REPORTER 48

The Magazine of Leica Geosystems

Leica Geosystems

One of the most dynamic and diverse fields in the world

"When the water level in the stream falls you can see the stones better!" We are currently going through a period when this ancient, fundamental insight can be applied to the assessment of economic situations. At the moment it is easier for us to see what foundations make up the streambed of the international flow of goods, people and information, and determine the shape of our environment and our society. When you also consider the landscape of many third-world and emerging markets, including those of the former Eastern Block, you notice the greatest advances in those countries where privately owned property is documented and legally protected. If, on the other hand, you go to the most attractive and popular metropolises in the world, the gravitational centers of future urban development, they are linked with modern concepts of spatially referenced information and geographical information systems. Geomatic know-how and surveying services form, in both cases, an important basis for the sustainable development of national economies, metropolises and our environment.

The precise recording of spatial reality and the continuous update of changes to it, including its visualization and administration in manageable models, are the core areas of competence of land surveying and geomatics. Thanks to the increasing importance of these services, geomatic engineers have become more and more central to modern administrative activity during the past decade. And this trend continues unbroken. In numerous national, regional, municipal and local authorities, at universities and in private planning offices, interdisciplinary networks are being formed, grouped as specialist spheres that surround the core competence of spatial information.

Even the planning, optimization and restructuring of the reality documented in the GIS models make use of these geomatic technologies. Infrastructure planners are increasingly deriving their data seamlessly from such systems, up to and including direct spatial control of machinery. Today geomatics is not merely a central foundation for the sustainable development of our environment, but it now also represents one of the most dynamic and diverse fields in the world.

In this issue of the Reporter you will find more reports from various continents. Geomatic engineers appreciate the fact that Leica Geosystems offers the broadest spectrum of solutions in this field – and thus use Leica Geosystems' solutions more and more widely. Here too, geomatic engineers are now in a better position to recognize the stones upon which we will be able to confidently stand in the future.

Hans Hess
CEO Leica Geosystems

Contact

You can find Leica Geosystems at numerous exhibitions, congresses and road show presentations in your region. In addition, you can find information and documentation on our national websites or on www.leica-geosystems.com, www.cyra.com, www.disto.com, www.gis.leica-geosystems.com, and www.construction.leica-geosystems.com. Please visit us.

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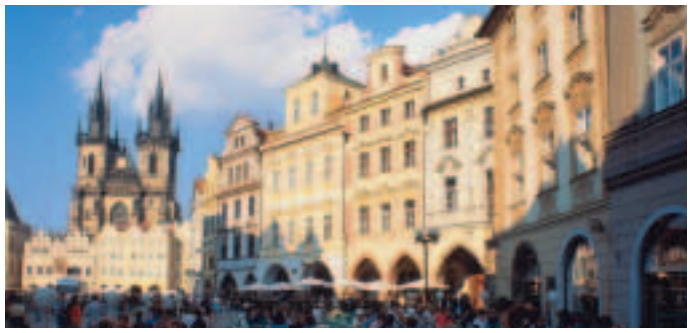

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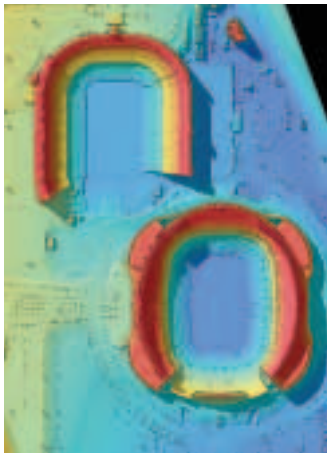

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Prague underground tunnels crossing the Vlatava River

The project for the construction of tunnels as part of the new extension of Prague's Underground was faced with certain space limitations due to the location of an existing station. In addition, the particularly rough terrain in the area had considerable influence on the position of the planned station. At the place of crossing, the line is located at a depth of only one metre under the riverbed of the Vlatava. This minimal depth of the overlaying formation prevents the use of the tunnelling method, and therefore there remains only one "classical" method of construction – cofferdams. It was decided to use three cofferdams for the tunnel crossing situated in the Vlatava stream channel. This method is, however, very time-consuming and expensive, and would cause considerable hindrance to river transport, and even possibly damage to the works by flooding. Considering these facts, the general building contractor Metrostav Co. proposed an alternative approach – the so-called immersed tunnel launching.

Panel for controlling the total stations TCRA 1101 X Range with graphic output of the readings and deviations of followed points from designed path.

The principle of the immersed tunnel launching method

The Underground line under the Vlatava riverbed passes through two tunnels with horizontal and vertical curvatures. The basic principle of the technique consists of pre-casting the tunnels in an open pit – the "dry dock". On one bank of the river, this pit is separated from the river by means of steel sheet piling. In the riverbed, a channel is dredged, into which the tunnel body is launched. The tunnel body is closed by steel lids and after immersion it is balanced with the help of a system of interconnected water tanks, and placed within the tunnel allowing for selective flooding. Using two hydraulic stations on the opposite bank, the tunnel body is pulled and thereby launched. The third station is placed on the bank of the dry dock, and acts as a brake if necessary. The rear part of the tunnel is provided with steel skids and moves on concrete strips; lateral movement is limited by means of steel profiles. The front part of the tunnel body is suspended with cable slings from a pontoon, the height of which can be changed. When the launch is complete, the tunnel body is anchored to the concrete strips within the excavated channel in the riverbed. The bottom of the tunnel is separated from the subsoil by means of textile bags, which are filled under pressure with concrete mix. The tunnel is additionally anchored with micropiles and the excavated soil is used for backfill.

Surveying work

Following the realisation of this method, great attention was paid to the surveying work, as the slightest inaccuracy of measurements would have an undesirable effect on the very principle of the technology. To minimize these undesirable influences, a micro-network was proposed in the area of the site, with permanent deep marking of points with forced centering. The surveying of the micro-network points was followed by the calculation of the three-dimensional coordinates of the points, which were invariable for the whole period of construction of the tunnel.

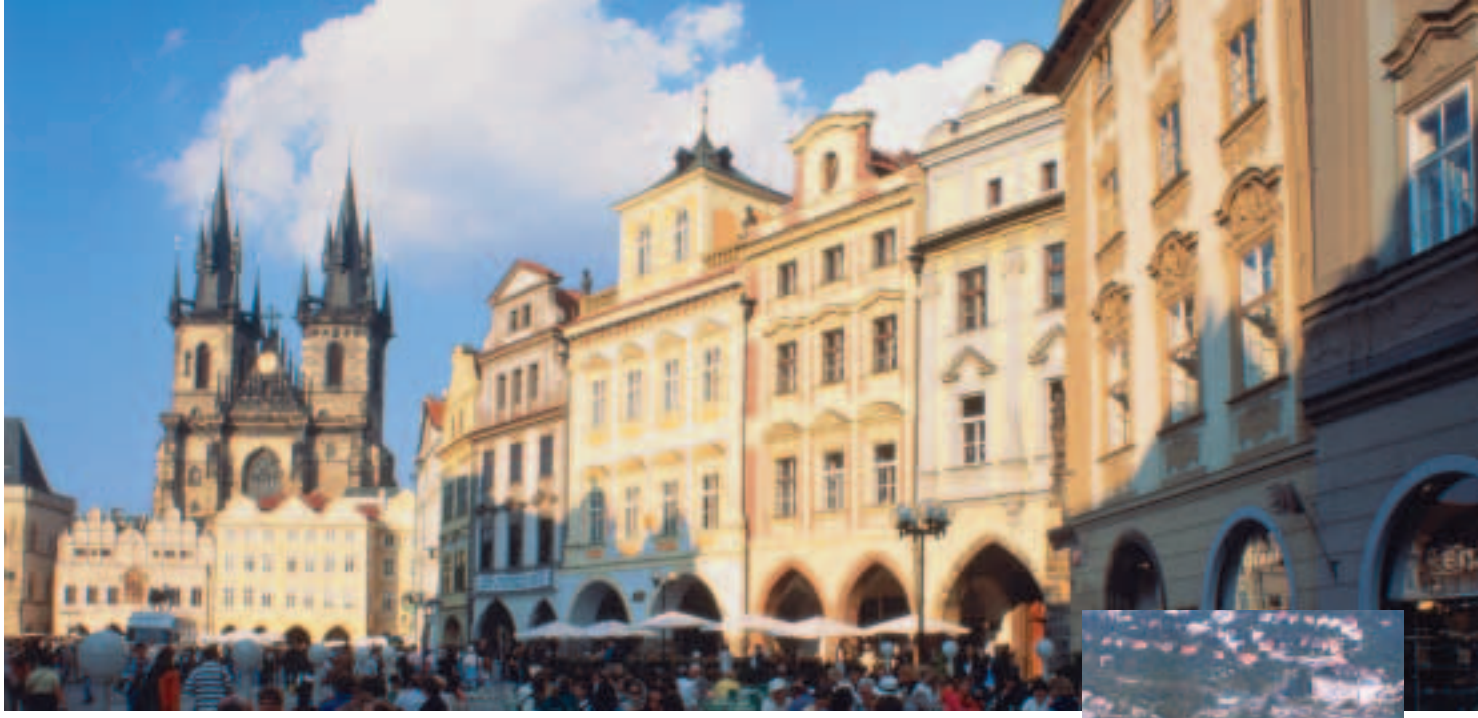
Surveying work during pre-casting of the tunnel in the "dry dock"

The surveying technology must secure the following:

- Staking out and survey of the three-dimensional position of the concrete soles;
- Survey of the three-dimensional position of the sliding formwork;
- Survey of as-built body of the underground tunnel;
- Calculation of the volume of the tunnel body and comparison with the design (special software was developed for this);
- Calculation of the mass of the tunnel body on the basis of the volume weight of samples of used concrete mix;
- Calculation of the volume of displaced water;
- Calculation of the coordinates of the centres of gravity of the segments;
- Determination of three-dimensional coordinates of the centers of reflection prisms mounted on steel structures in the front and central part of the tunnel body

Surveying work during the launching of the tunnel body

The basic requirement during the launch of the tunnel body was to create conditions for the conti-



nuous measurement and calculation of the three-dimensional coordinates of the points in the front and rear parts of the tunnel. It was also necessary to immediately evaluate deviations from the designed path; a difficult task especially when the bottom of the launched tunnel body was about 13 metres below the water level. The basis of the measuring system was two motorised total stations with a laser distance meter TCRA 1101 X RANGE connected on line to the computer and controlling system equipped with specially developed SW. During the monitoring and evaluation of the changes in the three-dimensional position of the launched tunnel, the influence of human factors was entirely eliminated. The measuring interval was set at 2 seconds, which at maximum displacement speed, represents an advance of two centimeters. The movement of the front part of the tunnel was independently followed and evaluated in the classical manner with a total station TCA 1102, and at the same time the transversal tilt of the tunnel was measured and evaluated.

During the launching, the number of measurements taken was
- 7907 in the front part of the tunnel
- 6668 in the rear part of the tunnel

The medium deviation of the followed point from the designed path was
- in the front part of the tunnel: P 0.012 m
- in the rear part of the tunnel: P 0.015 m

The final deviation of the tunnel axis (at the front of the tunnel) as against the design was P 0.004 m.

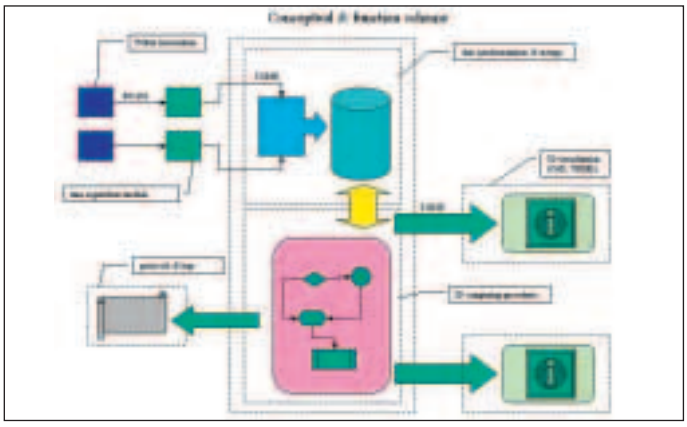


Diagram of the measuring and computing centre

Conclusion

The whole technological process of the construction of the tunnel and its launch into the desired position was undertaken without major problems, and accomplished with high quality. The proposed automated system of measuring and evaluating fully complied with the requirements established by the design, even though this unique technology was used for the first time in the world. Because the results of the measurements and evaluation were available on a continuous basis, it was possible to proceed and immediately correct the path and thus prevent the "oscillation" of the system. Justified praise goes to the total stations used, the TCRA 1101 X RANGE and TCA 1102, which contributed substantially to the successful accomplishment of the project, confirming their highly professional reputation. Following the success of this technology for tunnel construction and launch into the designed position, it will be used again without substantial changes in the construction of the second tunnel.

