## *Potentially a Strong Competitor in European Markets*

# Geokosmos

*With its recent active participation in various international conferences and in the Intergeo Trade Fairs, together with its prominent adverts in the trade press, the Geokosmos company from Russia has come increasingly to the notice of other European practitioners in photogrammetry and mapping - especially since the company has the potential to be a strong competitor within the European market for photogrammetric mapping, laser scanning and GIS services. Thus the publishers felt that it would be of interest to readers of GeoInformatics for them to acquire some information about the company and its professional activities. My participation in the recent conference on 'Laser Scanning & Digital Aerial Photography' held in Moscow provided the opportunity for me to gain some knowledge about the company and to pass it on to the readership.*

Gordon Petrie


***Fig. 1 (a)*** *- Sergey Melnikov, founder and president of the Geokosmos company.*
***(b)*** *- Peter Göllner, head of the Geokosmos international office based in Germany.*

## Background

Geokosmos is a privately owned Russian surveying and mapping company that was founded in Moscow in 1993 following the legalisation of the private sector in the former USSR. The president and main driving force in the company since its foundation has been Sergey Melnikov [Fig. 1(a)]. Originally he was a professional surveying engineer. After which, he held a lectureship in the Higher Geodesy Department of Moscow State University of Geodesy & Cartography (MIIGAiK). Under his leadership, Geokosmos has grown steadily in size and is now one of the leading companies in the commercial surveying and mapping sector within Russia and the CIS countries. Within Russia itself, Geokosmos has supplied its services to numerous companies in the oil and gas, electrical power and road and rail transport industries and to various organisations concerned with land management and urban development. Initially, after its foundation, the company was mainly involved in field surveying using GPS receivers and total stations. Then, from 1999 onwards, it started to use reflectorless (laser-based) total stations. A year or two later, it began to make use of airborne and ground-based laser scanners. In October 2002, the company formally established an aerial survey division, mainly based on the use of airborne laser scanners. Since then, the growth in the company has been rapid, indeed explosive. Currently it has a staff of 250 employees, a large number of whom are graduates of MIIGAiK.

## Equipment & Systems

Geokosmos is one of the larger operators of laser scanning equipment world-wide. Currently it operates five airborne laser scanners, all supplied by the Optech company from Canada [Fig. 2]. They comprise an ALTM-2050 model bought in 2001; three ALTM-3100 models bought from 2004 onwards; and one of the new ALTM-Gemini models ordered in 2006. Until 2005, Kodak DCS-760 small-format digital frame cameras were integrated with these Optech airborne scanner units. Since then, only Rollei AIC medium-format digital frame cameras have been used, the company now having six of these units in current operation. In February 2006, Geokosmos announced that it had purchased a Vexcel UltraCamD large-format airborne digital frame camera, the first of its type in Russia. It has already been used to acquire imagery of the cities of Nizhniy Novgorod (in Russia) and Wroclaw (in Poland) [Fig. 3]. On the terrestrial scanner side, Geokosmos operates various Riegl laser scanners, including the LMS-Z210, LMS-Z360i and LMS-Z420i models. For ground control and field surveys, Geokosmos deploys a large range of Trimble GPS receivers, total stations and data collectors.

To emphasize its commitment to these instrument and system suppliers, Geokosmos also acts as the official distributor for nearly all of these suppliers within Russia and the CIS countries, acting through two subsidiary companies founded in December 2004. These are ***Geolidar*** - which distributes Optech's airborne laser scanners and the Applanix POS GPS/IMU systems - and ***Geopolygon*** - which acts as the master distributor for Trimble's GPS and optical surveying instruments and has the exclusive right to distribute both the Riegl and Z+F terrestrial laser scanners within Russia. Besides which, Geopolygon also acts as the distributor for the hydrographic survey systems from Ohmex in the U.K.

## Evaluation of New Systems

At the recent Conference on Laser Scanning and Digital Aerial Photography held in Moscow, Dr. Kadnichansky, research director of Geokosmos, delivered two interesting papers that described the results of tests that the company has carried out with two new airborne imaging systems from Israel.


