Surveying Education

Fact or Fiction
The future of surveying?

Google Earth
NGS control stations

Tips & Tricks
Hidden point offset
By Marc Cheves, LS

Don Carswell
President, Optech Incorporated

Dr. Allan Carswell
Founder of Optech Incorporated, and current Professor Emeritus at York University in Toronto.

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In the early 70s, Dr. Allan Carswell, a physics professor at York University in Toronto, developed a pulsed laser system used in the world’s first lidar bathymetric mapping system. Based on his research, Carswell founded Optech Incorporated in 1974. The history of Optech is a good example of the technology that’s coming out of Canada. In addition to a surveying industry that is highly educated, Canada has contributed greatly in the technology arena. York University is just one of six world-class schools in the Toronto area, all of which provide a steady supply of scientists and engineers for Canada’s high-tech sector. Dr. Carswell is still active in the company, especially in its space activities.

Surveyors know Optech primarily for its Intelligent Laser Range Imaging System (ILRIS) laser scanner, but the company is far more than that. The original bathymetric scanner has evolved into several Scanning Hydrographic Operational Airborne Lidar System (SHOALS) which are being used all over the world. In 2001, to cooperate more closely with NASA and the U.S. Navy, the company opened an international office in Mississippi at the Stennis Space Center. Optech’s other airborne scanner, the Airborne Laser Terrain Mapper (ALTM) is being used to gather lidar data over land. Its industrial division produces the Cavity Monitoring System (CMS) for remotely gathering data underground. At the 2008 SPAR conference in Houston, one of the presentations...
showed how CMS had been used in a cave in Rome (see image). (RTN expert and surveyor Gavin Schrock has speculated that CMS might be useful for gathering detailed manhole information without entering the manhole.)

Moving farther away from the planet, Optech has also developed Differential Absorption Lidar (DIAL) for monitoring ozone levels in the atmosphere. As the first lidar company to be certified in space, Optech’s gear recently made its way to Mars on the Phoenix Mission. After decades of pioneering work developing the analytic lidar theory, and following terrestrial test campaigns chasing dust devils in the desert, Optech’s laser is helping to analyze Mars weather patterns. The company’s first foray into space took place onboard the Space Shuttle as part of an autonomous docking system.

Since my last visit to Optech in 2002, the company has built a massive custom-designed building several kilometers west of their old location, and with over 250 employees, it has more than doubled its work force. The new building has unique features, including a ring design where anybody can circulate around the outer ring. A swipe badge is needed to progress into the building core. Large rooms are located in the outer ring to accommodate the number of people that travel to Toronto for training. The new building has plenty of room for expansion, and is located right next to a future Toronto subway stop.

A great deal of excitement surrounds their new LYNX Mobile Mapper solution (see the article in our April/May 2008 issue). This vehicle-mounted system employs new Optech laser technology as well as a full positioning and orientation solution from Applanix (see the article in our September 2008 issue) to gather incredibly detailed information (±5cm at 1cm resolution), all while driving at speeds up to and beyond 60mph. Once the 3D info is onscreen, amazing things can be done with it.

In addition to the two main business units (Airborne Survey Products and Industrial & 3D Imaging) and a space division, the Advance Technology Group is probably the most exciting.

Archaeologists working to restore the palace of Emperor Augustus on Rome’s Palatine Hill discovered a cave they now believe is Lupercale—the place where, according to legend, a she-wolf suckled Romulus and Remus, Rome’s twin founders. To begin investigating their fragile find, the archaeological team from the Rome Municipality’s Cultural Heritage Department engaged Codevintec Italiana srl, Milan, which lowered an Optech CMS into the chamber and scanned the interior.

Assembly and repair
Headed up by Dr. Paul LaRocque, this is the R&D wing. The division is constantly looking for crossovers. ILRIS was a result of the space docking system. Looking ahead, the company knew what it needed for LYNX.

I met with several people during my visit, including Brent Gelhar, who is in charge of sales and support, manufacturing, and engineering. Gelhar has been in the industry for decades, and understands surveyors and surveying. He mentioned that the company focuses on products and technology and that 80 percent of the revenue is derived from products. He added, “Optech’s goal is the best possible data and software to handle that data. We concentrate on vertical niches and strive for longer range and higher accuracy from our eye-safe lasers.” Gelhar says, “We call ourselves The Lidar Company, and focus on hardware and the software to support processing that data.” Gelhar said LYNX was the result of a three-year R&D effort, with the design criteria being both a higher performance scanner combined with extreme ruggedness and easier manufacturability.

At any given time, Optech has 25–30 engineers onsite or in the air all over the globe doing repairs and support. Gelhar showed me the 24/7 support center that responds to requests from all over the world and connects customers to factory engineers. Toronto’s world-class airport allows engineers to travel anywhere in the world within 22 hours with typically only one stop. In addition to the traveling engineers, Optech also has repair centers in Italy, South Africa, Australia and China for the ILRIS and CMS products.