Dipl. Ing. Jaroslav Pohan,
CCE Prague, Ltd.

Aerial picture of a dry dock with concreted tunnel: (1) measuring and computer centre (2) station for centre independent control (3) construction ditch for fixing of the tunnel after transport.

Tunnel Facts:

Length of the tunnel:
168 m
Mass of the tunnel:
approx. 7 000 tonnes
External dimensions:
6.48 x 6.48 m
Thickness of walls:
730 mm
Thickness of top and bottom:
700 mm
Radius of horizontal curvature:
750 m
Radius of vertical curvature:
3800 m

Staying a step ahead on the construction site with the new DISTO hand-held laser distance meter

"Anyone who has performed measurements just once using a Disto hand-held laser meter, will always leave the trundle wheel and folding rulers back at home in future. And the same goes for a ladder and a second person to hold the other end of the tape measure or to steady the ladder," says Franz Noser. Using his Disto™ hand-held laser meter, Mr. Noser, a façade construction project manager of the Bern-based company Gesta, calculates all the necessary dimensions, areas and volumes at the press of a button.

This means that he works a great deal faster, more accurately and reliably as well as more cost-efficiently than when using conventional solutions – whether this be for drafting his quotes, construction plans, lists of materials, cutting to size, planning and inspections or for billing purposes. In recent years, these advantages have helped make these compact and handy laser distance meters from Leica Geosystems become one of the fastest growing categories of tools in the building and ancillary building trade.

Franz Noser is one of an ever-growing number of construction experts who save themselves a lot of time each day by using their compact Disto laser distance meter: "Before I owned a Disto, I always had to take a ladder along with me whenever I wanted to measure the dimensions of a façade. In most cases, a colleague would also have to accompany me in order to hold the other end of the tape measure. Occasionally, our almost acrobatic 'up-ladder escapades' when measuring high buildings were not only dangerous but also, to be quite honest, not even very precise due to the sagging tape measures or slightly bent and swaying folding rulers. In future, such inaccuracies will be tolerated even less. The Disto makes light work out of measurement tasks such as these – simply aim, shoot and measure. Anyone can do this straight away!"

At the press of a button and with a precision of 1.5 millimeters, Franz Noser from Gesta AG uses his Leica Disto pro⁴a to check the spacings of the finished façade on an over 200-meter-long building complex "Baumgarten" in Bern.

"Paid for itself in just one day!"

Franz Noser estimates that, thanks to his Leica Disto, he now saves himself an average of 15 minutes each day performing a wide range of measurement tasks, while his dimensional measurements are significantly more accurate than before. Thanks to the fact that his Disto measurements are precise to the last millimeter, it is now possible to prepare material and components from the outset to provide a better fit, thereby allowing work to be performed more swiftly, avoiding costly and time-consuming reworking and

The heart of the laser measuring technology

Each compact Disto comprises a miniaturized optoelectronic wonder of modern technology. It is based on the company's experience in laser measuring technology which is the longest in the world and which Leica Geosystems developed 35 years ago for professional measurement. This has since been further developed with leading innovations in pin-point precision distance measurement, laser tracking and laser scanning.
By way of illustration, the Leica Disto performs numerous individual measurements in a split-second, from which it calculates the precise average value. The distance is measured by means of light pulses, whose travel time over the distance to be measured is determined with the aid of a quartz crystal and which thus permits a direct conversion into the distance. Since the motion of the light pulse and thus its speed is influenced by various environmental factors, the Disto hand-held laser meters use advanced software when averaging the measured values to automatically take account of numerous parameters, such as the room temperature, brightness and target surface reflection. The "Disto pro⁴a" model supplies the distances accurate from 1.5 millimeters, and the other models accurate from three millimeters up to a distance of 200 meters. The Disto hand-held laser meters are energy-saving and constant, with a single battery charge lasting for up to ten thousand measurements!

Gesta AG used Disto measuring technology to erect 5000 square meters of carmine red, enameled glass façade cladding to provide both protection and an attractive appearance for the new service building "Baumgarten" in Bern commissioned by the general contractor Losinger Construction AG. Althaus Architekten Bern AG designed this aesthetically pleasing architectural service complex situated directly on Bern's east orbital highway for the client Winterthur Versicherungen insurance company.

bills to be drafted more reliably. This is also particularly true for conversion and renovation work, where frequently no plans are available or where plans that do exist no longer correspond to the buildings current state due to a long history of modifications. When recording measurements for a schoolhouse renovation project, for instance, Franz Noser recently used his new Disto hand-held laser meter to record all the necessary dimensions entirely on his own in only three hours. Without Disto, he and his colleague would have required almost an entire day using a trundle wheel and folding ruler for such an extensive measurement task. The façade surveyor said: "My Disto paid for itself in a single day. I have been making money with it ever since!"

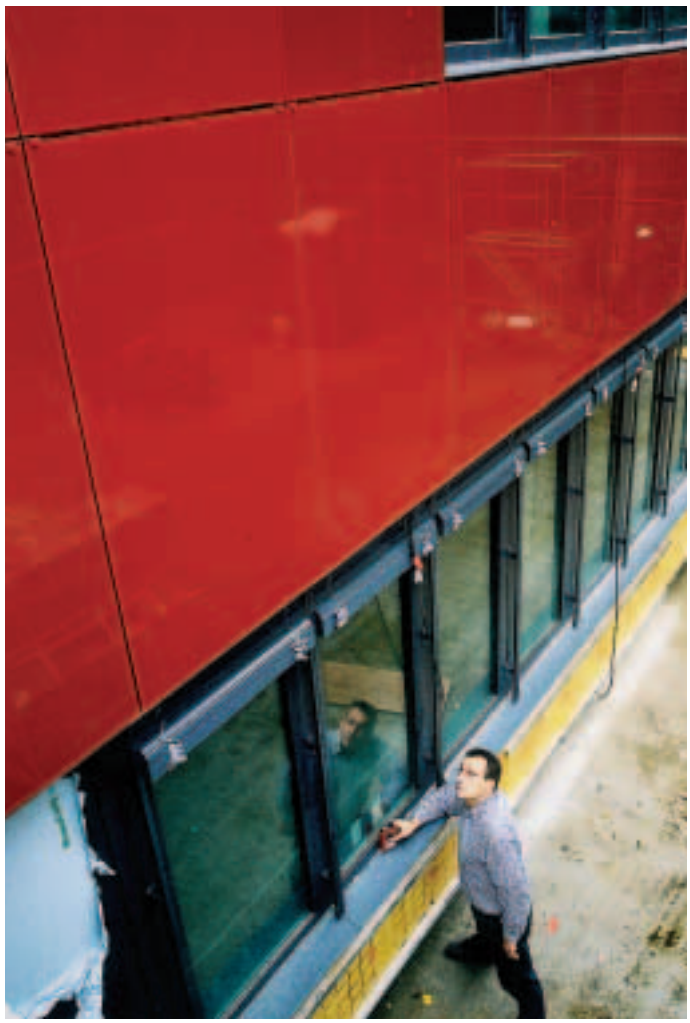
A modern measuring tool for numerous tasks

These distinct advantages are what make these compact Disto hand-held laser meters so popular among architects and interior design specialists, painters and decorators, metalwork fitters and glaziers, joiners and plumbers, floor layers and roofers, electricians and sanitary specialists – and of course among construction site foremen and property managers. They make an ideal Christmas or birthday present for any handyman or DIY enthusiast.

Fifth device generation with easy-to-use controls

"With the fifth Disto generation just launched, we will assert our number one position as the market leader and convince also new customers," says Klaus Brammertz, President of the Consumer Products Division of Leica Geosystems. "Today, following the reorganization of the sales structure for the Leica Disto hand-held laser meters, we have more sales outlets than a year ago and have succeeded in tapping into new sales channels in major markets such as the U.S." The reasons for expected higher sales figures are also due to the fact that the development engineers at Leica Geosystems in Heerbrugg (Switzerland) have – in launching the fifth device generation of the Disto hand-held laser meters – once again enhanced the controls, the weight, the range and the measuring durations. This renders the devices even more attractive for everyone thanks to their easy-to-use control keys. In addition to the new range of between 20 cm and 200 m with a degree of precision displayed accurately to the last millimeter, the devices of the fifth generation excel above all due to their clearly defined function keys and their clear-cut assignment. It is possible to read off the

"For measurement tasks where I once had to run up and down steps and mostly had to bring another man and a ladder with me, I now simply pull out my Disto laser meter. The new Disto models are even easier to use. Each of our construction crews is now issued with this measuring device," says Franz Noser of Gesta AG in Zollikofen.



Does the length of the building correspond precisely with the plan and our façade sub-framework? Prior to fitting the bottom row of enameled glass panes, Franz Noser of Gesta AG uses a Leica Disto lite[5] to check the distances quickly and accurate to the millimeter.

distance in clear digits in less than one split-second after pressing the key.

Strong DISTO position

The first hand-held laser meter in the world – the Leica Disto classic – was launched onto the market in small numbers by Leica Geosystems in the mid-nineties on the basis of the manufacturing principle of small-batch instrument construction. The now launched fifth generation is produced in large batches at a factory that has international experience in large-scale production and logistics of electronic commodities and consumer goods. The inventor Leica Geosystems is the clear market leader.

In Klaus Brammertz's words: "It's like this – in just the same way as Franz Noser, no-one in the building trade today wants to be without this clever and high-speed laser-measuring tool. And this is why it is important for the trusted supplier to include hand-held laser meters in his line. Via our distribution network, we ourselves offer four Disto models with differing features for different ranges of tasks." The features of the fifth Disto generation also impress Franz Noser, particularly their clear user controls: "I'm sticking with my Disto pro[4]a due to the 1.5-mm degree of precision. However, for my construction crews, I have already bought the new Disto lite[5] featuring a Soft-Touch keypad and clear function keys."

Stfi

Measuring using a Disto hand-held laser meter is:

Fast and efficient: Measure in a split-second at the press of a button without the assistance of another person, and save time and money at the same time.

Accurate: Measures distances up to 200 m accurate to the millimeter.

Reliable: Robust and suitable for use on building sites in temperature ranges of –10° to +50°C.

Versatile: Suitable for both indoor and outdoor use.

Safe: Leica Disto helps prevent accidents at work, i.e. no need to climb ladders.

Klaus Brammertz, President of the Consumer Products Division of Leica Geosystems: "Our Disto models makes it attractive and easy for everybody to use laser accuracy for his measuring work."

New PowerSearch sensor for Leica TPS1100 ...

Automatic, practical programs are the main features of the TPS1100 Professional Series. Modern functions that make working more productive, more precise and more relaxed. Now the new PowerSearch sensor for the TPS1100 features a quick and reliable prism search, which sets new standards for robotic surveying.

In PowerSearch mode, the instrument rotates around the standing axis and sends out a vertical laser fan. As soon as it finds a prism, the instrument stops rotating, and automatically targets the prism, even if there are brief interruptions of the line-of-sight. The total station is then ready to measure.

The entire prism search only requires a few seconds, thus representing a significant time saving in initial prism search and resumption of automatic target tracking after interruptions. With PowerSearch, overall productivity is increased significantly, making it ideal for stake out, topographical surveying and especially for one-man operation with the remote control RCS1100.

The entire PowerSearch sensor is integrated neatly into the total station and this unique technology allows working with any passive prisms. Consequently, no active prisms or additional accessories are required. The TPS1100 Professional Series with PowerSearch

... automatically finds the prism

offers everything surveyors can demand from a surveying instrument: A lightweight practical design, an easy-to-learn user interface, a wide range of practical application programs, a highly accurate reflectorless distance measurement, a powerful automatic target recognition, and an efficient one-man operation.

Leica DIGI – providing fast, safe and accurate tracking of buried objects

You're on the job site and you want to start digging as soon as you can, but you're unsure of what is underground. You don't want to wait for the line inspector, and you don't want to incur the expense, either. The solution: Leica Geosystems' DIGI™ Underground Service Location System, providing a fast, safe and accurate solution for tracing buried utility services.