***Fig. 2 (a)*** *- A large Russian-built Mil-8 helicopter used as the platform for an Optech ALTM airborne laser scanner. In the foreground are the tripod-mounted antennas of the Trimble 5700 GPS receivers that are used as the ground-based stations for differential GPS positioning of the helicopter during its flight operations.*
***(b)*** *- The Optech ALTM airborne laser scanner mounted in the Mil-8 helicopter.*

(i) The first concerned the ***VisionMap*** system which generates its imagery using 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. Using photographs taken from a flying height of 3,520m with a ground sampled distance (GSD) of 0.125m, orthophotos were produced having a ground resolution of 0.15m. The planimetric (X,Y) accuracy of the final product, when checked against ground control points, was ±25cm when full airborne DGPS control was used and ±37cm when only airborne GPS control data was used. The resulting orthophotomosaic was reported to be of an excellent quality.

(ii) The second set of tests involved the ***MultiVision*** software system for use with oblique photography. Geokosmos 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. The tests evaluated the oblique image data for (a) the production of orthophotomosaics; and (b) the visual analysis of the oblique images. The flying height for the test was 800m and the ground sampled distances (GSD) on the resulting oblique images taken by the Rollei cameras varied from 11 to 20cm across the frame. The accuracy at the check points was ±0.39m (in X), ±0.34m (in Y) and ±0.46m (in Z). Using the elevation data measured by an ALTM 3100 lidar, a set of 3D city models was produced based on the oblique photos on which measurements of distance, height, area, etc. could be made with errors of less than 1m. Geokosmos has already adopted this oblique imaging system as part of its technology portfolio.

## Applications - Oil & Gas Industry

One of the biggest markets for the services offered by Geokosmos within Russia is the oil and gas industry. In particular, the company has been engaged in numerous projects concerned with the 3D mapping and modelling of gas and oil fields; the surveys and mapping of the enormous lengths of pipeline required to cross Russia; and the detailed surveys of the complex engineering structures associated with the industry. Detailed corridor surveys of pipelines have been undertaken both for engineering and for cadastral purposes, using airborne laser scanning and digital photography, usually on the basis of generating orthophoto mosaics and DEMs. For the large areas of terrain covered by oil and gas fields, systematic block coverage is carried out, again using the airborne lidar and digital photographic combination. The resulting orthophoto and DEM data is used as the basis for the design of new construction and development; to monitor existing structures and to carry out cadastral and land registration operations [Fig. 4]. Besides these operations based on airborne data, Geokosmos has undertaken numerous ground-based surveys to measure and model large and complex engineering structures such as compressors, separators and gas treatment plants as required for maintenance and management purposes [Fig. 5]. For these surveys, the company uses its terrestrial laser scanners and total stations. In July 2006, Geokosmos completed the largest mapping and GIS project carried out for the Russian gas industry. This covered an area of well over one million hectares in the gas fields of the Tyumen region in Western Siberia that are owned by Gazprom and the Urengaygazprom company. The region includes large areas of tundra and swamp land and experiences harsh environmental conditions with temperatures down to -30°C in winter. Once again the combination of airborne and terrestrial laser scanning allied to digital photography was used successfully to carry out the extensive land surveys and the modelling of the engineering structures that were required.

