A Report on the Moscow 2006 Conference

Laser Scanning & Digital Aerial Phot

The 6th International Conference on Laser Scanning & Digital Aerial Photography, organised jointly by the Russian Society of Photogrammetry & Remote Sensing (RSPRS) and the giant Gazprom company, was held in Moscow between 6th and 8th December 2006. As the Conference title suggested, it was focused on three main themes - (i) airborne laser scanning; (ii) terrestrial (ground-based) laser scanning; and (iii) airborne digital photography, with particular reference to their applications within Russia. On the one hand, the detailed papers on these three technologies were given mainly by Western system suppliers or their Russian representatives. On the other hand, the papers on the applications of these technologies were presented mainly by Russian contributors, who have adopted these technologies enthusiastically with numerous interesting and varied applications.

By Gordon Petrie

Fig. 1 (a) - The President Hotel in Moscow where the 6th International Conference on Laser Scanning & Digital Aerial Photography was held.
(b) - A map showing the location of the Hotel in a prominent position in the central part of the city on the south bank of the Moscow River.

Conference Venue & Organisation

The Conference was held in the large and luxurious five-star President Hotel overlooking the Moscow River and directly facing the massive new monument to Peter the Great and the Russian Navy and the newly re-built Cathedral of Christ the Saviour with its gilded onion domes. The Hotel itself was built 25 years ago specifically to accommodate visiting foreign heads of state and delegations and to host high-level meetings and conferences. Thus it features a series of conference halls and meeting rooms of different sizes capable of accommodating groups of several hundred down to a few dozen people as required. With 220 participants, the Conference only occupied a small part of these extensive facilities. The plenary and general sessions, including those concerned with airborne laser scanning and digital photography, were held in a beautiful lecture theatre and concert hall equipped with a raised stage, superb seating, good acoustics and excellent projection and audio facilities, including a simultaneous Russian/English translation service. The parallel sessions covering ground-based laser scanning were held in an a smaller conference room adjacent to the lecture theatre. Besides which, there was a further suite of adjacent rooms in which the exhibitors had small booths. The dining facilities and food were first-class. Much of the organisation and running of the Conference was carried out on behalf of the RSPRS by the staff of the large Geokosmos surveying and mapping company and its associated companies, Geolidar and Geopolygon, who are agents for and suppliers of aerial imaging and surveying equipment respectively. Collectively these three companies were the general sponsors of the Conference, with further sponsorship being provided by the Opten company.

I. Airborne Digital Imaging

I.1 Large-Format Imagers

As one might expect, the three major suppliers of large-format airborne digital imagers all made presentations of their products under this heading. The charismatic Prof. Franz Leberl (***Vexcel***) gave one of his trademark oratorical performances setting out the merits of the company's UltraCam cameras. In this, he was supported by a separate paper from Tom Tadrowski from the Australian AEROmetrex company which operates an UltraCam camera. They both spoke of the special advantages of the multi-ray measurements of position and height that are permitted by the UltraCam camera when it is being operated with large overlaps. Dr. Hartmut Rosengarten (***Intergraph***) gave a less flamboyant but equally persuasive account of the merits of his company's DMC camera; while Valentin Zaitsev from ***Leica Geosystems***' Moscow office set out the main characteristics and selling points of the ADS40 pushbroom line scanner.

I.2 Small- & Medium-Format Imagers

With all these prior presentations of large-format systems in mind, the present writer (Gordon Petrie) provided an overview of airborne digital imaging technologies that concentrated more (i) on the numerous small-format and medium-format digital cameras that are now in widespread use for airborne imaging; and (ii) their integration with airborne lidars. In this area, there was also an excellent presentation by Tobias Toelg, who described the latest version of the Rollei AIC medium-format digital camera and, in an interesting aside, mentioned that over 60 of these cameras had been sold to date. He also announced the setting up of a new ***Rolleimetric*** company to develop the AIC cam-

ography: Today & Tomorrow

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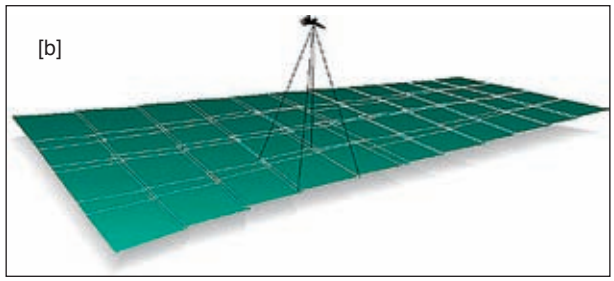