Today's industrialized areas are populated with some very dangerous or at the very least troublesome utility services buried underground. The main DIGI™ System comprises of the DIGICAT™ 100 underground service locator, DIGITEX™ 8/33 signal generator and DIGITRACE™ 30, 50 or 80 service tracer. With this integrated system, locating underground cables and pipes becomes a secure, simple and speedy task.

DIGICAT™ 100 utilizes three detection modes: Power to locate energized power cables up to 3m deep; Radio to locate metallic services which radiate radio waves; and Generator to locate tracer information generated by the DIGITEX™ 8/33 in inactive power cables and other services.

The DIGI™ System allows fast and accurate location of underground services. The tools are rugged, easy to operate, efficient and increase onsite safety for any excavation job.

The DIGITEX™ 8/33 is a dual frequency generator for maximum flexibility giving highly accurate results.

The DIGITRACE™ 30/50/80 is a coiled 4.5 mm diameter fibreglass rod on a reel, which incorporates a copper wire. The wire is connected to a DIGITEX™ Signal Generator to pass a 33 or 8 kHz traceable signal either through the entire length of the rod or just the end. This is used in tracing non-metallic pipes, such as drains or sewers, plastic pipes, plastic ducting etc.

Earth moving made easy task by intelligent dozer

Moving earth is a fact of life in mining and construction – a painstaking and time-consuming task. Leica Geosystems, in partnership with Tritronics (Australia) Pty Ltd and assisted by their Australian Distributor, C.R. Kennedy & Company Pty Ltd, however, have developed just the solution – the Leica DOZER 2000T. Without even stepping out of the office, the mining engineer and surveyor have direct radio contact with the machine operator who is working with the bulldozer. Digital Terrain Models (DTM) are relayed directly to the machine, guiding and verifying earth grading by real time GPS and completing this task more efficiently, in less time, and with considerable savings across the entire project.

The success of a recent trial by mining giant BMA (BHP Billiton Mitsubishi Alliance) at their Blackwater coal mine in Queensland, Australia, has led to an order of 15 Leica Dozer 2000T integrated systems for the Blackwater Mine. A further 19 units have been ordered for three other mines within the BMA operation – a significant sign of the considerable potential that this revolutionary technology has for the industry.

The Leica Dozer 2000T guides and verifies earth-grading by real time GPS.

For some time, BMA have wanted to improve the process of relaying instructions from the office to the various machine operators on site. After an assessment of all dozer systems on the market, BMA approached Leica Geosystems at the end of 1999 to further investigate the Leica Dozer 2000 machine guidance package.

It was decided to trial the Leica Dozer 2000 package at BMA's Blackwater Mine. Using Global Positioning System (GPS) technology, the Leica Dozer 2000 is able to clearly indicate the position of the earth moving machine relative to the desired "design" surface, enabling the operator to move left or right, and to cut and/or fill accordingly.

Better data transfer and integration

Although the Leica Dozer 2000 worked well during the trial, there was still a requirement for better data transfer. "In particular we were looking for productivity improvement because at that stage there was no way to bring data back to the office automatically," said Ian Rogers, Technology and Communications Manager for BMA. The normal Leica Dozer 2000 setup meant that data had to be transferred via a PCMCIA card from the office computer to the on-site machine.

"BMA wanted to simplify the radio networks and obtain the production data in real time," David Williams from Leica's Australian Distributor, C. R. Kennedy & Company Pty Ltd said. "The Leica Dozer 2000 is a stand alone system as the memory card needs to be returned back to mine office for transferral of data. On a mine that stretches 64km, this can be very time consuming."

Integrated Mining System

In February 2001, BMA introduced Leica Sales Representatives to Queensland Company Tritronics (Australia) Pty Ltd, world leaders in the design, development and installation of mine machine monitoring and information systems.

For the past six years, the Blackwater Mine has been using Tritronics' Fleet Management System – a communications network that allows mine production to monitor machinery throughout the whole mine by use of GPS receivers. BMA has invested significantly into this system with the upgrade of 75-80 pieces of equipment with new high-speed radios in order to incorporate them into the new system software Integrated Mining System (IMS). The IMS combines powerful reporting and analysis software with reliable radio telemetry to deliver accurate monitoring and reporting. "Tritronics were well established and well trusted," Anders Mangen, C. R. Kennedy's National Survey Division Manager, said. "They had proven to BMA that they could deliver a good system – particularly for a complicated big mine like the one at Blackwater."

"With the IMS system we can locate drills, water trucks and other vehicles over the entire 64km mine strip on a computer back in the office," BMA surveyor Brad Payne said. "Information such as the job description, production statistics and current machine operator can also be provided."

Following discussions with Tritronics, it was decided to incorporate the Leica Dozer 2000 package into the Tritronics Integrated Mining System.

"We were asked to do the integration between the GPS systems and the data telemetry system and also to connect the dozer into the reporting system," said Geoff Baldwin, Manager of Tritronics. "It wasn't overly complicated. The biggest problem was the file transfer system – ensuring that large files can be transmitted over the radio system. This is especially difficult when there are often breaks in transmission such as when the dozer is turned off during a download."

Productivity, security and savings

Consequently, over the last six months BMA Blackwater has been trialling the Leica Dozer 2000T integrated system – which has opened up a radio link, providing the engineer with direct contact by radio to the machine operator and allowing complete computer designs in the office to be sent directly out to the dozer.

The integration of the IMS and Leica Dozer 2000 has demonstrated a considerable increase in productivity. According to Ian Rogers, the company envisages considerable savings. "We believe the trial showed some productivity gains and though it's hard to say how much at this stage, we are looking for pay back from the system within three years."

Most of these savings are generated by eliminating the need for survey staking and reducing the re-handling of spoil.

For Operators such as Les "Pfeffy" Pfeff, the Leica Dozer 2000T has made the job easier. "It's a lot easier to do the job now because you follow a plan," he said. As

The GPS Base station transmits data to the Rover.

The cab holds a ruggedised touch-screen computer.

The bulldozer operator is in direct contact with the office.

Mine design software is used to provide details of cut and fill.

Leica Dozer 2000

The Leica Dozer 2000 combines a Machine Guidance Global Positioning System (GPS) receiver with Computer Aided Design (CAD) software, to allow determination of the exact position of the vehicle in "real time". A screen display in the cab clearly indicates the position of the earth moving machine relative to the desired "design" surface, enabling the operator to move left or right, and to cut and fill accordingly.

For high accuracy, a GPS Base Station is established on site, consisting of a GPS receiver and radio transmitter to transmit differential GPS signals to any number of rovers within 10km range. The Rover is mounted on the Dozer, consisting of a GPS receiver (Leica MC500), a ruggedised touch-screen computer loaded with the Leica Dozer 2000 software, and a radio receiver. The radio receives the GPS data transmitted from the Base Station where it is processed in the Rover GPS receiver, displaying the position of the machine on the Computer.

Once operating, the Rover GPS receiver measures the grade 10 times per second and the Leica Dozer 2000 software displays cut and fill amounts along with views of the dozer.

In the office, surveyors and engineers need to prepare data files to the Leica Dozer 2000. Mine design software (such as Vulcan) is used to create these files with text of final design plans detailing the cut and fill from a design surface. In addition, the location of equipment relative to existing features (buildings, existing roads, bridges etc), calculation of the offset from a road centreline and the volume of earth that has been moved during each work period can be provided. The 'Leica Site Manager' then enables the conversion of these files to configure the Leica Dozer 2000. The information is then ready to be transferred from the office computer to the site computer and back again.

The Leica Dozer 2000 product can be purchased as a standard Leica Dozer 2000 stand-alone system with data transfer via a PCMCIA card, or it can be purchased as the Dozer 2000T system integrated into the Tritronics IMS system. The Leica Dozer 2000 system was introduced to the market by Leica Geosystems, in cooperation with Carlson Software.

The Rover GPS radio receiver is mounted on top of the Dozer.

The Leica Dozer 2000T communications components are mounted outside the cab.

Surveyor Brad Payne: "Now we get it right the first time – there is no cause for errors."

for training and operation, Pfeffy said that it really is just a matter of pushing the buttons on the touch screen. "You haven't got to be a whiz kid to understand this sort of thing."

Work is also safer, especially at night when visibility is poor. There is now less need for the operator to get down from the cab to check the equipment or stakes. The Leica Dozer 2000T also provides a warning alert when the design plan is not being followed correctly.

"Here on the mine its just lots of dirt and as quick as you can," Bevan Reibel, Senior Stripping Foreman said. "However, near enough is not good enough – by doing it accurately the first time, it is quicker because there is no re-handle and re-work. This system gives live information and therefore it is an aid in the machine to help the operator to do his job."

"Ultimately this allows the operators to feel more in control," Andy Davidson, Engineer for the Business Improvement Group said. "Information between shifts is shared, promoting more efficient work towards a common goal and eliminating time wasting. We are empowering operators to do their job better, and with million dollar equipment involved, involving the operators is a crucial part of adding value to the process."

Brad Payne was also keen to highlight the productivity saving during the re-grading of roads. "The slope of a grade is really important – and it is best for the machines to stay in second gear to get up the hill, otherwise the transmission is strained. In the past, to re-grade a road we used to have to work five to six hours on the weekend just to build up the ramp and get it right. Now we get it right the first time – there is no cause for errors."

Operator Les "Pfeffy" Pfeff: "The Dozer 2000T has made the job easier. It's just a matter of pushing the buttons on the touch-screen."

Working smart will also save machinery from wear-and-tear as well as reduce maintenance and fuel costs.

There have also been discussions to install the device in the supervisor's vehicle. "There is no reason why this won't work," Bevan Reibel said. "We could then just drive up and check the shovel for grade control. Inspection vehicles are becoming just as important as the dozer."

The future looks extremely bright for the Leica Dozer 2000T following the order of a total of 15 of the systems for the Blackwater mine, making it the largest single sale of the Leica Dozer 2000T to any single mine in the world. These will be fitted to six dragline dozers, four stripping dozers, two mining dozers, two pre-strip dozers and one dragline assist dozer and were implemented during July and August. Another eleven have been ordered for the Peak Downs mine, six for the Saraji mine, and two for the Goonyella mine.

"Ultimately, this is part of a larger program," said Andy Davidson. "The Leica Dozer package is a key element of our long-term success strategy. Demonstrating real benefits from machine guidance technology promotes acceptance, which ultimately starts to change the culture of the business. This is a classic example of working smarter – not harder. You have to do different things, to get different results."

And Tritronic's Geoff Baldwin considers the Leica Dozer 2000T project as the beginning of a long partnership with Leica Geosystems. "We are looking to forge a tighter alliance with Leica Geosystems and hope to promote the use of GPS-based guidance products in the mining industry long into the future." ***Bt***

Blackwater coal mine

The BMA Blackwater coal mine produces up to 14 million tonnes of coking and thermal coal per year and has been operating for over 35 years. As an open-cut operation, draglines and truck/shovel fleets are used for overburden removal and coal seams are mined by front-end loaders or hydraulic excavators.

Website:
http://bmacoal.com/bccom/export/operations/blackwater/index.html

Leica Geosystems' technology for the cadastre in Guatemala

Guatemala signed a comprehensive Peace Accord on 29 December 1996 to end thirty-six years of civil conflict. The Accord supports the establishment of democracy and the introduction of economic policies that will foster sustainable growth. The promise of peace has provided Guatemalan society with a point of convergence, opening spaces for the Government of Guatemala to pursue fiscal, institutional and legislative reforms to support its development agenda. Guatemala's greatest challenge is to reduce the poverty, which afflicts over 75% of the population, 86% of the rural population and 93% of the indigenous population.

The Accord's land-related commitments include establishing a cadastral-based land registry. Other commitments include establishing a Land Fund and land conflict resolution mechanisms. Since the return of civilian rule to Guatemala in 1985, progress towards negotiating lasting peace, establishing democracy and introducing economic policies that will foster sustainable growth has been slow and uneven. The World Bank and other Development Banks have been instrumental in the implementation of Land Reform Projects of which several subprojects are now in the execution phase. Leica Geosystems has been contracted by Guatemala to deliver equipment for field data acquisition and the development of the National Geodetic Network. Twenty-five total stations and nineteen global positioning systems were acquired in 2002. The continuation of the Land Administration Project stipulates to modernise the Geographic Institute of Guatemala for which Leica has set the standards in the past. The projects are ongoing and will be supported by Leica's local representative, Precision S.A of Guatemala City, through continued local technical support and service.