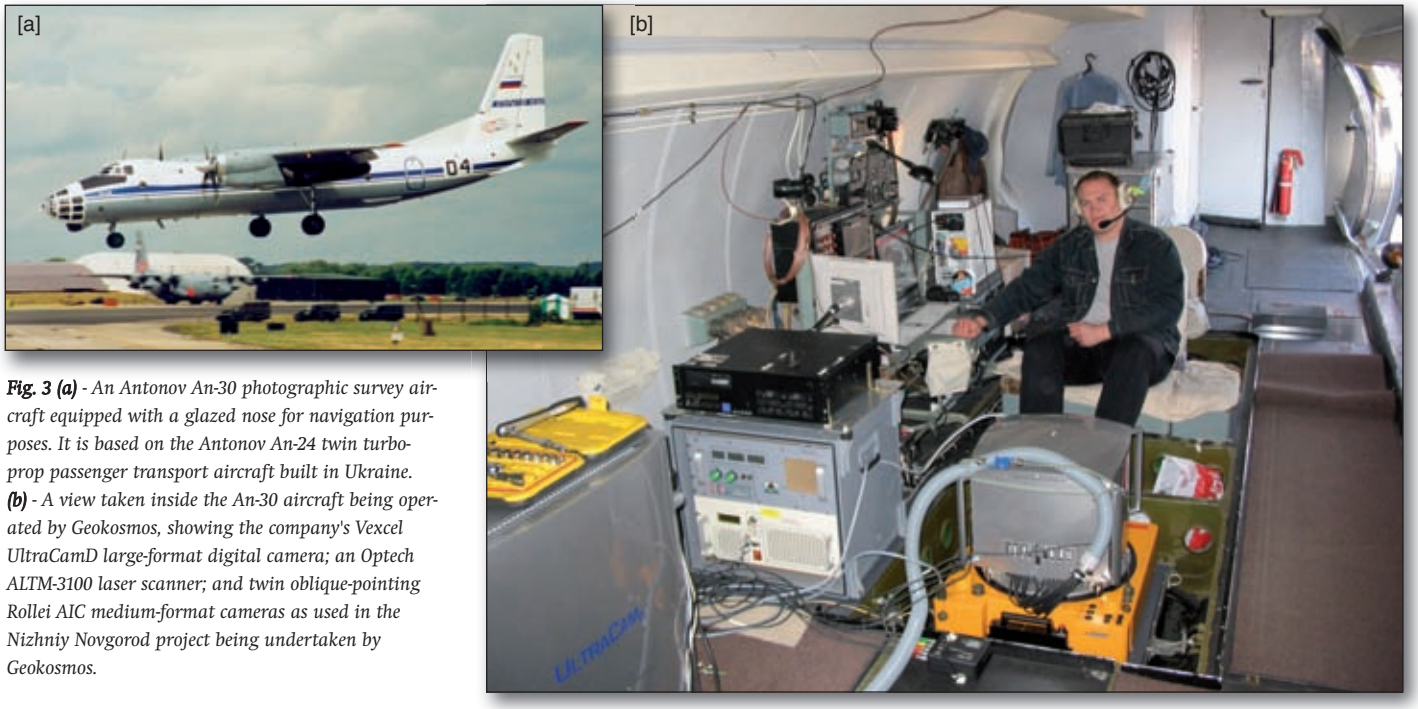


***Fig. 3 (a)*** *- An Antonov An-30 photographic survey aircraft equipped with a glazed nose for navigation purposes. It is based on the Antonov An-24 twin turboprop passenger transport aircraft built in Ukraine.*
***(b)*** *- A view taken inside the An-30 aircraft being operated by Geokosmos, showing the company's Vexcel UltraCamD large-format digital camera; an Optech ALTM-3100 laser scanner; and twin oblique-pointing Rollei AIC medium-format cameras as used in the Nizhniy Novgorod project being undertaken by Geokosmos.*

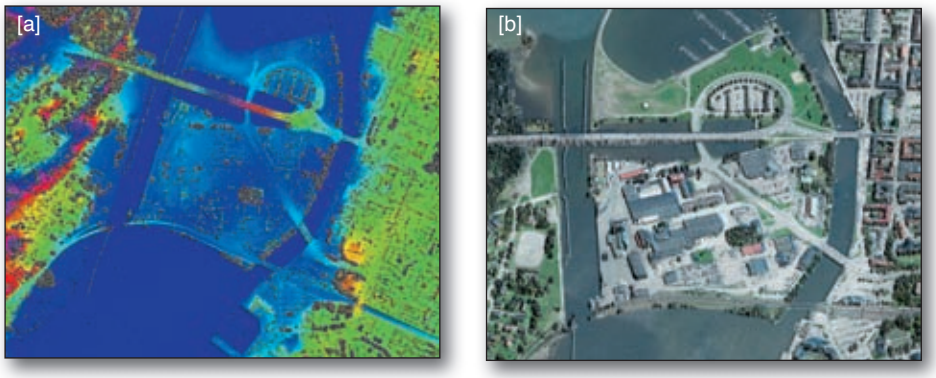


***Fig. 4 (a)*** *- A Digital Surface Model (DSM) of an urban area derived from airborne laser scanning data .*
***(b)*** *- The corresponding image of the same area formed by merging the elevation data of the DSM with the orthophoto image data collected simultaneously using a Rollei medium-format airborne digital frame camera.*