Fig. 2 (a) - The VisionMap A3 digital stepping frame camera that was introduced at the Conference. (Source: VisionMap)
(b) - The pattern of the ground coverage of an area using a stepping frame camera. (Source: Recon/Optical Inc.)

era technology further.

The new company is owned jointly by Rollei and Phase One, the Danish supplier of the digital backs that are fitted to the AIC. Also within this category of medium-format cameras, the Russian representative of ***IGI*** covered the DigiCAM in his presentation. Finally, within this category, there was a presentation by Stephen Mah of ***Itres Research*** in Canada that covered his company's hyperspectral pushbroom scanners - including the latest models in the well-known CASI series producing linescan imagery in the visible and near infra-red (VNIR); the SASI 600 model operating in the short-wave infra-red (SWIR); and the TABI 320 producing imagery in the long-wave infra-red (LWIR) thermal part of the spectrum.

I.3 Russian Applications

As became apparent from subsequent contributions, notably that from Dr. Evgeny Medvedev, the General Manager of ***Geolidar*** - who gave an overview of Russian experiences with airborne digital imagers - many of the digital cameras in current use in Russia are of the small-format and medium-format types, often used in conjunction with airborne lidars. Indeed the market has developed sufficiently within Russia for a mount to be offered that is designed and built locally, specifically for use with these small- and medium-format cameras. This Aerosight camera mount, which is marketed by Geolidar, corrects for drift (heading) through a motorized drive under the control of the aircraft's GPS-based flight management system. As for the large-format airborne imagers, at present within Russia, there is only a single Vexcel UltraCam digital frame camera in use with the Geokosmos company and two Leica Geosystems ADS40 pushbroom line scanners that are being used in the LARIS (Land Registration Implementation Support) Project being carried out by the Russian VISKHAGI cadastral research organisation. The funding for the purchase of these ADS40s was provided by the World Bank. So, in spite of the categorical statement from Vexcel that "Film is Dead!", in fact, large numbers of aerial photogrammetric film cameras remain in use within Russia and the CIS countries, Thus there is plenty of room and a real opportunity for further sales of large-format airborne digital imagers in Russia. Dr. Medvedev felt that such a development was "inevitable".

I.4 Israeli Contributions

Within this section on airborne digital imagers, there were also two very interesting presentations by participants from Israel. The first of these, presented by Yaron Vilan, was the introduction of the new ***VisionMap*** system from the company of that name based in Tel Aviv. [See the Web site - *www.vision-map.com/*] VisionMap is based on the imagery acquired by a stepping frame camera that sweeps the ground rapidly in a series of steps to provide continuous cross-track coverage at right angles to the flight line. To a certain extent, the VisionMap camera resembles the CA-261 stepping frame camera from Recon/Optical that is used by the U.S. Air Force. [See the relevant Web page - *www.roi.bourns.com/cameras/ca261.asp*]

However VisionMap is a metric camera and is currently being tested by the Geokosmos company for mapping applications, especially orthophoto production, as set out in a paper at the Conference given by Dr. Kadnichanskiy of that company. The second paper from Israel was presented by Ilan Friedlander and covered the ***MultiVision*** software package that is being used by Aerial Cartographics of America (ACA), GetMapping in the U.K. and various other companies that are competing against Pictometry and its licensees in the area of multiple digital oblique frame images.