Graduation and the issuance of a certificate is the last step before the trained specialists move to the field to perform their duties.

Together with the 25 Leica Total Stations and 19 Leica GPS Systems, Leica Geosystems also provided comprehensive training. Through the knowledge of area manager Leoncio Olvera and the office of Alfredo Bran from Precision SA, Leica Geosystems were able to complete practical training and continue to locally support the initiative.

Bolivian IGM adopts leading-edge technology

The Instituto Geografico Militar (IGM) in Bolivia has recently purchased 12 Leica TC705 Total Stations to help in the execution of the different surveying and geodetic works around the country.

CORIMEX Ltd, the exclusive distributor of Leica Geosystems Surveying and Engineering Division in Bolivia, has been working closely with the IGM to provide solutions to their surveying needs. The IGM's mission is to prepare the National and

Armed Forces Maps. As a Scientific-Technical unit of the Army, the IGM reached superior levels of excellence thanks to their highly technical education and the efficiency in their work. "The only way to cope with the 21st century challenges is to keep ourselves technologically up to date," said Colonel Luis Suarez Arteaga, Commander of the IGM.

The purchased units will be transferred to the 13 different Geographic Districts located around the country, equipping each of them with leading-edge technology. The instruments will support the survey crews in their field works for the National Cartography, giving more emphasis to Thematic Maps. It will also allow them to execute Cadastre works in their respective areas of competence, with the goal of providing the physical, juridical and fiscal identification of the properties for the Cadastral and Scientific Maps.

Statue of Liberty 3D Cyra scan provides historical

State-of-the-art Cyra laser-scanning technology was adapted to quite an extraordinary task recently when it was used to document the detailed surface geometry of New York's most famous landmark – the Statue of Liberty. Traditionally used in the industrial plant and civil infrastructure fields, laser scanning's ability to capture highly detailed, 3D surface geometry of large structures made it a good match for the complex geometry of the Statue of Liberty.

Above: Frog's eye view of the Statue of Liberty. Most of the scans were taken from the base of the statue and a few from the top observation balcony.

Above Right: The University of Texas used their Cyrax 2500 laser scanner to produce a detailed survey of the statue.

Historical Documentation
The College of Architecture at Texas Tech University in cooperation with Historic American Buildings Survey (HABS) and the National Park Service (NPS) began digitally documenting the Statue of Liberty in order to create, for the first time, complete architectural drawings of the statue's exterior, accurate to ¼ inch. These scaled drawings will be used to monitor and care for the statue, providing a complete historical documentation. The drawings could also be used to reconstruct an exact, full-scale duplicate of the statue, in the event of any catastrophic loss. The project team consisted of Associate Professor Glenn Hill, Associate Professor Elizabeth Louden, Professor John White, several grad students, all from Texas Tech University, as well as Tim Woodruff from Cyra Technologies, Inc.

Point, Shoot, Survey!
Using the Cyrax 2500 3D Laser Scanner, a complete 3-D digital scan in the form of a dense, data point cloud was made of the statue. The first step was to set 32 highly reflective scan registration targets on the statue. Easily identified by the scanner software, these targets would be used to very precisely connect multiple scans that were collected as the scanner was repositioned around the statue. The target centers were also surveyed using a Leica Geosystems TCR702 reflectorless total station for independent quality control. The optimum location for scanning was at the promenade level – involving 13 scanner locations around the base. The scanner was simply oriented toward the scene, the desired measurement area and scanning density was selected, and then auto-scan began.

Each of the highly detailed scans took approximately 15 minutes requiring about 2 hours for each of the 13 scan locations. To speed up the process, the team broke into two shifts, morning and afternoon. Each day, a two-person crew would arrive on the first boat to Liberty Island at 6:30 am and work

Bentley and Cyra Technologies announce partnership to spur growth of "3D point cloud" content

Bentley Systems, Incorporated, a global provider of collaborative software solutions and Cyra Technologies have formally announced that Bentley will distribute Cyra's CloudWorx™ application software for Bentley MicroStation™.

The CloudWorx application, first announced by Cyra in December 2001, lets engineers and designers take advantage of rich, 3D point clouds directly in MicroStation. Pointclouds created by Cyrax®_3D Laser Scanning systems represent a powerful, new source of information content for organizations and projects that require accurate "as-built" or "as-is" information. "As-built" information derived from point clouds is being increasingly used by professionals to create better designs of modifications to existing facilities, for better construction planning and quality assurance, and for more efficient asset management. Industries taking advantage of point clouds include plant manufacturing, transportation, and building.

In addition to providing a familiar interface for MicroStation users, CloudWorx for MicroStation also slashes time requirements for processing 3D point clouds into as-built 2D drawings and 3D models. Another advantage for MicroStation users is that they can use 3D point clouds as a backdrop against which to better design a modification to an existing site or structure. Better retrofit designs enable retrofit construction projects to run more smoothly by eliminating construction interferences and construction fit-up problems.

until 2.00 pm with the second crew working from 2.00 pm until the last boat left the island at 9.30 pm. Since the scanner works as effectively in total darkness as in light, the 6.00 pm sunset did not hinder the effort. In just four days, the team scanned over 500 million points, measuring every quarter of an inch of the statue's visible complex surface!

Creating a polygonal model
Returning to Texas Tech University, the university team downloaded all of the data to their servers and began converting the 200 million xyz data points into a 3D model and 2D drawings in order to create a complete architectural drawing record of the Statue, Pedestal and Fort.

For the 3D model, the first task was to register the separate ScanWorlds (scans taken from different scanner positions) into a single point cloud consisting of polygons, often referred to as a polymesh or polygonal model. Geometrical anomalies around the torch and the spires of the crown caused by swaying of the statue in 50 mile per hour winds were corrected or eliminated to achieve better results. Registration solutions based on scan targets were supplemented in certain cases with mathematical stitching of the different point clouds to create the final registration of all 13 ScanWorlds. The completed polygonal model was then used to derive 2D drawings.

Future phases
This initial scanning effort has digitally registered approximately 60% of the Statue, which represents the most prominent and distinctive features. However, from the scanning position at promenade level, the pedestal blocks the feet and the top of the crown is out of view. Future scans would require some limited scaffolding and the remainder will require access to the Statue in some other way, such as photogrammetry or airborne scanning.

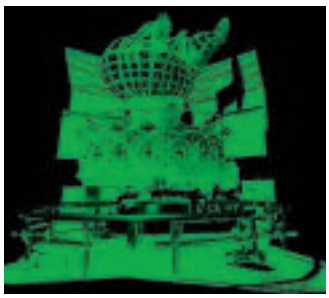
Generating the eight elevation drawings of the statue presents a different problem. One method involves capturing line drawings using hidden line procedures in a CAD program. The other captures images of the 3D model from an orthographic view. These rendered images could serve as dimensionally correct photographs and, thus, could be traced in a process similar to photogrammetry. The team plans to use both methods.
Phase II funding is currently being sought to scan from the Pedestal and photograph the statue. The team is also exploring airborne technology utilizing drone helicopters with similar laser scanning technology. Unfortunately, this method is less accurate (3/4" to 1"). Phase III of the project is to begin to use the 3D model and high-resolution photographs to create a small-scale GIS system for the maintenance and management of the statue.

Once finished drawings and models of the Phase I work are delivered to HABS and the NPS, the NPS will use the 3D model for maintenance. The 2D drawings will become part of the Library of Congress archives, part of recorded history for at least the next 500 years.

The Statue of Liberty

The Statue of Liberty was a gift of international friendship from the people of France to the people of the United States in recognition of the friendship established during the American Revolution. The 93-metre tall statue has been standing proudly over New York Harbor since 1886. Master sculptor Frédéric-Auguste Bartholdi reproduced the statue, not from architectural drawings, but from multiple scaled models. It took a team of craftsmen over 10 years to shape over 81,300 kg of copper and 113,400 kg of steel.
Visitors climb 354 steps to reach the crown or 192 steps in order to reach the top of the pedestal. There are 25 windows in the crown that symbolize gemstones found on the earth and the heaven's rays shining over the world. The seven rays of the Statue's crown represent the seven seas and continents of the world. The tablet, which the Statue holds in her left hand, reads (in Roman numerals) "July 4th, 1776." In 2001, more than 4 million people visited the Statue of Liberty.

More information can be found at:
http://www.arch.ttu.edu/digital_liberty/



Above: A detail of the point clouds containing the face. Some details were scanned at very high resolution (points placed densely) such as the highlighted green area on the crown.
Below: A detailed view of the torch.

Visualisation of North Sydney, Australia. This view was generated within a GIS project accomplished by Leica Geosystems customer PSN Survey, integrating data from different Leica Geosystems sensors (aerial camera, GPS, total stations) and digital photogrammetry software.

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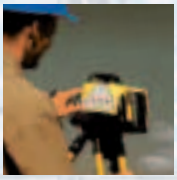

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Now incorporating the product lines of ERDAS, LH Systems, Cyra Technologies and Laser Alignment, Leica Geosystems provides the most comprehensive and internationally unique range of products and systems for capturing, visualising and modeling spatial reality worldwide. Customers benefit from easy integration of all data, smooth workflow and the extension of their activities into new growth areas. In each of its six divisions, Leica Geosystems provides products at the top of the scale for productivity, value and reliability.

THE TOP TEN is a selection of some of the most innovative, exciting solutions from several of the company's divisions. Each of these products has been developed in response to customers' needs, to get the job done faster and more cost-effectively. Visit us at our websites or contact your local representative to learn more about the new possibilities.

Leica Geosystems

Leica Geosystems AG, Switzerland, www.leica-geosystems.com

Setting new standards in portable Coordinate Measurement

For over a decade, Leica's Trackers have defined metrology in the aerospace, automotive, and general industry. In the near future, Leica Geosystems will take tracking to a new level by turning traditional trackers into portable CMM solutions, adding a revolutionary set of accessories.

New standards – more applications

The Leica Laser Tracker LTD800 sets new standards in portable coordinate measurement.
Based on proven technology used by operators in every major industry, we once again set new standards by introducing the LTD800, which will give you more features and advantages than any other tracker on the market. Add to this the LTD800's compatibility with an upcoming series of accessories enabling 6DOF tracking, armless, wireless probing, and handheld, non-contact 3D-scanning, and you can go beyond tracking tasks towards a complete PCMM solution, giving you a wider perspective – in all dimensions.
The latest generation of Leica Trackers and the upcoming accessories will provide probing as well as scanning capabilities for measurement and analysis, uniting all elements of metrology into a revolutionary All-In-One Solution.

T-Probe for inspecting also deep locations.

Open software architecture

Thanks to the embedded system control, the Laser Tracker can be controlled from any platform. Whether one chooses Leica's leading inspection software Axyz or the latest CAD-based software Horizon, Leica's Trackers provide perfect freedom and maximum ease of use.

The Leica Tracker with its built-in client server concept opens new dimensions for fast, easy, and flexible integration and allows to completely integrate the Leica Tracker in automation processes in UNIX, Linux, and MS Windows.

New accessories to come

The accessories will enable the LTD800 to measure anything – quickly, easily, and on site: from sophisticated car bodies over exacting windmill hubs to the latest advances in aerospace technology. Depending on the requirements, the LTD800 is applied for traditional tracking, for wireless and armless probing or for scanning with the unique handheld non-contact scanner.

Tracker Camera (T-CAM):
Measure precisely position as well as orientation of any object in space.

Tracker Probe (T-Probe):
Inspect anything, due to its ability to measure easily into deep locations on parts and tools.

Handheld Tracker Scanner (T-Scan):
Digitize complex surfaces with virtually no set up time for subsequent inspection and reverse engineering.

The cutting edge characteristics

- 3D non-contact coordinate metrology
- Extremely fast digitization with the capture of millions of surface points in minutes
- Precise measurement and analysis of large as well as small parts
- Wholly portable coordinate measurement system, fully mobile and with negligible set-up times
- Probing as well as scanning capabilities
- All-In-One Solution with the coming unique series of accessories
- Proven for use in the toughest industrial environments.

