containing a stabilised mount with multiple Red cameras inside. This way the downwash was eliminated from the shot, although it required the skills of the pilot to bring the suspended rig to a stop without it swinging around.

What makes a great shot?
Often the 'Eye Of God' shot can give an overall perspective, and it can also offer a more threatening or somewhat voyeuristic point-of-view, particularly if the subject is in a car and apparently unaware of anything above them. The 'Plan View' shot from directly above is also a shot used in cities with the camera apparently skimming skyscrapers or trees.

Ironically, it is often when the shot doesn't look like a helicopter or drone, but is part of telling the story as a seamless blend into the rest of the picture that makes for the right visual. And sometimes it is not about flying over a subject, but more about an object moving through the frame from a high angle that creates a great sequence.

Favourite shots in a movie?
The 1985 film *Out Of Africa* (dir. Sydney Pollack, DP David Watkin BSC) is widely seen as having one of cinema's most beautiful and emotionally evocative aerial sequences, as Robert Redford and Meryl Streep soar over Kenya's rift valley landscape in a biplane, accompanied by a beautiful John Barry score.

Marzano says he is particularly proud of his work on the armada approach sequence and ensuing battle in *Black Hawk Down* (2001, dir. Ridley Scott, DP Sławomir Idziak), which was shot in Mogadishu.

Below: Helicopter Film Service's Jeremy Braben Associate BSC GBCT
Lower: Aering Media multi-camera array

XM2 Pursuit
XM2 Pursuit's in-house R&D teams create bespoke solutions to fit the needs of the most exacting filmmakers. Its custom aircraft and payload mounting solutions are designed, manufactured, tested and integrated by skilled teams of engineers, developers and pilots.
"We provide solutions for the VFX work that has become integral to Hollywood's biggest blockbusters," says the company's CEO Stephen Oh. "Our LIDAR systems are capable of ground and aerial scanning, whilst our photogrammetry technology can create highly-accurate and complete 3D models of any large set, environment or location, with detailed location, measurement and volumetric data, ranging from sandy beaches, to towering cliffs, to historic buildings. We also have proven experience in the Virtual Reality space."
Working with Pursuit Aviation and Shotover, the firm is the first aerial production company to introduce a fighter jet platform, called The Jetcam, that offers 6-axis, gyro-stabilised imagery for high-speed aerial cinematography. Based around the Shotover F1, and after vigorous testing and modification, the resulting F1 Rush allows the operator to capture stabilised images at high speeds and high G-forces.
Additionally, its Whiskey Wheels provides new options for DPs and camera operators who would traditionally stay on the ground. Whiskey Wheels allows these operators to transition their skill set to the skies using wheels, rather than a joystick, to operate a K1 Shotover. The company has services offices in Seoul and operates out of LA, Atlanta, London, Melbourne and Australia's Gold Coast.
Credits: *Dunkirk, Gemini Man, Thor feature films, plus Lethal Weapon, Westworld and Ray Donovan TV series*
www.xm2pursuit.com

For Jeremy Braben, it is *The Last Sign* (2004, dir. Douglas Law, DP Jean-Claude Larrieu). "We had a big wide shot, flying in Canada through forests and electricity pylons, then into a town and up to a man's face who had crashed his car into a tree – all in one shot," he says. "It needed a great pilot to bring the helicopter to a gentle stop to bury the zoom I needed to get such a close-up."

Luc Pullain says, "I really like sequences in Pixar's *Cars*. Even though I know it isn't real, they have some great shots I would love to do! Apart from that, the work by Marc Wolff on *Spectre* (2015, dir. Sam Mendes, DP Hoyte Van Hoytema FSF NSC ASC) is really outstanding."

For me personally, *Mission: Impossible – Fallout* (2018, dir. Christopher McQuarrie, DP Rob Hardy BSC) has one of the most real and terrifying helicopter chase scenes. And who can't wait to see what lies in store with *Top Gun: Maverick* (dir. Joseph Kosinski, DP Claudio Miranda ASC) releasing later in 2021?

Where next?
FPV or "First Person View" means wearing head-mounted displays that show a live stream camera feed from the drone. The idea originates from FPV drone racing, a niche sport that began between 2011 and 2013. It means a total immersive flying sequence, and can be more responsive. It is now legal to fly with certain parameters, and opens-up new possibilities for action drone shots we have never seen before.

Outer Space
NASA has worked for many years on the concept of flying an unmanned drone to explore other planets, and the first-ever flight of a small solar-powered drone, called Ingenuity, over the surface of Mars took place on April 19th 2021.

The technology to make this possible was largely due to advances in commercial drones and the requirements of drone pilots on Earth – including highly efficient electric motors, lightweight carbon fibre rotor blades and increased battery power.

Aering Media
Aering Media is a European specialist in the coordination and achievement of helicopter aerial shots for digital cinema and broadcast, shooting celluloid film as well as full HD to 8K, plus 3D stereo and live TV. The company, which has offices in France, Belgium and London, is led by Luc Poullain, who says the business strives to maintain itself at the forefront of technology and capabilities.
"Our team combines passion and attentive professionalism to put our know-how and technical expertise at the service of our clients," he says. "We adapt to specific needs and find the best tailor-made solutions. Our competence spans the field of cinema as well as live TV and broadcast through the use of aerial and gyro-stabilised technologies that are innovative and perfectly adapted for the work. We are able to mobilise human resources and equipment in a very short time frame across France, Europe and all over the world."
Aering is an authorised service provider for the Shotover brand, and has the largest selection and availability of Shotover systems anywhere in Europe. These include the Shotover K1, Shotover F1, Shotover M1, plus Dual Lens and Multi Camera Array systems. The company also develop systems for particular work, such as The Rocket system for filming above water.
Credits: *King Kong vs Godzilla, Dunkirk, Mission: Impossible – Fallout, Star Wars: Episode XI – The Rise Of Skywalker, Fast & Furious Presents Hobbs & Shaw and Transformers: The Last Knight*
www.aeringmedia.com

Ingenuity even carries a small swatch of fabric from one of the wings of Flyer 1, the aircraft that made that historic flight by the Wright Brothers at Kitty Hawk, North Carolina, just over 117 years ago.