[The relevant Web site is *www.ofek-multivision.com/*] Indeed the Geokosmos company is using the software to process the oblique frame images being taken by a pair of Rollei AIC cameras, each firing at an angle of 45° from the vertical to the left and right of the flight line. Furthermore, Dr. Kadnichanskiy of Geokosmos gave another two papers on the results of the tests that have been carried out at his company using the MultiVision system to process this oblique image data for (i) the production of orthophotomosaics; and (ii) the visual analysis of the oblique images.

II. Airborne Laser Scanning

II.1 System Suppliers

If the take-up of large-format airborne digital imagers has been comparatively slow within Russia, quite the opposite situation exists with regard to airborne laser scanning. The technology has been adopted enthusiastically by Russian organisations. Already no less than fifteen of these expensive devices are in use within the country. Of these, twelve are ALTM

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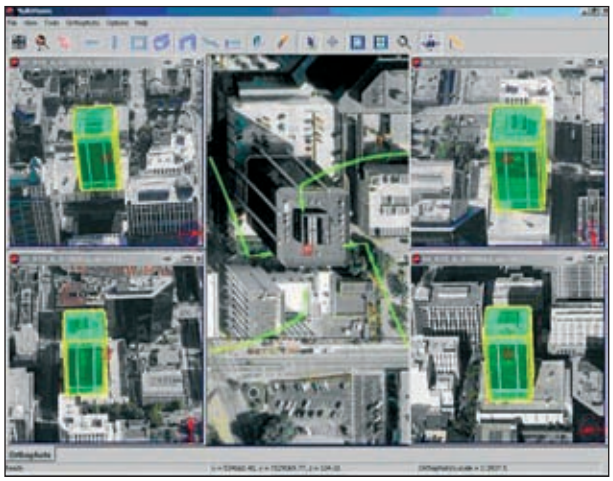

Fig. 3 (a) - A MultiVision screen display showing the central (nadir-pointing) image surrounded by the corresponding four oblique images of the same area taken from different directions.

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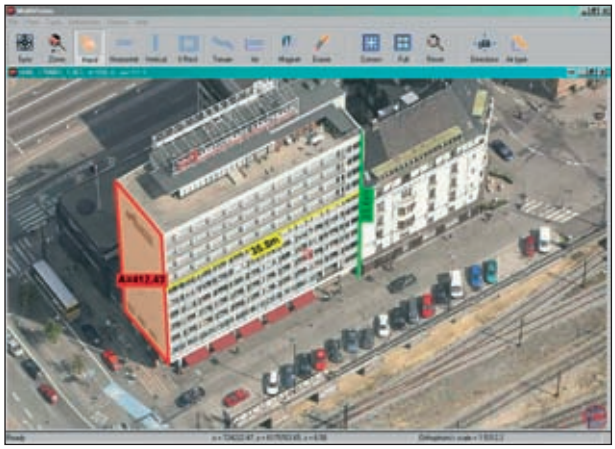

Fig. 3 (b) - The dimensions (length, width, height, area, etc.) of many aspects of an individual building can be derived from an oblique image using the MultiVision software. (Source: Ofek MultiVision; Image of Copenhagen courtesy of COWI A/S)

models that have been constructed by Optech; two are Leica Geosystems ALS50 laser scanners; while the remaining instrument is a Riegl LMS-Q560. Naturally Optech were very much to the fore during the presentations. Daina Vagners first gave an introduction to airborne laser scanning in general and then described in detail the new ALTM Gemini instrument from Optech. Among the many interesting points that she made was the information that, up till now, Optech has now sold 95 ALTM scanners world-wide. Even more interesting was the news that, besides its 100 Hz scan rate, the ALTM Gemini is employing a multi-pulse technology that already produces a 167 kHz laser pulse repetition frequency (PRF) - a feature that was not announced when the instrument was introduced at the INTERGEO 2006 trade fair held in Munich a few weeks ago. Optech has also introduced its new DASHMap post-processing software to support the ALTM Gemini's higher PRF speeds. Dr. Valerie Ussyshkin of Optech also presented a paper providing an assessment of the accuracy of the ALTM 3100EA model in the detection of power lines - a matter of considerable importance given the huge distances over which such lines need to be built to cross Russia. Valentin Zaitsev of ***Leica Geosystems*** had also included details of his company's ALS50 laser scanner along with his presentation on the ADS40 pushbroom line scanner.