Says Denny G. Deegan of Tooling Methods Engineer, Bombardier Aerospace, Wichita:

"The Tooling Department relies on Leica laser trackers to provide highly accurate, large volume 3D measurements to support the manufacturing, testing, and servicing of Bombardier aircraft as well as the construction and maintenance of precision tooling for those aircraft. The quality of our Leica trackers is matched by the support provided by the people at Leica who make every effort to ensure your success in the use of their products."

In the near future it will be possible to scan precisely any surface using the T-Cam and handheld T-Scan.

Non-contact measurements open new dimensions

Industries worldwide have come to rely more heavily upon precision measurement. Even though technologies have moved toward lasers and away from the traditional contact probe CMMs, most precision measurement has continued to include some element of contact. Until lately precision non-contact systems could only measure small distances. It's only recently that technology has made large-scale non-contact precision measurement possible with the advent of a new type of laser radar: the Frequency Modulated Coherent Laser Radar (FMCLR). MetricVision acts as a partner in this project.

Incomparable performance opens new perspectives

The LR200 directly measures surfaces, points or scans features using coherent laser radar. The sensor directs a focused invisible infrared (IR) laser beam to a point and coherently processes the reflected light. As the laser light travels to and from the target, it also travels through a reference path of calibrated optical fiber in an environmentally controlled module. The two paths are combined to determine the absolute range to the point. Huge laser modulation bandwidth (100GHz) makes precise measurement possible in a millisecond. The distance measurement is then combined with the positions of the two precision encoders to determine a point on a surface in space. The Laser Radar scans complex geometry that was impossible to scan before because it was too large, difficult to reach, very complex, soft or delicate or just too labor-intensive. Comparison to CAD is an expected feature for most work.

Large scale 3D metrology made mobile

The new Laser Radar LR200 is fast, easy to use, very accurate and portable. The open interface of the LR200 enables direct software control for embedded applications. The system contains a cart with one or two monitors. In a two-display system, one LCD screen displays the application software while the other screen shows a color video image of the area to be measured. Only one person is required to set up the system, and it can continue to run unattended. The system works indoors or outside, in any lighting, and on any surface. The system may easily be integrated into remote automated systems. Data can be imported into leading 3rd-party software to meet a broad range of inspection, quality assessment, reverse engineering, and other special application needs.

LR200 speeds up Process Control

Aerospace firms like Boeing have been early adopters of Coherent Laser Radar. Antenna makers have eliminated mysterious noise by identifying, modifying, and rechecking some very subtle surface irregularities. Other industries as well have come forward with compelling justifications. The instrument accurately aligns large parts during assembly. It certifies tooling and then monitors its repeatability during production. It measures metal, plastic and composite as-built parts and compares them to as-designed CAD models. Coherent Laser Radar can be used for many applications today. It rapidly samples as-built surfaces directly to a CAD model and does it over extremely large areas in a contiguous coordinate system. And because operators can accurately reference key features or fiducials as they go, relocating the system eliminates the need for complicated reassembly of data clouds after the job.

The LR200 may even measure backsights by reflection on a mirror

Industry requirements fulfilled

For in-process applications, the system aligns aircraft and automotive components and support robotic positioning. It can measure orientation, gap, flushness, and fit. In addition, it monitors tool and fixture stability during use. A single machine can monitor several manufacturing work cells automatically without the need for operator intervention.

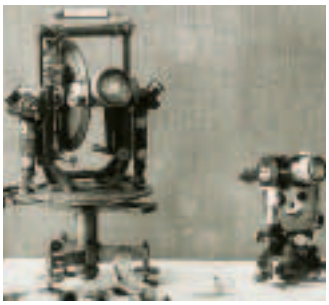
Major manufacturers of aircraft, large automotive parts and heavy machines are integrating Coherent Laser Radar technology into their manufacturing processes because they do not want to wait until parts fail dimensional inspection to take corrective action. And by embedding the LR200 technology into critical processes, they eliminate scrap and increase production speed in a broad range of manufacturing areas.

Says Bill Griffin, Senior Research Engineer of Mission Research Corporation:

"Mission Research Corporation in Dayton, Ohio uses LR200 Laser Radar to perform precision 3D volumetric measurements and analyses toward the development, verification, installation and alignment. Our collimating surfaces, feed systems, positioning systems, and shielded anechoic rooms, all require the use of the LR200 Laser Radar to ensure the proper design and cooperative relationship of all components. The ability to obtain precise data on a non-contact basis from the system has saved weeks of on-site effort with more complete results. Our success is guaranteed not only by the reliability and usability of the system, but also by the support."

Non-contact 3D Laser Metrology System Leica LR200

Technological revolution 100 years ago on Swiss mountain peak



Left: A repetition theodolite like the one used by Heinrich Wild on the Dents du Midi.
Right: The small theodolite Wild T2 is the precursor of all modern surveying equipment.

Everyone knows that a specific landscape and climate leave their mark on the people living there. The same goes for the history of technology, surveying and mapping where these factors triggered important technological developments and signalled the starting shot for new companies. Thus, the history of modern surveying began exactly one hundred years ago in Switzerland's Lower Valais region on the slopes of the Dents du Midi. These 3200-metre peaks, whose reflections shimmer on Lake Geneva, were the decisive challenge for a basic discovery in the field of surveying. Not far away on the Pierre de Nilton on Lake Geneva, which was taken as the zero levelling point, work was commenced in the same year on the new Swiss national land survey. In 2002, the Swiss Professional Associations for Geomatics celebrated 100 years of surveying.

Only one hundred years ago, theodolites were still huge pieces of equipment, which could only be carried across country with the aid of several people. Large, finely engraved, vertically and horizontally-mounted metal discs with correspondingly heavy supporting brackets were necessary to enable a precise triangulation.

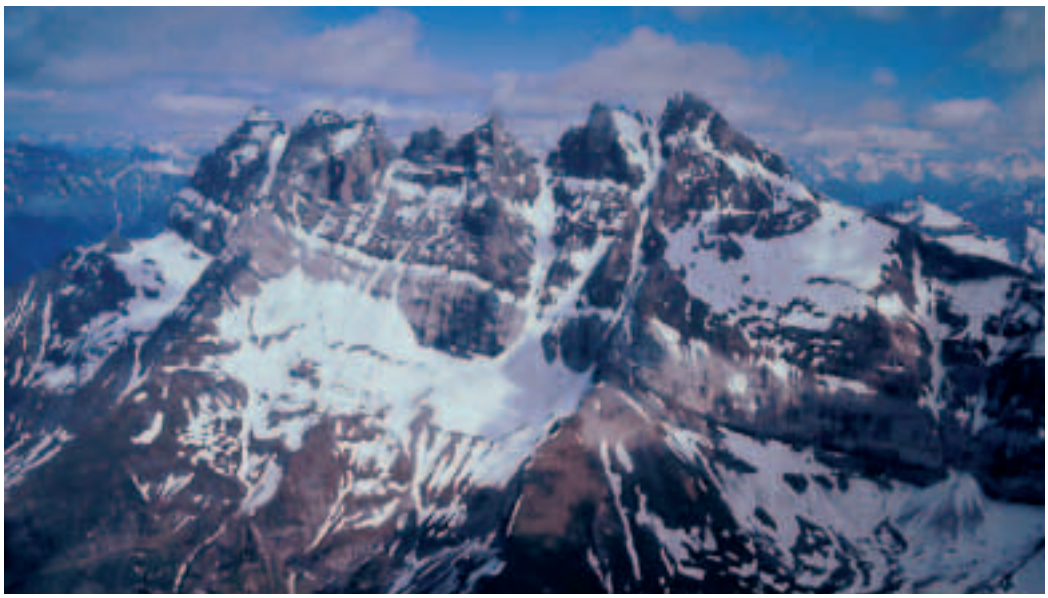
In September 1902, topographer Heinrich Wild who had been instructed to map the Lower Valais region had in the course of several days' work just finished heaving his massive theodolite to the high triangulation point when the weather suddenly took a turn for the worse. Before he was able to home in on a neighbouring peak serving as a triangulation point, a severe snowstorm forced him back into the valley without having achieved anything. "If a smaller, lighter piece of surveying equipment that did not have to be readjusted each time it was used had been available, I would have completed my triangulation on the eastern peak of the Dents du Midi long before the storm set in!" the disappointed topographer said to himself and from then on started thinking about the possibilities of constructing smaller surveying equipment. The following decades proved that Heinrich Wild was not only a first-class surveyor, but also an outstanding inventor. Instead of huge metallic theodolites, he developed circular glass discs no larger than the palm of the hand engraved with capillary-like divisions. He then mounted them into handy, stable and easy to transport metal housing, well protected against dirt and moisture. In order to read the 21,600 miniature arc markings scored onto the glass discs and further arc seconds markings, Heinrich Wild developed an integrated microscope.

A few years after his crucial experience on the Dents-du-Midi, Heinrich Wild submitted his patent application to the office for intellectual property (Patent Office) in Bern, which at the time also employed a federal clerk by the name of Albert Einstein who later went on to win a Nobel Prize. Two decades later, Wild, the geologist Dr. Robert Helbling, from Flums, and the industrialist Jacob Schmidheiny from Balgach, put the ideas into practice in their own Swiss plant in Heerbrugg.

Here Henry Wild constructed his legendary Wild T2 theodolite – the precursor to all modern surveying equipment. Heinrich Wild's former "optical workshop" in Heerbrugg subsequently developed into Leica Geosystems.

Leica Geosystems - Milestones in precision engineering - Heerbrugg

Heinrich Wild's ascent with heavy surveying equipment was hard work, encouraging him to start to think about smaller devices.



Following the descent from the 3200 metre Dents du Midi, it was here on the banks of Lake Geneva, where Heinrich Wild had his ground-breaking ideas exactly 100 years ago.

Superiority in the field of photogrammetry and remote sensing

As early as the 1920s, Heinrich Wild's inventive genius in developing aerial imaging cameras and photogrammetry mapping devices had also a decisive influence on aerial surveying – and the company's strong "air position" has remained until this very day. For quick and accurate survey of landscapes and towns, 3-D lidar laser scanners and aerial digital imaging sensors and visualisation are used together with geographic information software developed by ERDAS and LH Systems – both belonging to Leica Geosystem's GIS & Mapping division. With such equipment, experts in recording, visualising, mapping and modelling 3-D objects are successfully continuing the pioneering work in geomatics of the surveyor and constructor Heinrich Wild. Their software products expand these functions to include the analysis, integration and administration of such data in geographical information systems (GIS). Following the electronic angular sensing and distance measurement technology developed in recent years and the global positioning systems today's 3-D laser scanning (Cyra) and geo-referenced 3-D software now count as key technology of the future. In keeping with tradition, Leica Geosystems is a pioneer in these two segments as well.

The topographer Heinrich Wild would be amazed at how his business successors have led geomatics into the next century and secured a position as a global player for his former workshop. Were he to look inside a laser tachymeter from 2002, which still reflects the construction principle of his T2 theodolite, Heinrich Wild would not only discover that his glass discs are now digitalised using barcodes, but also that countless other elements have been miniaturised ever further – such as laser diodes and electronic chips. In addition, software used now to perform the equations – that would normally take him weeks to calculate. Having the modern instrument at his side, would have enabled Wild to gather the necessary measurements and return from the summit, long before the snowstorm had the chance to interrupt his work. ***Stfi***

The most modern tachymeters of our time are based on Heinrich Wild's basic idea. Admittedly, they incorporate laser distance gauging, microelectronics and software including countless measurement and calculation functions at a keystroke.

This chart prepared to mark the company's eightieth anniversary combines the principle surveying and photogrammetry product lines of Leica Geosystems' Heerbrugg factory, the successor to Heinrich Wild's precision mechanics and optical workshop. The microscopy division, which is not included here, was separated in 1996 and the special products division in 2002. Kern & Co., Aarau, was added to Leica Geosystems in 1988. The companies Cyra, Erdas, Laser Alignment and L H systems followed in 2001.

The Leica premises in Heerbrugg (Switzerland) photographed in May 2002 using the world's first digital aerial imaging sensor, the Leica ADS40.

The Point-and-Click Future of GIS

A Report from Geospatial Solutions

Since its 2001 acquisition of LH Systems and ERDAS, Leica Geosystems GIS & Mapping Division has mobilized to integrate its product offerings in airborne data acquisition, geographic imaging, GPS/GIS, and Land Information Systems. As it begins to optimize the interoperability of these complementary technologies, Leica Geosystems aims to transform the way we capture, analyze, and use spatial data.