## Applications - Power Line Surveys

Another large market for Geokosmos is the survey of overhead power transmission lines. Again Geokosmos uses its integrated ALTM laser scanner and digital camera systems to conduct these surveys. For this particular application, the airborne laser scanner is normally mounted to point backwards at an angle of 20° against the direction of flight in order to pick up the detail that is required. The aircraft or helicopter will be flown at a low altitude - typically at 500m to give a swath width of 200m. The "first reflections" from the pulses emitted by the laser scanner will come from the towers/pylons/poles, conductors, strings of insulators, power line cables and vegetation foliage. The "last reflections" from the laser pulses will come from the terrain surface and the ground objects such as buildings and other structures. After the laser and image data has been acquired, the processing and analysis of the combined airborne laser scan and digital photographic data is carried out using the ***Altexis*** software developed in-house by Geokosmos. Besides the creation of orthophotos and DEMs for this particular application, the software carries out the modelling of the power transmission lines, including the determination of the elevations of the towers; the span lengths and sags of the overhead cables; their distances to the ground and surrounding vegetation; and all the other quantities and parameters that are of importance to power line engineers [Fig. 6]. Afterwards an analysis of the vegetation growing along the routes of the overhead power lines will be carried out with a view to initiating preventative work to avoid damage to the lines and possible outages. At the same time, any damage to towers and their foundations can be identified, located and assessed with a view to their repair or replacement. Using these techniques and procedures, Geokosmos has carried out extensive power line surveys for the Federal Grid Company RAO ES.

## Applications - Transport

Another obvious application area for Geokosmos's airborne technology is the mapping of the linear features - roads, railways, canals - and associated infrastructure forming the country's main transport network. In this respect, Geokosmos has undertaken a number of such projects, for example, producing maps, orthophotos and DEMs for existing and proposed highways in the Ural Mountains and for a proposed local railway running from the main Far East Railway to a new coalfield that is being opened up in Eastern Siberia.

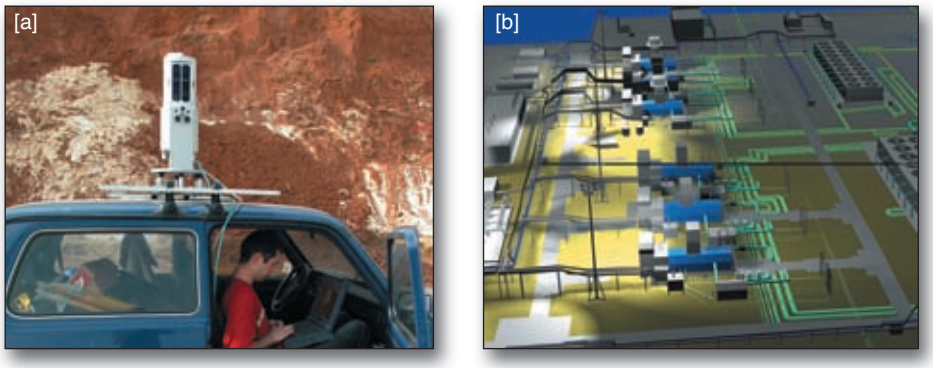


***Fig. 5 (a)*** *- A Riegl terrestrial laser scanner mounted on the roof rack of a car to form part of a mobile mapping system.*
***(b)*** *- A perspective 3D model of an oil and gas processing facility based on terrestrial laser scan data, together with its associated underground communications and pipeline networks.*

## European Initiatives

Outside Russia, Geokosmos has started to compete in the commercial mapping market in a substantial manner. It has set up an international office in Bad Soden in Germany, with Peter Göllner - who has had extensive prior experience with Leica, Trimble and Applanix - as its director [Fig. 1(b)]. The company has also opened another office in London that deals with the legal and financial matters related to its international activities. With regard to actual projects, in July 2006, Geokosmos, in partnership with two French organisations - IGN International (the international arm of the French national mapping organisation) and GeoMod (which is a GIS consultancy and solution provider) - won a large contract to create an information system for the gas pipeline network covering Kazakstan and the Central Asian countries of Uzbekistan, Kyrgyzstan and Turkmenistan that is being funded by the European Union. Under the contract, more than 5,000 km of gas pipelines will be surveyed and mapped and a suitable information system will be created to manage the supply of gas to the Central Asian region.