Also concerned with airborne laser scanner technology was the presentation and accompanying paper from Anders Ekelund of ***Airborne Hydrography AB*** (AHAB) from Sweden giving details of the new Hawk Eye II combined bathymetric and topographic laser system for coastal surveys. First he traced the development of Swedish laser bathymetry systems, including the original Flash device and the subsequent Hawk Eye systems. He then followed this account with (i) a detailed technical description of the new Hawk Eye II system and its post-processing software; and (ii) the results of their operation by Admiralty Coastal Surveys. It was a most interesting and informative presentation!

II.2 Service Providers

When it came to the applications of airborne laser scanning, then the Russian participants came to the fore. In the opening plenary session, S. Melnikov, the President of the ***Geokosmos*** company outlined the present market for laser scanning within Russia and then gave his forecast of the market development in the years up to 2010. He was backed up by his colleague, Roman Podoprikhin, who outlined the new products and services that are being offered by Geokosmos - which now operates five Optech ALTM airborne laser scanners. Then Dr. Medvedev of ***Geolidar*** gave his second paper in which he adopted a more academic approach than the others, discussing airborne laser surveys as applied to topographic mapping; defining and discussing the terms commonly used in this area; and discussing the technology in terms of it providing a real-time mapping system. However the other Russian contributors were much more pragmatic and specific. Boris Mekhanoshin of Opten informed the audience that his company was the first company in Russia to employ airborne laser scanning (in 1996). Since then, it had specialized in the application of the technology to the provision of engineering services, including the design work, maintenance and infrastructure of a variety of mostly linear objects. These include oil and gas pipelines; overhead power transmission lines; fibre-optic communication lines; and both existing and proposed roads and railways. Since 1996, Opten has completed about 80,000 km of corridor surveys using its airborne laser scanners, including 38,000 km

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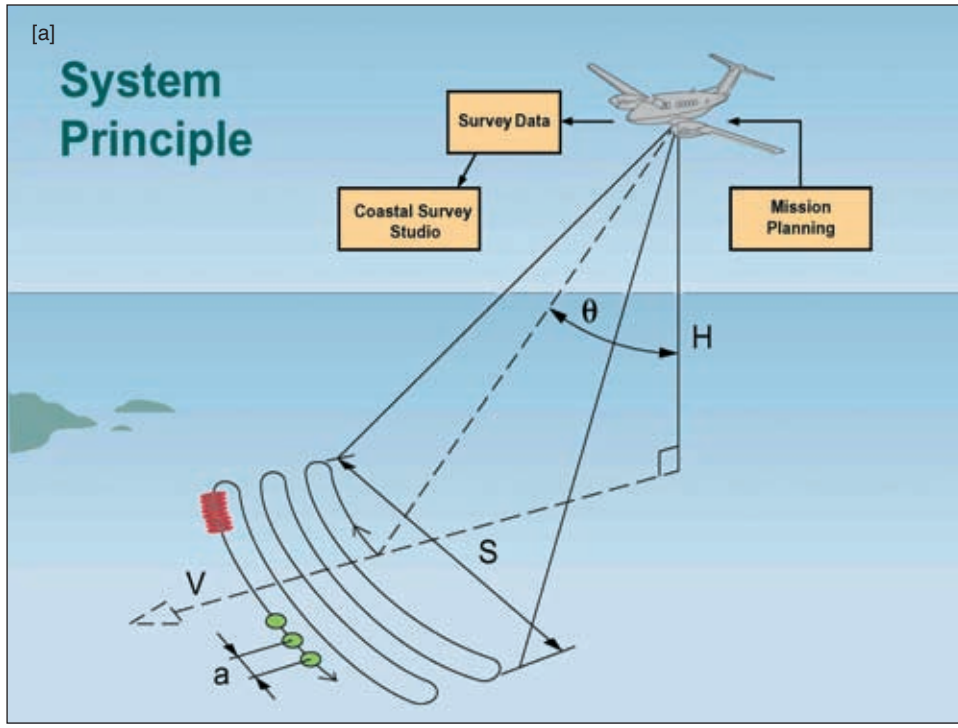


Fig. 4 (a) - The operating principle of the Hawk Eye Mk. II airborne bathymetric and topographic laser scanning system showing the scanning pattern used to survey the land and the sea floor of coastal areas.