Wouldn't it be nice if populating your GIS database was as simple as using a digital camera? With consumer-level software for digital cameras, one can shoot a series of photos in a panorama and the software finds the matches and mosaics the individual scenes into a single large image.

Perhaps in the not-too-distant future, GIS professionals will acquire spatial data in a similar manner. After all, it is already quite commonplace for individuals to acquire images located with GPS. And many systems now allow GPS field data to be fed directly into a GIS. With the combination of GPS, inertial navigation systems, and digital imaging, it is already possible to create accurate orthomaps with little or no ground control.

As the software supporting these solutions continues to advance, the technological complexities will become increasingly invisible. Much as a GPS user needs to know little about complex mathematics and satellite signal processing, the user who wishes to extract features from imagery will soon need only minimal knowledge about the underlying photogrammetry to reap its benefits. Soon, software will be able to transparently assemble a collection of images, automatically determine tie points, solve the orientation, extract elevation information from the overlaps, generate orthophotos, and create a single large mosaic – with no need for human intervention.

From the orthophotos and the elevation information, one could then enter a virtual world and visit the site of the imagery. Because all the imagery and orthophotos would be geographically aware, they could all be used to create photorealistic worlds, which could be accurately measured. This 3D world could be used to verify existing 3D GIS databases or build new ones. Software could then recognize and identify features in the images such as roads, ground cover, buildings, and so forth. The 3D world could also be shared among office and field workers, with wireless communications enabling two-way data flow. Field crews could send data to the office, while office staff could wirelessly transmit database updates to workers' image-enabled systems, all in real time.

Is this a utopian vision of 3D GIS data capture – some wild dream that can never be realized? Hardly. After all, the convergence of spatial technologies has been proceeding at full steam for several years.

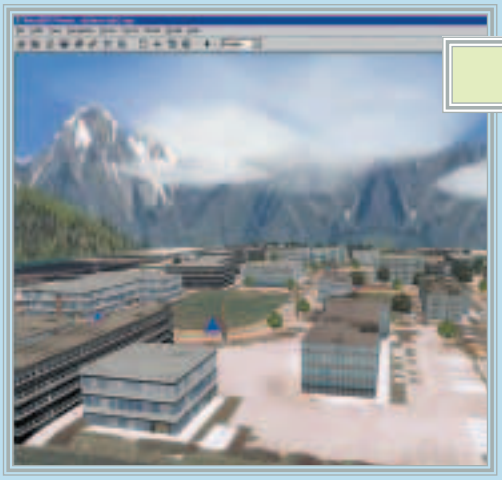
Convergence. Once disparate tools used by distinct disciplines, GIS, GPS, and imaging technologies are becoming increasingly integrated. Add to that the increased power of handheld computing and the proliferation of wireless communications capabilities and such an ideal seems quite real and very near.

Such is the long-term vision of Leica Geosystems' GIS & Mapping Division. And it was just this type of farsighted thinking that led the Division last year to integrate the geographic imaging expertise of ERDAS and the aerial imaging and

photogrammetry know-how of LH Systems with its own GPS/GIS prowess.
"Combining these resources allows us to address the growing requirements for acquisition, processing, and visualization of 3D imagery to populate GIS and CAD databases," said Bob Morris, President of Leica Geosystems' GIS & Mapping Division. "It creates a tremendous opportunity to leverage the strengths of each group in developing world-class solutions for producing intelligent 3D maps and databases."
And Leica Geosystems has a lot of strength to build on.

A firm foundation

The company already has extensive expertise in each of the markets and technologies it aims to coalesce. Its RC30 aerial film camera, for instance, is well established in its marketplace and has recently been complemented by the ADS40, an Airborne Digital Sensor, and the ALS40, an Airborne Laser Scanner. Each of these products is well positioned to serve customers whose focus is on airborne operations.
The Division's photogrammetric solutions include options for the professional photogrammetrist and the GIS analyst. The longstanding SOCET SET® software suite, with ORIMA for triangulation and PRO600 software for data extraction and editing, is complemented by the DSW500 film scanner to meet the increased editing and speed demands of the professional photogrammetrist.
The ERDAS flagship product suite, ERDAS IMAGINE®, with its numerous specialty tools for image processing, remote sensing, and photogrammetric processing and analysis, enhances the workflow requirements of the Division's diverse customer base. Its IMAGINE OrthoBASE® and OrthoBASE Pro™ have also made a quick impact on the photogrammetric marketplace since their recent introductions to the GIS analyst. And, as a tool for visualizing imagery and data, IMAGINE VirtualGIS™ has a significant future in a variety of applications that could benefit from image-enabled data acquisition tools.
With its roots in surveying and GPS technologies, Leica Geosystems was already a top contender in GPS/GIS data acquisition. Its GS50, and now GS50+, coupled with its GIS DataPRO™ office software, and the brand-new GS20 (see page 17) enable users to collect spatial data and store them in a GIS-ready format. Add the soon-to-be-released Land Information Systems products to the equation and you have top-notch management solutions that bring survey-quality measurements into the GIS world. These products include a unique innovation to provide survey tools that extend the functionality of ESRI's ArcGIS, providing a new route from survey measurements to the GIS database with integral quality management tools (ESRI's Survey Analyst); a powerful package that manages surveying, mapping, and database operations for cadastral purposes (ArcCadastre); and a tool for field data collection and update using the ESRI Geodatabase format (FieldGIS).
Indeed, each of the previously distinct organizations that make up the Leica Geosystems GIS & Mapping Division already boasted an impressive product lineup and supported a well-established customer base in disparate application areas (see "Customer Snapshot" sidebar on page 24). But building on the synergies among the products and people is really where the Division's future lies. The coalescing of talents and products from these well-established technology leaders may just be the key to realizing the vision of point-and-click GIS.



IMAGINE VirtualGIS will be central to image-enabled data acquisition tools.

Coalescing technologies

Today, Leica Geosystems' GIS & Mapping Division provides customers with integrated mapping solutions across four previously distinct areas – airborne data acquisition, geographic imaging, GPS/GIS, and Land Information Systems. The company's sensors, field data collectors, workstations, and software enable users to create and update GIS databases quickly and accurately. Such capabilities enable Leica Geosystems to offer products and support for data acquisition ranging from space-

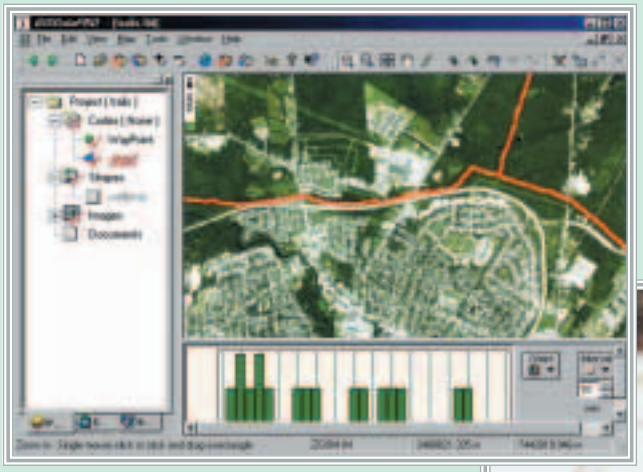
The company's product lines are increasingly bundled and integrated. Customers who purchase a GS50 or GS50+ data collector through March 2003, for instance, will receive a free copy of IMAGINE Essentials software to organize, edit, and present their data.

borne (satellite remote sensing) to airborne (aerial photogrammetry) to handheld, with precise GPS/GIS and land information management. And, cross-pollination among the Division's more than 300 employees – plus 2,100 more innovators that drive Leica's other five divisions (Consumer Products, Industrial Measurement, New Businesses, Special Products, and Surveying & Engineering) – promises to yield technological advances that cut across the company's entire product line. "Leveraging the scope, experience, and tremendous expertise of our employees, along with the

Customer Snapshot

Versatility in mapping. In New Brunswick, Canada, the City of Fredericton uses Leica Geosystems' GS50 handheld GPS/GIS data collectors to map snowmobile trails in the winter and storm sewers and manholes when the snow recedes. And the mapping work isn't just done by surveyors. According to GIS Supervisor Rob Lunn, the GS50's simple interface means end users can complete their own mapping tasks according to their own schedules and in accordance with their specific needs.

Indiana DOQQs. In 2002, Kosciusko County, Indiana, tasked mapping and design firm Woolpert LLP (www.woolpert.com) with acquiring aerial photography, ground control, and LIDAR data and producing digital orthophotos.

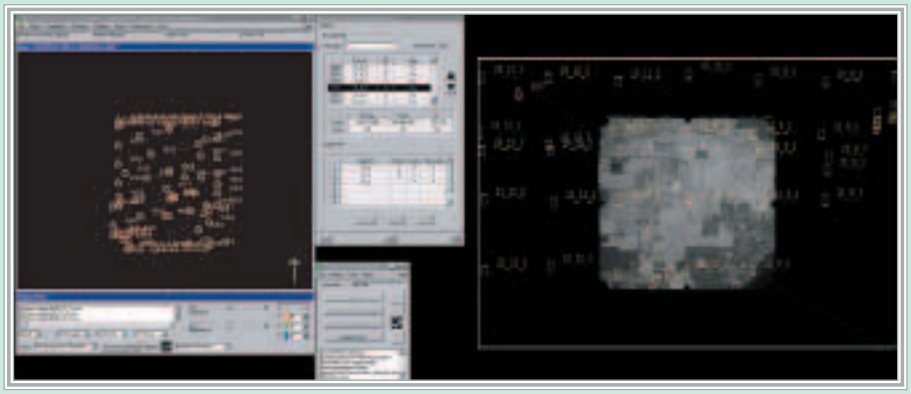


City of Fredericton staff use the GS50 to map snowmobile trails in the winter (above and right) and city infrastructure in the summer.

The Chinese Ministry of Agriculture is using ERDAS IMAGINE to estimate grass areas for the entire country.

Woolpert used SOCET SET, ORIMA, and GPS support software supplied by Leica Geosystems to perform the aerial triangulation. According to Woolpert, using SOCET SET and ORIMA decreased production time 75 percent compared with using conventional aerial triangulation methods.

Woolpert chose SOCET SET, ORIMA, and GPS for aerial triangulation (below).



Monitoring grasslands. In China, where grasslands compose 40 percent of the entire country, monitoring the structure, function, and dynamic change of this important land resource is critical, especially given the growing population and threats from natural disasters and development. To manage grasslands, the Ministry of Agriculture (MOA) is building a unified information system for monitoring grass bio-logy. It is using SPOT (www.spot. com) images to acquire the most current information about the grasslands, ERDAS IMAGINE to estimate the grass areas from these images, and ESRI's (www.esri.com) ArcGIS to conduct analysis. The MOA will integrate historical information, statistical data, and the considerable experience of its staff with spatial monitoring of grassland conditions (including the transition from grassland to desert or marshland) and productivity. From the information gathered, the MOA will develop a prediction and protection report to provide to government decision makers.

pure economies of scale, will allow us to provide unparalleled service to our customers," said Morris.
Already, the GIS & Mapping Division has announced significant developments that demonstrate the evolving technology cohesion.

Digital data processing.
In May, for instance, the Division introduced the Leica Terrain Productivity Bundle, a software package that combines the workflow functionality of IMAGINE OrthoBASE Pro with the terrain editing capabilities and speed of SOCET SET. Comprising ERDAS IMAGINE, IMAGINE OrthoBASE PRO geographic imaging software, and SOCET SET's CORE, STEREO, and ITE modules, the bundle enables customers to more effectively process, edit, analyze, and visualize such data as automatically generated digital terrain models.
"We are developing logical interaction across our extensive product lines to make our systems even more intuitive and responsive to customer needs," said Morris. "This bundle is especially designed for GIS and mapping professionals whose technical requirements demand greater terrain editing flexibility than is available with IMAGINE, but do not call for the full functionality of SOCET SET's advanced photogrammetry system." (For more about uses of SOCET SET, see "Mapping the Hoover Dam Bypass" sidebar. Read more about image processing with ERDAS IMAGINE in the "Calculating Open Land" sidebar on this page)

Image cleanup. For image dodging and balancing, Leica Geosystems' GIS & Mapping Division recently introduced the ImageEqualizer. Tailored for photogrammetrists, the product is a standalone application for correcting such image variations as hot spots, unequal lighting, atmospheric and temporal effects, or color cast in single and multiple images simultaneously. Once the user selects the images to be corrected, the product sections imagery into tiles and collects statistical information about brightness and contrast. It then uses this information to create a correction function that compensates for disproportionate variation for each image.

