



# AERIAL SURVEILLANCE

FROM MOVIE MAGIC TO TERRAIN TRACKING, UNMANNED AERIAL VEHICLES (UAVS) HAVE LONG BEEN A HOT TOPIC IN THE AEROSPACE INDUSTRY. NOW THE TWO ARE SUPPORTING TOMORROW'S AERIAL DEFENCE PROBLEMS.

This interest stems from the growing demand for aerial surveillance of large areas of land and sea for a wide variety of applications – done cost-effectively and without putting the lives of pilots at risk. Whether it's scouting terrain before deploying troops or identifying targets, the technology is there to save lives and the information gathered needs to be as detailed and precise as possible.

Putting video surveillance equipment into UAVs isn't exactly a new science, but as technology moves on we can expect to see improvements in the cost and quality of such devices. It's also fairly common that developments made in the defence sector are picked up by private industry and made commercially available. Yet it is the world of movie special effects that is about to offer up some of the most interesting developments for the use of video capture in the defence sector. And it's a UK company leading the charge.

Oxford Metrics Group (OMG) is a group of technology companies producing image understanding solutions for the entertainment, life science and engineering industries. Be it for capturing the movements of actors (for the movie industry), sportsmen (for video games or improving team performance), children with cerebral palsy, rehab patients and animals (for medical, life science and research industries) or virtual reality displays (for engineering and development), OMG has

the world leading market position and a strong international reputation for precision instruments, and has even won an Oscar and Emmy awards.

2d3, a subsidiary of OMG, is better known as a developer of visual effects software. However, it is making the move into the UAV market by developing defence applications based around its image understanding technology, which it showcased at the world famous Farnborough Air Show in July. Some of these technologies are already in use with defence contractors, being deployed to solve many of tomorrow's aerial defence problems.

The move from movies to military defence may sound like a giant leap but technology built around image tracking has many proven capabilities which will be invaluable in defence scenarios. From mapping 3D terrain and tracking targets, to 3D positioning, zooming in on video and picking out detail from super resolution, as well as creating a mosaic of overlapping images to form 3D models, 2d3's software already tackles many of the same process that will provide solutions for many of the key challenges facing UAV imagery.

Currently it can cost in the region of Euro 220,000 to fit out UAVs with video equipment, yet the quality of the images captured is well below standard – on a par with cheap CCTV footage. When

thousands of lives are at stake, you don't want to have overlooked an enemy convoy or misread a tank as a harmless rock.

Airborne surveillance is not only more flexible and of potentially better quality, it is also vastly cheaper than satellite borne imagery. This form of imagery does not use up valuable payload on passengers and life-support, doesn't put an aircrew at risk and opens up the possibility of using much smaller aircraft, which are by their nature cheaper to produce and harder to detect.

The downscaling of image-based aerial surveillance also means that in theory, everyone can do it – not just the super-powers. Besides the UK, there are current developments in the US, Canada, Brazil, Australia, France, Taiwan and Finland amongst many others. With so many players, the 10 year UAV world market is forecast to reach in excess of Euro 8.5 billion.

UAV applications are by no means limited to the battlefield, another report sets the commercial market for the next five years at over Euro 0.8 billion. One of the most successful new miniature UAVs, now licensed and sold by Boeing was originally developed to assist fishermen searching for tuna.

With so much potential for growth, why haven't UAV applications completely taken over the defence market? A recent conference on UAVs in Bristol clearly exposed two major obstacles currently limiting this sectors development; limited availability of frequencies for UAVs to transmit UAVs on, and image quality issues.

2d3's applications have developed a solution for both problems. Instead of transmitting live, low resolutions video to a base station, future UAVs will use on-board analysis. This will go a long way towards solving the bandwidth problem and will allow the use of higher resolution sensors.

Using 2d3's technology, overlapping images from a video stream can be automati-

2d3 Image Stabilization Super Resolution Mosaicing Hardware Lens Calibration Target Tracking Vehicle Tracking 3D Terrain

- Fully automatic "through the lens" structure-and-motion
- Provides accurate camera position and orientation
- Enables precise triangulation of target range and bearing
- Operates using video alone or combined with GPS

cally stitched together to create large high-resolution images, with optional geo-rectification. This stitching together of images – mosaic-ing – is an application, which although is not a new concept, is crucial in being able to build up a bigger and more detailed picture for further analysis.

Moving objects, such as heavy traffic, could also be removed from the mosaic automatically. Mosaic-ing still images using manual registration has been a standard part of mapping software for years, but 2d3's programme allows complete auto-registration at a fraction of the time and far more precisely.

While 2D maps don't tell the whole story, UAV-derived images can be used to build up accurate 3D topographical terrain models at a fraction of the cost of existing 3D mapping tools, such as LIDAR or SAR.

Target tracking is another essential task for UAV imagery. Man-in-loop (MIL) target indication, as it is referred to in defence sector parlance, is a difficult, tedious, but

essential task. The automatic, real-time identification and tracking of candidate targets is a 2d3 application which will make a real difference in the field.

A stable image is also essential for UAV MIL interpretation. With the addition of an image stabilisation module, it now makes much less sense to spend Euro 80,000 on a gyro-stabilised camera platform.

There is also lens calibration, an application in which high-resolution sensors allow wide fields of view without loss of detail. The distortion inherent in wide-angle lenses can be automatically estimated and corrected.

Vehicle tracking is another key application. UAV target geo-location starts from knowing the position, and critically the global pointing of the EO camera. Real-time image based tracking, supplemented by GPS, provides the answer directly.

Finally, the last and most impressive aspect of the application means that high-zoom UAV video can be put to real advantage. Every frame sees a slightly different image and when combined they can increase resolution five times or more.

These applications are not only ground breaking in their development, but are also set to change the face of the defence sector. 2d3's UAV technology is making a difference to the people who use it, while improving military intelligence at the same time. It is a software that is saving lives and protecting the people who protect us. 2d3 will definitely be a company to watch out for in the future as their software continues to branch into new sectors and initiatives.

**For more information:** Oxford Metrics Group ([www.omg3d.com](http://www.omg3d.com))

2d3 Image Stabilization Super Resolution Mosaicing Hardware Lens Calibration Target Tracking Vehicle Tracking 3D Terrain

- Automatic generation of orthographic ground mosaics
- Hundreds of video frames build a single high-resolution composite
- Traffic / moving objects automatically removed