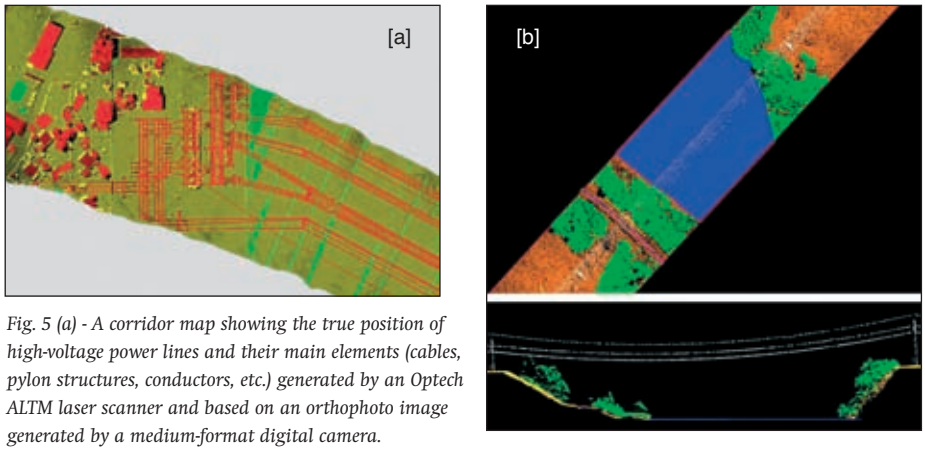


Fig. 5 (a) - A corridor map showing the true position of high-voltage power lines and their main elements (cables, pylon structures, conductors, etc.) generated by an Optech ALTM laser scanner and based on an orthophoto image generated by a medium-format digital camera.
(b) - Another linear corridor image map showing power lines crossing a river, together with a profile showing the catenary of the power lines and their clearance over the local vegetation. (Source: Opten)

of pipelines and telecommunication lines and 40,000 km of overhead power transmission lines. Like Geokosmos, Opten currently operate five airborne laser scanners - in this case, three Optech ALTM instruments, one Leica ALS50-II scanner and a Riegl LMS-Q560.

Vladimir Platinov of the ***Aeroscan*** company, which is a subsidiary of the Infrastructure Project Center, informed us that his company specializes in the monitoring of power transmission lines and the associated facilities such as sub-stations for the Federal Grid Company of the RF (Russian Federation) United Energy System. He then gave an account of his company's work utilizing two Optech ALTM scanners operating in combination with Rollei AIC cameras and an Agema thermal IR camera over the period 2004-2006. Once again, the lengths of the power transmission lines being surveyed are quite phenomenal - 50,000 km in this particular case. Still on the linear survey theme, another paper by S.N. Cherkesov outlined outlined the surveys of oil and gas pipelines and several highways carried out by his company ***NPI InjGeo*** using an Optech ALTM 3100 scanner. There was yet another paper in this area by Georgy Skorniakov of the ***Mosgiprotrans*** company which specializes in transport (road and rail) applications - in this case, using a Leica ALS50 laser scanner in conjunction with an Applanix DSS medium-format digital frame camera.

