GIM INTERNATIONAL INTERVIEWS CHRISTIAN HEIPKE

Tomorrow's Global Geospatial Needs

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, during the 2013 Geospatial World Forum in Rotterdam, The Netherlands. Here, he shares his views on topics such as the growing role of unmanned aerial systems (UAS) and oblique imagery – just two examples of major developments in data acquisition at the moment – as well as the future challenges for the industry.

Congratulations on receiving the Photogrammetric (Fairchild) Award, the highest scientific recognition from the American Society for Photogrammetry and Remote Sensing (ASPRS), in March 2013. How did that feel?

The award came as a big surprise. Of course, I felt very honoured to have been selected. But when I saw the list of previous winners, I felt that my name didn't really belong among them. Firstly because the award seems to honour lifetime achievements, and I still feel too young for such recognition. And secondly, I don't think my contributions are significant enough for this award. But then, I did feel proud as well ...

Two recent major developments in photogrammetry are oblique imagery and unmanned aerial systems (UAS). Which key opportunities does oblique photogrammetry offer in terms of 3D city modelling?

First of all, oblique images – which have actually been around for many decades – provide formidable facade texture for automatically rendering 3D city models. Obviously, if doors, windows, balconies and suchlike need to be entered into the models as spatial objects (in contrast to pure texture), these can be extracted from oblique images. In addition, monitoring activities taking place in urban settings are largely facilitated using facade views. Other applications comprise determining the facade material – such information can be useful for sound simulation – and monitoring a building's heat flux using thermal oblique images. In short, oblique images are a valuable tool for visualisation, and they can be used to derive a lot of information which is not accessible from aerial images.

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 Streetview in a number of countries. But with proper planning, these issues should not be a real obstacle for photogrammetric projects.

Research into image matching has been taking place for more than three decades now, and many of the multitude of methods developed have been implemented in commercial Digital Photogrammetric Workstations (DPWs). Nevertheless, it is still an active research area. Could you explain this?

Indeed, image matching has a

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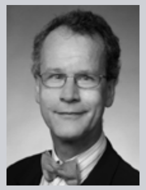

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long history, and from a superficial point of view, one might argue that the research should have been finished long ago. But we should not forget that matching serves very different purposes. The first goal was to produce a digital terrain model from aerial images in open areas. First attempts date back to at least the 1960s, and useful solutions appeared together with the first DPWs. Attention then shifted to automating image orientation, thus to automatically deriving tie points in aerial triangulations. Commercial solutions first became available some 15 to 20 years ago and have been refined ever since. In the meantime, we are able to use a very large set of images from the web, which were never intended to be used for photogrammetric purposes, for automatically reconstructing a model of the depicted scene.

Nowadays, researchers aim at reproducing 3D city models with many height discontinuities in extremely high resolution, and also at recognising obstacles in autonomous driving applications. The latter obviously needs real-time solutions. Matching results also start to be a very valuable piece of information for automatic image understanding, which is a major driving force for today's research into dense matching. For instance, when we want to extract buildings from images, we are well advised to take into account that buildings are higher than the surroundings. If this height information is available, it makes it much easier to discern buildings from other objects with similar grey values such as roads. Stereo operators have known that for a long time.

In a nutshell, when we talk of image matching we talk of a very broad range of methods with rather different applications. While some have been solved decades ago, research still struggles with others. I actually believe this situation will continue for a while.

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 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 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.

How do you see the role of ISPRS in the coming decade?

ISPRS is unique in its three dimensions: (1) ISPRS is a scientific society embracing the areas of photogrammetry, remote sensing and geospatial sciences. The society is the premier global player in the science of acquisition and automatic analysis of any kind of images and of geospatial information; (2) ISPRS is a society with activities ranging from pure science to exciting innovative applications, thus uniting academia, government, industry and private business. ISPRS is the ultimate meeting place for business, with major exhibitions demonstrating the commercial strength and future potential of our discipline; and (3) ISPRS is a truly global society serving the needs of people of all ages and organisations from all nations around the globe. ISPRS is thus also the global society for education, outreach, technology transfer and capacity building.

While all three dimensions are of vital importance to ISPRS, an undisputed lead in scientific matters forms its basis, since it is today's science which defines tomorrow's products and services as well as the answers to global geospatial needs. As a consequence, we need to make sure that ISPRS remains the number 1 scientific organisation for 'information from images'.

Orhan Altan, ISPRS president for the period 2008-2012, said in an interview with GIM International in 2012 that ISPRS should prioritise environmental monitoring and sustainable development. What is your standpoint on this?

I very much believe that Orhan Altan is right when he says environmental monitoring and sustainable development are major topics of today's world, and therefore ISPRS should contribute to them as much as possible. At the same time, photogrammetry, remote sensing and the spatial information sciences provide the core of the geospatial data infrastructure, which of course serves many different applications. In that sense I believe that ISPRS should make sure that the information from images benefits other areas as well: from our traditional field of topographic mapping to agriculture, forestry, resources and regional planning, and all the way to industrial metrology, cultural heritage, sports, the media industry and medical applications. Images and the information they provide play an important role in each of these very different applications.

Spread the word about an extremely interesting field with a bright future in terms of job prospects

Attracting sufficient students is a major issue for geomatics programmes at European universities. How is the situation in Hanover, and do you have any suggestions for how to increase the number of geomatics students throughout Europe?

Attracting enough students has been a challenge for many years. Also in Hanover, we would like to see more students than we presently have. We are active in a number of ways in order to try to change the situation. A current initiative is our 'Day of Geodesy and Geoinformatics' to be held on 15 June 2013. We are joining forces with private industry and public administration to present the different facets of our profession, as the employers too are starting to realise that there is a real shortage of well-educated young professionals in our field.

We are addressing both students-to-be and people already within our industry who can act as multiplying factors by spreading the word about an extremely interesting field with a bright future in terms of job prospects. ◂