

GIM INTERNATIONAL INTERVIEWS CHRISTIAN HEIPKE

# UAS: Filling the Gap



**The International Society for Photogrammetry and Remote Sensing (ISPRS) is one of the leading organisations within the geomatics sector and has a long-standing partnership with *GIM International*. We spoke to Christian Heipke, secretary general of the ISPRS, and asked him to share his views on the growing role of unmanned aerial systems (UAS), a major development in data acquisition at the moment. Christian Heipke is also member of the Scientific Committee of UAV-g 2013 in Rostock, Germany, a conference which focuses on unmanned aerial vehicles in geomatics.**

*One of the most recent major developments in photogrammetry is the rise of unmanned aerial systems. What do you think of the all the exposure that UAS are receiving these days?*

I believe that the development of UAS is very positive for our community: first of all, it increases the possibilities for remotely capturing data – image sequences, laser scanning data, temperatures, gas concentration, etc. – and thus gives people who employ this technology professionally a competitive advantage. Secondly, when you have control over the complete sequence of acquiring, processing and distributing geospatial information, you have more confidence in this technology, especially if you are not a geomatics specialist. Also, UAS enjoy considerable media coverage which helps our industry. And finally, there is a fun aspect to UAS – people like playing around with such devices, which again gives our industry a positive image, and may even help to attract more students to our field.

*Which geo-related applications are likely to benefit most from using UAS?*

As a platform, the type of UAS we are talking about in photogrammetry closes the gap between terrestrial and aerial imaging. A UAS is much easier to

employ than aircraft, and at least for small projects it is much more economical. Possible applications include archaeology, precision farming and mapping small areas in general. If monitoring is part of the job and the area needs to be revised frequently, for instance in construction site documentation or when monitoring traffic jams or sporting events, this is of course an added bonus. One can also envision a UAS being equipped with a thermal camera to detect heat leakages in industrial plants. In disaster management, of course, rescue crews can benefit from using UAS to quickly obtain an overview of the situation, and security applications also profit from UAS.

*What will be the role of UAS for modelling the built environment in 3D?*

Since the built environment is of course an area where much change happens, monitoring is a major task. UAS can be used for checking if a database of the neighbourhood is complete and up to date by comparing its content to UAS images, or for acquiring newly constructed buildings, annexes, etc. As mentioned before, oblique images taken from a UAS can also be used to render the 3D city model for visualisation purposes.

*Are there any major obstacles blocking the path to UAS becoming an established photogrammetric technology?*

In terms of technology, power is

one of the most limiting factors today. Batteries are very heavy, thus UAS can only stay in the air for a relatively short amount of time. For rotary wing UAS such as quadcopters and octocopters as well as for some fixed wing systems, wind and weather can be another limiting factor – flying in rough meteorological conditions is not advisable. On the non-technical side, flight permits are sometimes hard to obtain for safety reasons, and data privacy may become an issue, as was the case with Google Street View in a number of countries. But with proper planning, these issues should not be a real obstacle for photogrammetric projects.

*Legislation is an issue when it comes to wider implementation of UAS in the geomatics sector. Which developments do you foresee in terms of the legal aspect?*

I see two issues here: data privacy and technical safety. As far as data privacy is concerned, we need clear regulations, preferably not only on the national level, which state under which circumstances the use of a UAS is allowed. One way to increase public acceptance might be to enable people who feel they are being observed by a passing UAS to make contact with the UAS. They could for instance send a message from their mobile phone to learn what type of data the UAS is currently capturing. They could also ask to have an online video stream transmitted to their local device, ▶

Christian Heipke



**Christian Heipke** is a professor of photogrammetry and remote sensing at Leibniz Universität Hannover, Germany, where he leads a group of 25 researchers. His professional interests comprise all aspects of automation in photogrammetry and its connections to computer vision and GIS. He has authored or co-authored over 300 scientific papers, more than 70 of which have appeared in peer-reviewed international journals. He received the 1992 ISPRS Otto von Guericke Award, the 2012 ISPRS Fred Doyle Award and the 2013 Photogrammetric (Fairchild) Award from ASPRS. He currently serves as ISPRS secretary general and chairs the German Geodetic Commission (DGK).