Away from the main theme of linear corridor surveys, there was also a paper by Evgeny Boyko of ***IngGeoGIS*** on the use of airborne laser surveys for the measurement and evaluation of snow cover, depth and accumulation in mountainous areas. The method involves two surveys carried out before the snow falls and then during the period of maximum snow accumulation. Using the Spatial Analyst module of ESRI's ArcGIS software, the subsequent analysis is carried out for areas at risk from avalanches, including the areas planned to be used for the Winter Olympic games to be held in Sochi. Finally the Conference heard descriptive accounts of the Terramodel, Lidar Analyst and PolyWorks software packages that are already very familiar to Western users of laser scan data and it also received a presentation on the Canadian Novatel company's SPAN inertial & GPS technologies given by its Russian agent.

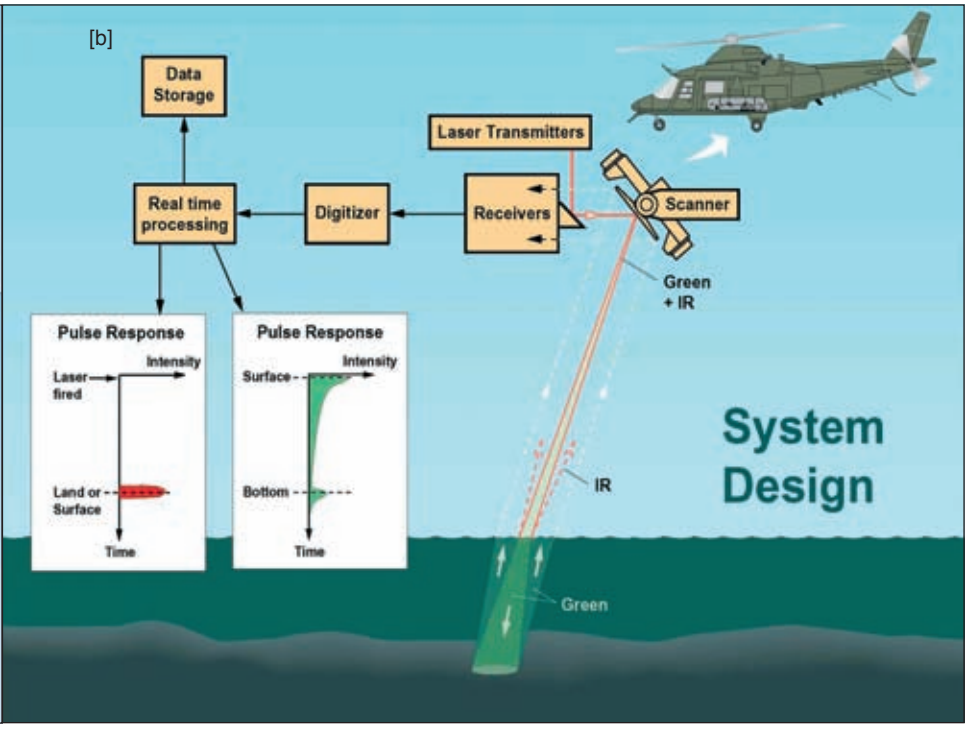


Fig. 4 (b) - The pulses from the red/NIR laser are reflected from the sea surface or the land; while the pulses from the green laser penetrate the water and are reflected from the sea floor. (Source: Airborne Hydrography AB)

III. Terrestrial (Ground-Based) Laser Scanning

III.1 Instrument Suppliers

Since I had attended all the sessions on the airborne side, I was unable to attend the sessions on ground-based laser scanning which ran in parallel with the airborne sessions. Furthermore only a few of the papers on the ground-based side were available in English on the Conference CD-ROM and could be read later. Nevertheless, it was obvious that several of the main instrument suppliers from the West - Leica, Trimble/Mensi and Riegl - were all active and made presentations in the terrestrial laser scanner part of the Conference. Riegl, who are represented by ***Geopolygon***, were particularly prominent - with two presentations by Alexander Kovrov of the Geopolygon company, (i) on the capabilities of Riegl's laser scanners; and (ii) their use in mining and architecture.