Image-enabling. Among the most lofty product integration goals still in development is that of image-enabling many of the company's data acquisition products to make them even more intuitive and easy to use. The ERDAS IMAGINE product line will serve as a core development environment for this task.
"The power and versatility of IMAGINE VirtualGIS for visualizing imagery and data is remarkable and will have a significant future in a variety of applications," said Morris.
This particular development avenue truly highlights the ongoing trend toward coalescing spatial technologies.
"These small examples demonstrate our commitment to product integration," said Morris, "but soon we plan to introduce even more integrated service offerings covering the spectrum from hardware service through software support to education and training."
Meanwhile, the company continues to innovate in each of its business and technology areas.

Mapping the Hoover Dam Bypass

When contractors for the Federal Highway Administration began to weigh their options for the $198 million Hoover Dam Bypass, they required aerial imagery to help them evaluate the environmental, historic, cultural, and aesthetic impact of multiple proposed roadway and bridge concepts. The bypass project aims to relieve major traffic congestion on U.S. Highway 93. A major commercial corridor between Arizona, Nevada, and Utah, the highway passes along the top of the Hoover Dam National Monument.

Kenney Aerial Mapping used SOCET SET digital photogrammetric software to create color digital orthophotos of Hoover Dam.

In July 2001, the prime contractor, HDR Engineering (www.hdrinc.com), tasked Kenney Aerial Mapping (KAM, www.kam-az.com) with the aerial mapping. Once ground control was established, KAM flew nine flight lines at 1,800 feet over the project area, acquiring photography at a scale of 1:3,600 with 80-percent overlap. They captured additional stereo coverage at 1:12,000 and 1:24,000 to support future mapping efforts. Design mapping was completed covering an area 4.3 miles long and 500 feet along either side of the proposed alignment. Next, using SOCET SET's digital photogrammetric software from Leica Geosystems, KAM created color digital orthophotography with a 0.3-foot ground sample distance.

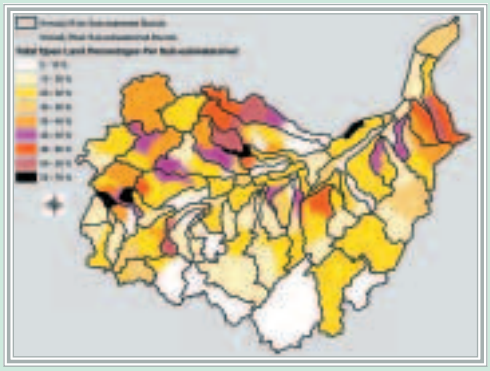
The mapping project extended up the cliff faces. KAM digitized a 3D model where vertical stereo imagery was inadequate. Surveyors scaled the cliffs to establish control for these areas. Ground-based LIDAR helped capture 3D data of the cliff faces, resulting in an integrated 3D surface model for the entire project.

"Compilation of the irregular terrain created a challenge," said KAM's John Cahoon. "It required numerous breaklines to depict rock outcrops and rough swales accurately, and that's not to mention processing the massive and complex electrical facilities of Hoover Dam." Despite the challenging work environment and schedule, though, the imagery was acquired, processed, and delivered in only six weeks.

Calculating Open Land

Human alteration to the landscape of the Nemadji River watershed — which covers 275,000 acres in northeastern Minnesota and northwestern Wisconsin — has accel-erated erosion of the area's glacial till and red clay soils. Consequently, extensive sediment is being deposited into Wisconsin's Superior Bay. To analyze and address the problem, the Nemadji River Basin Project set out to identify the subwatersheds in which the amount of open land — land that is either in agricultural production or timber that has been harvested in the past 15 years — was 40 percent or greater.

To identify open land within the watershed, the project called on Community GIS Services (www.commgis.org), a nonprofit organization serving the needs of government entities. Community GIS used 16 years of Landsat 5 and Landsat 7 imagery to develop 0–15-year timber age class GIS coverage using ERDAS IMAGINE Professional software for image rectification and change detection.



To delineate open land and conduct change detection, Community GIS processed Landsat data using ERDAS IMAGINE.

"ERDAS [IMAGINE] performed astoundingly well while rectifying 16 scenes of Landsat imagery," said John Kubiak of Community GIS. "Our next step was to analyze changes in the land cover by comparing the rectified Landsat scenes on a year-to-year basis. We used ERDAS (IMAGINE) change detection to give us a good idea on where to look, but continued to review them manually throughout the analysis."

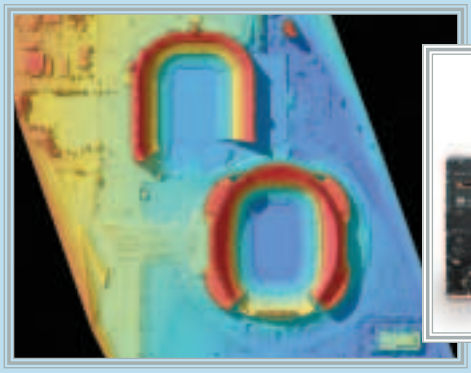
Local governments will use the information to work on a voluntary basis with public and private landowners to coordinate timber harvesting and tree planting along riparian corridors in subwatersheds that are approaching the 40-percent open land threshold.

Digital sensing. In the airborne data acquisition realm, the GIS & Mapping Division recently debuted the ADS40 to American customers. Offering the coverage performance of an aerial film camera, the ADS40 provides multispectral data, something normally acquired from a spaceborne platform. The digital sensor – which captures 3 panchromatic channels (forward, nadir, and backward) and 4 multispectral bands (red, green, blue, and near-infrared) simultaneously – can be used for crop and land-use analysis, environmental planning, and all photogrammetric applications. "The convenience of the all-digital workflow means an up-to-date, efficient production environment for our customers," said Ludger Ullrich, Vice-President of Airborne Data Acquisition, Analog/Digital Sensors.

LIDAR. Moving well beyond traditional digital sensors, Leica Geosystems' integration of LH Systems also introduced LIDAR (light detection and ranging) to the mix. Its ALS40 reportedly offers the widest field of view (75 degrees) and highest altitude capability (6,100 meters above ground) of any LIDAR system available. Further, range and intensity can be altered midflight, on a flightline-by-flightline basis.
"The ALS40's flexibility to switch modes midflight can save users a tremendous amount of storage and processing costs by collecting exactly the level of detail necessary for each flightline," said Doug Flint, Director, LIDAR, Leica Geosystems GIS & Mapping.

Centimeter-level GPS. To enable centimeter-level GPS/GIS data collection, the division recently unveiled its GS50+ with a real-time kinematic, 24-channel, dual-frequency receiver GPS engine. For GIS data acquisition with GPS position, the GS50+ stores ESRI shapefiles in its GIS DataPRO post processing software. (For more about use of the GS50 and DataPRO software, see "Building a Bus Route GIS" sidebar on page 27.) The shapefiles can be automatically transferred to any software capable of reading shapefiles – including ERDAS IMAGINE – to visualize, manipulate, analyze, measure, and integrate geographic imagery into two- and three-dimensional environments.
The unit features full expandability, offering scalable architecture in

The ADS40 simultaneously captures data from three panchromatic and four multispectral bands, as seen in this imagery of Adria, Italy - no difficult choice to make between panchromatic, color and false color film.



Merrick and Company used the ALS40 to acquire LIDAR data and render the above image of football stadiums in Aurora, Colorado.

which users can switch from GIS to survey functionality or add GIS capabilities to an existing survey receiver. It also boasts a real-time accuracy monitor, graphical navigation display, area/ perimeter calculation, and one-step transformation and coordinate geometry that allows users to conform to any coordinate system in the field and on-the-fly. For transferring data, the unit supports data radios and also enables users to transmit via digital modems or cell phones. By plugging the modem into the product box, users can control it from their handheld terminal.

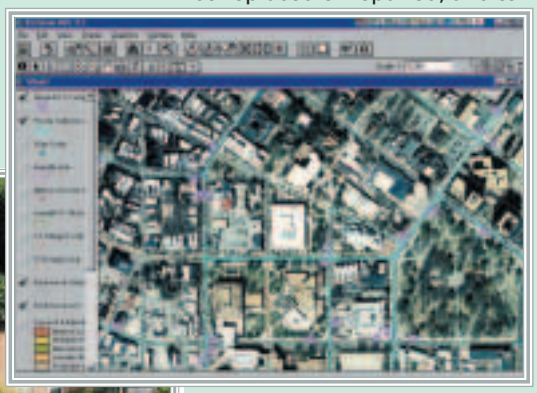
Just point and click

So what does the future hold for Leica Geosystems' GIS & Mapping Division? "Very simple," said Morris. "We aspire to be the leading player in offering 3D solutions in data acquisition, processing, quality control, update, and visualization for GIS databases. 3D GIS is at the very center of our development efforts."

Combine this with effective workflows and wireless data transfer, and Leica Geosystems may just make point-and-click simplicity a part of your GIS world.

Building a Bus Route GIS

The GRTC Transit System operates more than 180 buses and serves about 2,800 county bus stops. In the past, it ran this extensive network without an in-house spatial database. As the primary provider of bus and other transport-ation services to the fastest-growing metro-politan area in central Virginia, GRTC Transit needed to remedy this situation, and quickly, especially with urban growth demanding that new bus routes be added regularly. So, in early 2001, it acquired a GS50 data collection system and set out to build a GIS.



Using the GS50, Jake Helmboldt mapped the location and attributes of 2,800 central Virginia bus stops en route to building a transit system GIS.

GIS Coordinator Jake Helmboldt first built a base layer using centerline, roadway, and sidewalk files, along with orthophotos and parcel data obtained from the City of Richmond and Henrico County. To develop the bus stop layer, he hit the streets with the GS50 and recorded the GPS locations of all existing bus stops. While at each stop, he also recorded curb lengths. He obtained positions on each end of the curb when necessary and recorded such impediments as intersecting driveways or business entrances. He further documented the positions of trash cans, benches, shelters, and ramps and noted existing conditions and maintenance needs.

Using a codelist he specifically developed for the project, Helmboldt recorded attributes of each feature, including length, bus stop number, sign type, and bus stop-facing direction.

He used the GS50 to note which bus stop signs needed to be replaced or repaired, and to indicate which signs had already been replaced. From a project management standpoint, Helmboldt said the sign replacement data had been especially valuable. Back at headquarters, Helmboldt downloaded the data into Leica's GIS DataPRO for post processing.

"This was really easy with DataPRO," Helmboldt said. "Not much post processing was necessary. It was mainly a matter of matching up our data to verify our bus stop identification numbers and eliminate duplication in our database."

To accomplish this, he simply cross-referenced bus stop identification numbers with bus routes. Then, he converted the data to ESRI shapefiles and used them to create an entire route network.

Using this GIS database, he's already conducted some proximity analysis to assess holes in coverage areas and done some buffering to analyze walking distances for prospective riders. In addition, some of the attributes Helmboldt collected have helped the transit company to determine whether stops are Americans with Disabilities Act–accessible and decide where additional amenities are needed. And, as soon as they get their hands on ESRI's Network Analyst, GRTC Transit will start to conduct routing analysis.

Leica GPS measures crustal movements in the Antarctic

Leica Geosystems is providing eight Global Positioning System (GPS) receivers to the West Antarctic GPS Network (WAGN) project to assist in the measurement of crustal motions of the bedrock underlying and surrounding the West Antarctic Ice Sheet (WAIS). Antarctica occupies a key location in both the global system of tectonic plates and the global climate system. The future of the WAIS and the corresponding effect on sea level is largely controlled by the behaviour of the lithosphere underlying the ice sheet. WAGN is a National Science Foundation-sponsored project involving The University of Texas at Austin Institute for Geophysics (UTIG), the Pacific GPS Facility (PGF) at the University of Hawaii School of Ocean Science and Technology, and the Center for Earthquake Research and Information (CERI) at the University of Memphis.

Leica Geosystems is providing eight GPS receivers to assist in the measurement of crustal movements under the ice sheet.