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so that they can check whether or not their privacy is being infringed upon. Such two-way communication with an unknown UAS might seem unrealistic, but today's technology makes it feasible. As far as safety is concerned, we need to develop the systems to a level that accidents will become very unlikely. Air traffic control can serve as a role model in this regard. We must realise, of course, that accidents will still happen – just as they do in manned air traffic. The challenge is to make UAS safe enough that the level of risk becomes acceptable.

*The spatial resolution of today's satellite imagery is 41cm, although this figure is effectively 50cm due to the US government's restrictions on civilian imaging. The trend is towards increasingly higher resolution. Will such imagery eventually become a competitor for aerial photogrammetry?*

The answer is a clear yes. At a ground resolution of 50cm, we already see severe competition. Of course, celestial mechanics can't be beaten – the satellites must follow their orbits. Hence, today, images from space cannot be acquired with the same flexibility as those from the air. But this situation may change once we have access to satellite constellations, and these have started to appear in recent years. RapidEye with five satellites in medium resolution and the French Pléiades system with two high-resolution satellites are only the first two examples. On the other hand, there is a clear demand for even higher ground resolution for many applications. Many of the aerial images acquired today have a pixel size on the ground of 10cm or less. Thus, it seems that there will still be a market for both satellite and aerial imagery in the foreseeable future.

*UAS can operate autonomously as a result of digital flightplans, while today's software enables automatic generation of digital elevation models and*



*orthoimagery. How do conventional DPWs need to be adapted in order to become UAS software?*

Most DPW software is optimised with respect to aerial image blocks with parallel viewing direction and regular overlap in and across the flight direction. However, UAS produce many more and often smaller images with rather varying exterior orientation and irregular overlap, and the viewing direction may be oblique or nadir. In order to handle such images, DPW software must become more flexible and more robust – this also goes for input formats, but primarily for automatic generation of approximate values to run matching and bundle adjustment processes, and for a proper consideration of distortion during image exploitation. Furthermore, manual inspection of oblique images is a necessity. Finally, due to the many images, a free and smooth roaming across different stereo models without operator intervention is a must.

*Which major developments do you foresee, in geodata acquisition technology in general and in photogrammetry specifically, in the next five years?*

I guess what we will see is an even closer integration between methodologies from aerial and close-range photogrammetry – UAVs and oblique images are just two examples of this trend. We will also see a further integration of different sensors (optical and thermal cameras, laser scanners, etc.) to form geosensor networks and platforms for mobile mapping and robotics applications. On a more general note, crowdsourcing and community mapping are very interesting alternatives to traditional data acquisition. On the processing side, we will see more and more automation for vector data acquisition, updates and monitoring. Sensor orientation, surface matching and orthophoto generation are automated already, and classification and image interpretation will follow in the



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future. The need is partly due to the sheer amount of data being acquired every day; think of the many satellites in orbit, and how many millions of images are being uploaded to the web every day. Automation is the only way to process this increasing volume of images. Real-time processing is another trend which will become more important. I already mentioned obstacle avoidance, which by the way is also important in UAS campaigns, but many monitoring tasks demand fast results as well. Geoinformation for personal use such as pedestrian navigation and personalised location-based services are another driving force in our field. All these trends are of course governed by the development of the internet, and standardisation and ubiquitous computing will become increasingly important.

*UAS have been called a hype by some people in the geomatics industry. Were these people too sceptical, and should they now admit that the UAS revolution has begun?*

I believe more in evolution than in revolution. Like in many other fields, once a new and promising

have great potential to fill in the gap between aerial and terrestrial survey. At present, power supply and thus flying time is limited, UAS are sensitive to wind, and a number of legal issues await a solution (see above). But UAS are too good and too promising to be seriously

*UAS will find their way into practice as a complementary data acquisition technology in the geomatics field*

technology or trend emerges, there are always some people who believe it will solve all current problems. Of course, UAS do not, but they do

hampered by these issues; they will find their way into practice as a complementary data acquisition technology in the geomatics field. ◀

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