III.2 Applications

The other papers gave a further insight into the versatility of ground-based laser scanners and the range of their applications. Thus it was interesting to learn about the measurement and calibration of large foldable antennas and reflectors for use in space that had been carried out by a team from ***BUM Techno*** (who are industrial measurement specialists) and ***NPO EGS*** (who build large deployable antennas) using photogrammetric, electronic tacheometric, multi-theodolite and laser scanning methods on a comparative basis. The most accurate data were obtained (i) using the Leica MTM multi-theodolite system and its AXYZ software package; and (ii) the Metric Vision MV260 laser scanner from Metris. However the use of the laser scanner significantly increases the speed of measurement and the degree of automation that is possible as compared with the method using multiple theodolites. Another paper that was also concerned with deformation measurements was that written by a team from Barcelona and presented by Michele Crosetto of the

Fig. 6 - A mobile laser scanning system based on a Riegl ground-based laser together with a supplementary GPS in use for city modelling in Moscow. (Source: Riegl)

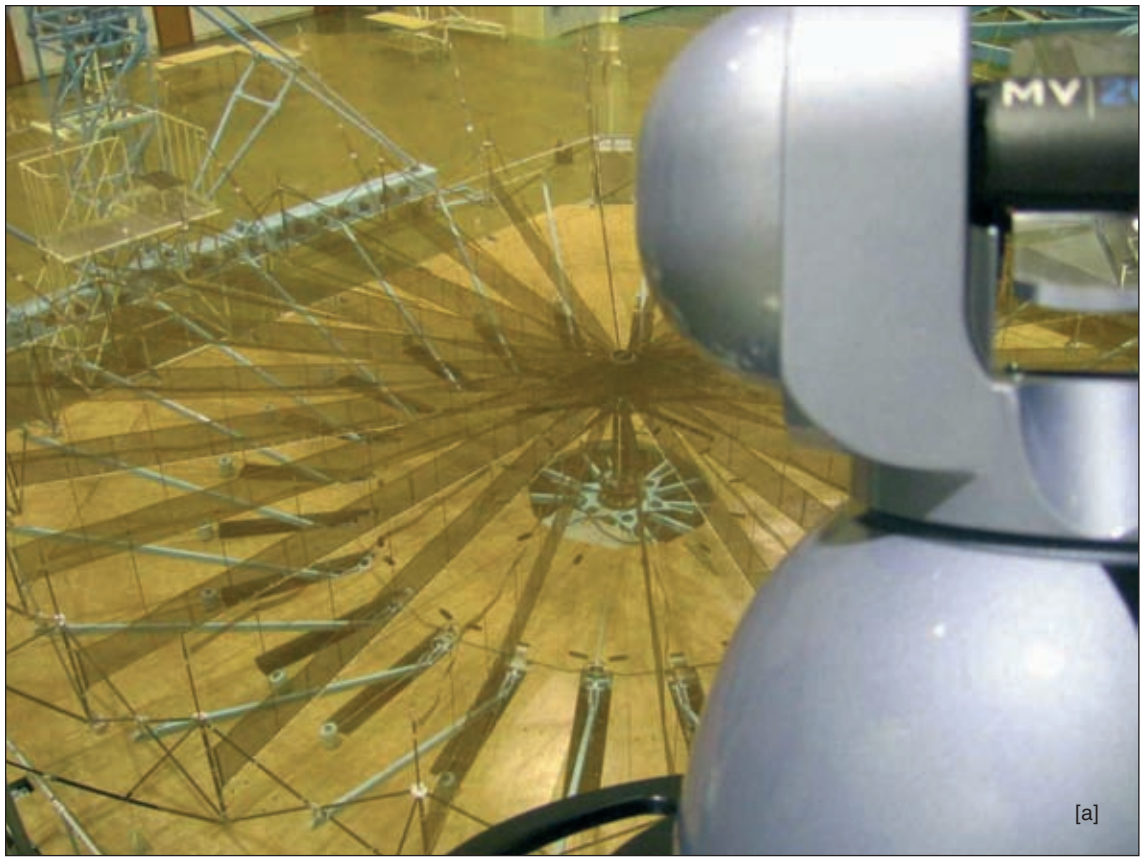
Institute of Geomatics in Catalonia. This involved the monitoring of the controlled and measured deformations of a test field of artificial targets using repeated scans with an Optech ILRIS 3D scanner and the analysis of the acquired data using surface matching software developed at the ETH, Zürich.