Blacktie celebration for Grand Opening

On 14 May 2002, the Michigan Spatial Reference Network celebrated its Grand Opening in Lansing, Michigan, with over 190 guests attending the "Blacktie" event. Guests of honor for the festivities were Hans Hess, CEO of Leica Geosystems and Mathew Smith, North America President of Leica Geosystems. The Michigan Spatial Reference Network (M.S.R.N.) is considered the most advanced GPS reference network in the Western Hemisphere. It consists of 17 permanently-fixed high precision GPS antennas (Leica AT504) mounted on "Earlconic" proprietary concrete pillars and powered by Leica's world famous RS500 high precision GPS receivers. "As a result of the infrastructure put in place by the Michigan Department of Transportation, local county and city governments can now integrate Reference Stations into their own communities, thereby increasing survey production at a local level and providing common coordinate data for their many uses," said Richard R. Sauve II, Leica Geosystems' Technical Sales Representative for the state of Michigan.

The Leica Geosystems team in attendance stands around an "Earlconic" Michigan Spatial Reference Network Antenna.

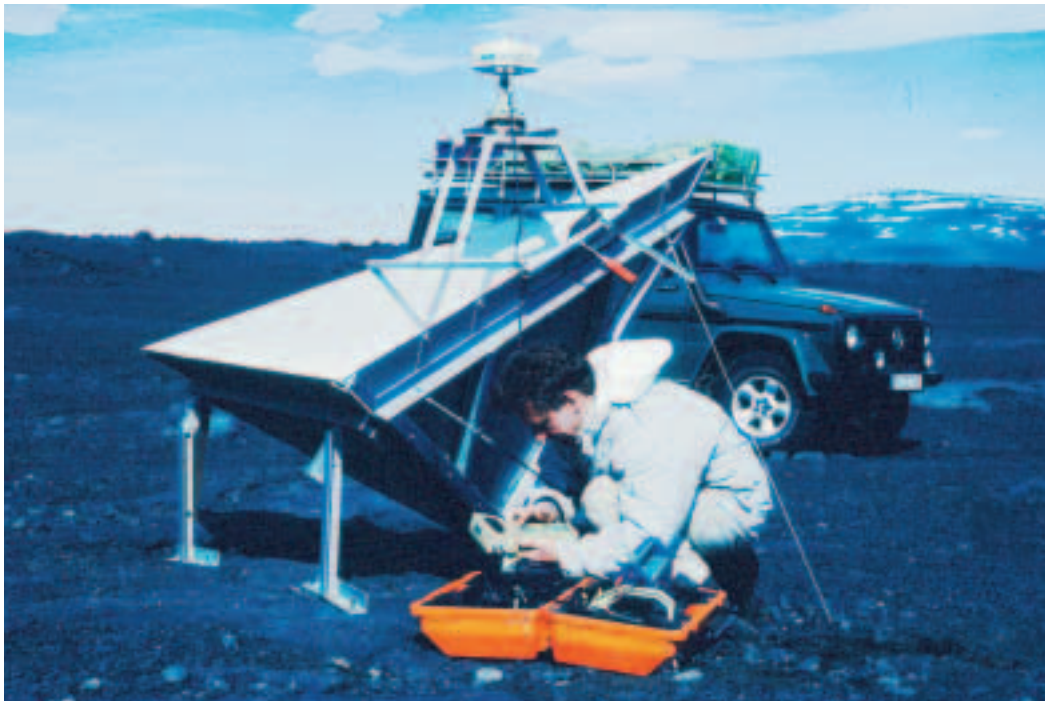
Europe's Earth Observation Satellite – ENVISAT

Envisat is in a near-polar Sun-synchronous orbit at a mean altitude of 800km. The satellite has ten different instruments mounted on-board, many of which are a development of those from ERS-1 and ERS-2. This means that it will be possible to make comparisons between conditions observed during Envisat's lifetime and those recorded during the past 10 years. Envisat is carrying three imaging devices: the Advanced Synthetic Aperture Radar (ASAR), the Advanced Along Track Scanning Radiometer (AATSR), and the Medium Resolution Imaging Spectrometer (MRIS). The remaining instruments are designed to measure certain atmospheric parameters and many of the actual constituents of the atmosphere helping scientists to understand each part of the Earth system and to predict how changes in one part will affect others. There is a dual-frequency radar altimeter (RA-2) to help with the determination of the surface topography of the oceans and also a DORIS microwave Doppler tracking system to provide precise orbital data.

Nowhere is volcanism more impressive and varied than on the largest volcanic island of the earth – Iceland. During the last decade the European Space Agency (ESA) has supported a number of disaster monitoring research projects utilizing the radar satellites ERS-1 and ERS-2. Following the recent launch on 1 March 2002 of the ENVISAT – Europe's newest polar-orbiting scientific satellite – it is envisaged that this continuing research will be greatly improved.

Dr Ulrich Münzer from the Institute of General and

ENVISAT research project uses Leica GPS for disaster monitoring in Iceland



Dr Th. Bahr with a Leica GPS200 System at the corner reflector V5 (Vatnajökull North) with sign-post volcano Trölladyngja (Photographs: Dr U. Münzer)

Applied Geology at the Ludwig-Maximilians University in Munich is conducting ongoing ESA projects in Iceland together with scientists from Germany, Iceland and Austria. Following volcanic eruptions in 1996 and 1998 in the Vatnajökull glacier of Iceland, an ESA project was initiated to investigate the possibilities of radar remote sensing to observe glaciers and volcanic areas.

Seismic activity in glaciers
Volcanic and seismic activity is common in Iceland, which is located on the Mid-Atlantic ridge where the plates of North America and Eurasia spread apart. In the south of the island some of the volcanoes and geothermal areas are covered by glaciers, making it a particularly interesting place for the study of glacier-heat and glacier-volcanic interactions. In several of the sub-glacial geothermal areas, destructive "jökulhlaups" – sudden bursts of water from the glacier – can occur causing extensive damage to the landscape and large vegetated areas, forming canyons, and transporting huge amounts of sediments. During the volcanic eruption in 1996, the water travelled up to 53,000 cubic meters per second. Jökulhlaups are caused when ice melts continuously within the geothermal areas forming a reservoir of the melt-water underneath the glacier. When the water level has reached a position high enough to over win the overburden ice pressure, the water rushes out and a jökulhlaup starts.

Radar remote sensing
The ERS-1/2 Tandem Satellite Missions in 1995-1996 and the Check Outs up to 2000, offered a unique opportunity to investigate the possibilities of radar remote sensing to observe the ongoing dynamical processes. Research aimed at detecting changes on glaciers due to sub-glacial geothermal areas and volcanic activity, and observing the geomorphologic effects of the jökulhlaups.

Improved features on ENVISAT
ENVISAT contains a number of new instruments that are designed to provide additional information about the Earth's land and sea surfaces. A number of instruments from Leica Geosystems have been used on Iceland for this disaster monitoring. Aerial photographs were taken over the Vatnajökull glacier with a Leica RC30 aerial camera, precise photogrammetric elevation model was developed with the workstation DPW770, and documentation photos made with Leica R7 and R8. A GPS measuring campaign was also made with the Leica GPS 200 system.

Purpose-built corner reflectors
In the active zone of south Iceland, a total of 30 Corner Reflectors were purpose-designed and built. Due to their positioning in areas with only minor surface roughness they show excellent signal reflection capabilities, and therefore are used as tie points for the ERS-1/2 Tandem mission processing and for geocoding the SAR data. With help from the Leica GPS 200 equipment, all reflectors were aligned to the Azimuth of the satellites with the highest precision; the determination of the position and the height (WGS 84) was carried out with differential GPS, and was reached in a measurement time of two hours with centimeter precision. Since the ENVISAT has the same satellite orbit as the ERS-1 and ERS-2, the corner reflectors can now be used for the new ENVISAT Project "Hazard Assessment and Prediction — Long-term Observation of Icelandic Volcanoes and Glaciers Using ENVISAT-ASAR and Other Radar Data" making a valuable contribution to the project in general.

Dr. Ulrich Münzer (left) and Uwe Bacher work on the corner reflector V4 (Vatnajökull North).

RUGBY 100 LR: combining heritage and expertise

The RUGBY 100LR is the first branded laser built from the combined heritage and expertise of Laser Alignment and Leica Geosystems. Rugged, reliable and the best-value-for-money general construction laser, the RUGBY 100LR is an automatic self-leveling general construction laser. According to Dan Dykhuis, Program Director of Lasers, "The RUGBY 100LR is a result of listening to our customers. It is built to be rugged, yet easy to use, and can make quick work of concrete forming, pad placement and

Construction on a new level

Leica Geosystems' new solutions for the construction site measurement

framework, setting foundation and footings, as well as elevation indication for heavy equipment."

The RUGBY 100LR has a working range of up to 2500' (770 m), automatic elevation alert function, manual grade up to ±10% with cross-axis self levelling. It levels automatically and very quickly too, has a simple five-switch keypad that controls all the functions, plus a low-battery and an out of level indicator. "Building along the same principles that guided the development of the earlier product, the RUGBY 100, customers can look forward to the same level of reliability and robustness. The Rugby 100 has received an overwhelmingly enthusiastic response from both Dealers and Customers worldwide" added Dan.

The co-molded housing of high-impact plastic and rubber is as rugged as it looks. RUGBY 100LR is the first Leica branded product combining the heritage and expertise of Laser Alignment and Leica Geosystems.

Rod-Eye™ Sensors

The Rod-Eye™ Family of Sensors offers solutions for any general construction and interior application, and are ideally matched to work with the RUGBY™ Family of lasers. They are construction-tough, designed to work in harsh, loud environments, and provide precise and repeatable accuracy. The sensors emit three selectable beeper sounds (rapid, slow and continue, when high, low and on-grade respectively).

Fusing GPS technology with Machine Guidance

The Leica 3D Control System for Graders has been further developed, so that now, in addition to the TPS1100 and the TPS1000 series, the Leica GPS System 500 can be used. The higher measuring frequency of the GPS sensor and the wider range will greatly improve working conditions. The version 3.0 software has also been further optimized to make it easier for the driver to operate the colourful touch screen on the new machine computer.

The Leica 3D control system for Graders greatly improves work conditions

Higher efficiency and lower work stress
Fusing GPS technology with machine control broadens the scope of application as GPS can be used 24 hours a day, in just about any weather. It is also no longer a requirement to maintain visual contact between machine and total station, meaning that the driver can concentrate on grading. Compared to total stations, GPS only has to be set up once and covers the entire construction site. Construction sites of 10 x 10 km can be covered with a single reference station. 3D control systems with GPS are very well suited for jobs involving preliminary grading and for projects that require a lot of earth-moving with accuracy down to the centimeter.
Beside 3D Control Systems for the Grader, Leica Geosystems offers solutions for other automated construction machines like the Slip Form Paver, the Trimmer, Paver and Bulldozer.

TPS400 - A new approach in user friendliness

Another one of Leica Geosystems' latest innovations is the new Series TPS400 Total Stations launched world-wide in July 2002.

The TPS400 instruments are designed for general construction, simple alignments or complex stake outs, earthmoving or pipe layout, simply for any kind of civil engineering applications at all.

Based on Leica's long experience in optics, mechanical and electronic design the technical concept of the TPS300/700 series, the TPS400 features a complete new approach in user friendliness. All models come with an intuitive keyboard and a large, high resolution LCD-display and have been designed to require zero learning time, and the instrument can be used to its full capacity with only four function keys. Setting up the instrument with a laser plummet and electronic level is easy and the endless fine drives and the accurate Leica telescope with 30-times magnification precisely targets each measuring point. The integrated electronic distance meter, featuring convenient infrared and reflectorless technology, measures to target plates, prisms or any given surface.

Taking account of the most frequently required construction applications, the TPS400 Series is supplied with the following applications programs: Surveying with Coding, Stakeout, Free-Station Survey, Tie Distance, Reference line, Remote Height, Area Computation, Target Point Offset and Height Transfer. In addition to the onboard programs, Leica offers the new "Leica Survey Office", a PC based program package for data transfer that comes with each instrument. The program package helps you create co-ordinate files, code-lists or user-defined data output formats.

LEICA DNA Digital Level

Surveying Experts

Advance at a glance. Keep everything in sight thanks to the large Liquid Crystal Display of the new digital levels by Leica. But there is more. From the alpha numeric keyboard to the PCMCIA–storage card that provides safe and fast data transfers. Why hesitate now that you can get all the features you always wanted? Ask your Leica Geosystems representative for more information.

Leica Geosystems

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