Another large contract that Geokosmos has won on a competitive basis is one to create three-dimensional models for the ten largest cities in Lithuania. Apparently the contract, which was awarded by the Lithuanian National Land Service, was won in competition with FM-Kartta (from Finland) and TerraImaging (from the Netherlands). At the opposite end of Europe, in July 2006, Geokosmos successfully completed a survey of the Guadalquivir River in Andalusia, Spain covering an area of 700 sq. km. For this project, the company used one of its ALTM-3100 airborne lidars in conjunction with a Rollei medium-format airborne digital camera. The resulting 3D digital terrain model is being used to plan preventative measures against flooding and create a GIS for water resource planning purposes [Fig. 7]. Geokosmos has also acted as a sub-contractor for various other European mapping contracts, for example, in projects undertaken in Denmark, France, Germany, Poland and Sweden. For these operations, normally a suitable aircraft or helicopter is hired locally and the appropriate equipment and personnel, including a small quality control team, are sent from Russia to the operational site abroad.

## G2B

Another interesting initiative of Geokosmos has been the formation of the G2B company in 2005 in partnership with Groupe FIT based in Nantes, France. The latter group includes the FIT-Conseil company that specializes in engineering and environmentally related projects; the FIT-Topo

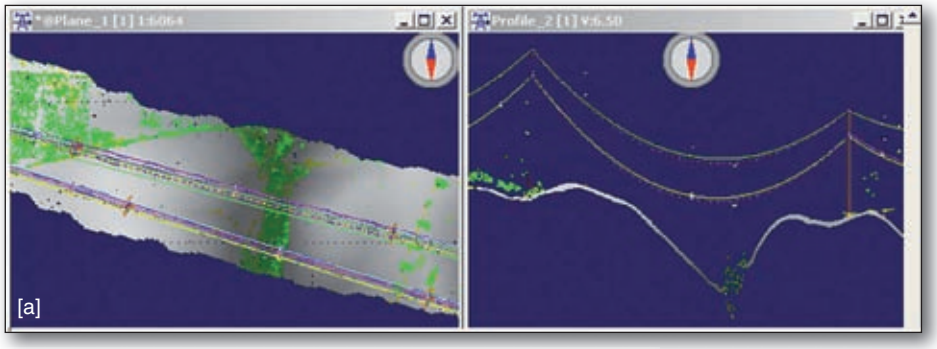



***Fig. 6 (a)*** *- Shown at left is a corridor image map giving the locations of a network of high-voltage overhead power lines, while at right is the corresponding profile of the lines showing the pylons and the catenary of the cables over the ground.*

***(b)*** *- A perspective 3D model of an electric power sub-station based on terrestrial laser scan data.*

company that is involved in photogrammetry, topographic mapping and engineering surveying; and the Memoris company that offers GIS consultancy and development services. To the G2B partnership, FIT contributes a Leica Geosystems ADS40 airborne pushbroom scanner that it purchased in May 2006 in partnership with Sintegra, another French surveying and mapping company. The two French companies operate the ADS40 through a subsidiary called GeoPhenix. Inspection of the G2B Web site (www.g2b-3d.com) and the company brochure shows that the company's business is aimed squarely at DTM and digital orthophoto production in France and the French speaking countries where Groupe FIT is already well established. Within this context, Geokosmos is acting as sub-contractor for some G2B projects, carrying out the survey operations and data processing (if necessary) using its own equipment and personnel.

## Japanese Initiative

Yet another international venture of Geokosmos has been the foundation (in July 2006) of a joint venture company in Japan, called ***Geokosmos Japan***, which is based in Toda City in the Saitama Prefecture. See the Web site - www.geokosmos.jp.

## An African Project

In June 2006, Geokosmos completed a mapping project in Ghana for the gold mining industry. This involved the survey of three large areas of the country using airborne lidar technology - in this case, conducted with one of Geokosmos's ALTM 3100 laser scanners equipped with an integrated IMU supplied by the French Sagem company. This survey has been carried out to provide the basis for the development and monitoring of the goldfields and their infrastructure.

## Conclusion

It is extremely interesting to observe the way in which the Geokosmos company has made extensive use of advanced Western technology such as laser scanners, digital cameras, GPS and total stations to overcome the very demanding conditions - extensive land areas, difficult terrain, huge distances and adverse climate - that face the surveying and mapping community within Russia. It will also be interesting to see to what extent the company can make use of its extensive and hard won experience to undertake surveying and mapping work outside Russia.

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***Fig. 7 (a)*** *- An orthophoto image showing a part of the valley of the Guadalquivir River in Andalusia, Spain produced from airborne digital frame images acquired by a Rollei AIC camera.*

***(b)*** *- A 3D perspective view of the same area produced by merging the orthophoto image data with the elevation data acquired by an Optech ALTM-3100 airborne laser scanner.*