Then there was a paper from the ***Trest State Unitary Enterprise*** on the use of a Leica HDS3000 laser scanner to carry out surveys of existing buildings in the historic centre of St. Petersburg. These surveys had been carried out so that extensions to these historic buildings or new developments in their vicinity could be planned and undertaken within the strict regulations designed to conserve these important heritage sites. A final paper from a Czech contributor, Oleksandr Gorbyk, set out the experience gained from undertaking terrestrial laser scanning during the reconstruction and modernisation of electric power sub-stations. Taken altogether, these presentations on ground-based laser scanning combined to form a varied and interesting set of applications.

Conclusion

It was a really worthwhile meeting to attend, not least for the insight that it gave into the widespread adoption and varied applications of laser scanning technology within Russia.

Gordon Petrie is Emeritus Professor in the Dept. of Geographical & Earth Sciences of the University of Glasgow, Scotland, U.K. E-mail - g.petrie@ges.gla.ac.uk.



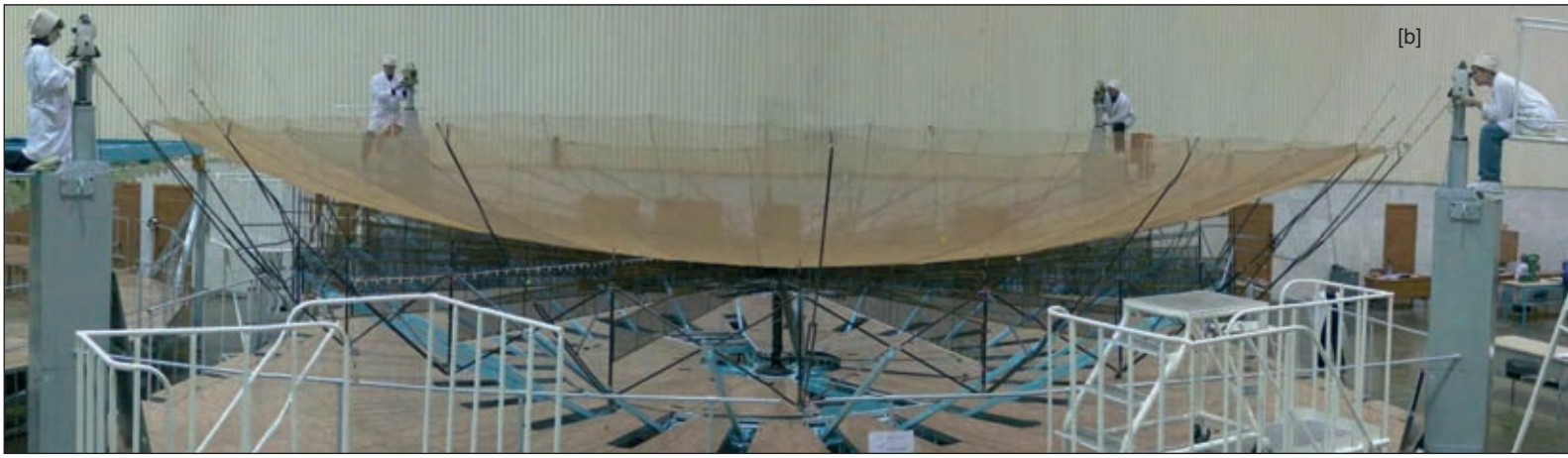


Fig. 7 (a) - This Leica MTM multiple theodolite system is being used to measure the surface of the Large Deployable Reflector (LDR) with its diameter of 12m that has been constructed by the Russian NPO EGS company for the European Space Agency. (b) - The measurement of the surface of the LDR mesh reflector is also being carried out using the Metric Vision MV260 laser scanner. (Source: BUM Techno)