As we toured the assembly and repair areas, Gelhar pointed out various technical innovations, including a folded optical loop above the ceiling that is used to calibrate most of the lidar equipment. In a very small closed space, Optech has found a way to create a 2km baseline. (We discussed the ongoing effort by NIST to establish standards and specs for laser ranging equipment. Even though the various committees seem to be taking some time to publish the results, Gelhar is confident that the effort will level the playing field.) Gelhar says Optech’s original importable data format for its airborne lidar equipment has now evolved into the industry standard LAS format. The company published the open IXF format for its ILRIS gear three years ago. I asked if Optech had any difficulty hiring people and Gelhar said that, with the six universities in the area, it’s not a problem attracting qualified technicians, engineers or scientists. Gelhar discussed how all the equipment is built in limited production runs, with ILRIS being built in batches of 10–15 instruments. Approximately 100 ILRISes are produced each year and more than 300 have been delivered.
I met with Glenn Farrington, general manager for Airborne Survey Products, the new business unit that combines the company’s ALTM and SHOALS businesses. Farrington was formerly operations manager for the Airborne (ALTM) Division. More than 120 ALTMs have been delivered, with more than 15 of them being the new multi-pulse Gemini model. The Gemini operates at 167KHz and offers a 62% increase in data coverage and effective collection rate by allowing collection at twice the altitude of previous models.

Supporting the Gemini is Optech’s DASHMap processing software, its next-generation in lidar data processing with an accelerated data acquisition-to-processing ratio. Optech estimates that 2–4 ALTMs are running somewhere in the world at all times. Farrington commented that demand for airborne lidar imagery has increased dramatically, and that the price per square kilometer has dropped by nearly half.

Farrington said the majority of the ALTMs are being used in medium to large-scale mapping, with the largest growth in corridor mapping. Mounted in helicopters, the ALTMs can gather data from just 80 meters above the ground and are being widely used on power lines and railroads. For power lines, the asset owners are interested in the catenaries of the lines and tower slump or twist. It’s also being used to create DEMs for flood mapping and for change detection.

Farrington discussed year-to-year bridge and dam monitoring projects in the UK and said they are getting ±3–5cm accuracies. He also mentioned an Ohio DOT mission where the system was able to detect surveyors’ footprints in the snow!

A highlight of my visit was a session I spent with Albert Iavarone, business unit manager for Industrial & 3D Imaging Products. Iavarone’s responsibilities had included ILRIS and CMS (and Optech’s other object-positioning and level-monitoring sensors), but had recently grown to include the LYNX Mobile Mapper. According to the company, the LYNX boasts a revolutionary new lidar sensor head that leverages Optech’s 33 years of development experience and the latest in lidar innovation—integrated FLEXible lidar electro-optics (iFLEX)—to collect survey-grade lidar data at over 100,000 measurements per second with a 360° field-of-view, while maintaining a Class 1 eye safety rating. The LYNX can accommodate up to four lidar sensor heads, fuses the lidar data with an on-board passive imaging system, the Applanix POS LV 420 system, and a software platform to produce survey grade 3D data from a mobile vehicular platform. Gelhar mentioned that Optech is one of Applanix’s largest OEM customers.

**Simulation Science**

Iavarone commented that iFLEX is the result of a three-year R&D effort, and from the Canadian-made boards up, it represents an all-new electronic platform for Optech. He showed me how extensive mathematical modeling—called simulation science—is being used to develop new products. In addition to the 100KHz laser, the rotating mirror in the unit turns at 9,000 rpm! Priced at $400–500,000 and targeted at DOTs, large engineering companies and remote sensing companies, customers can mount from one to four sensor heads. If the four heads are hooked together in parallel, the system can handle 400,000 measurements per second! Dealing with huge amounts of data, even from four heads, is not a problem.

This is a company that literally gathers data from under the surface of the earth all the way to Mars.
Once in the office, the new LYNX Survey software aids in manipulating large datasets. I watched a demo of LYNX Survey and was impressed not only with its speed in manipulating the data, but also with the fact that it captured flow-line information if the vehicle passed over a grate in the pavement. Optech believes that, with the rapid data acquisition, LYNX has potential in machine control. The company also believes its equipment is conservatively spec’d.

Uses will include real-time 3D data visualization, data colorization, and rapid geo-referencing. Gelhar mentioned that Europe and the UK are ahead of the US in virtual reality, and showed me a cool application developed by the Norwegian company, Blom ASA. Blom’s Navigator will accept data from a variety of sources, including LYNX data and Pictometry’s extensive oblique imagery and meld the data into a viewer. (Check out the Navigator at www.blomasa.com/en/products--services/navigation). Gelhar mentioned that Google and Microsoft are collecting accurate 3D maps for police and taxi drivers, and for that matter, anybody who drives.

I finished up my visit with Optech president Don Carswell. He confidently stated that Optech’s strength is delivering products which generate the best data. He commented that lidar data is being used everywhere, even though it is the least known of all digital data. He predicts that the demand for solid models will decrease as 3D point clouds get richer, denser and cheaper. “Delivering data is a done deal for us. The next step is information, and we are partnering with companies like Blom, Infoterra, Pictometry and many others who are expert in this,” says Carswell. He added, “Our focus will remain on developing the best lidar tools in the industry.” He reiterated the success of Optech’s 24x7 technical support and said, “When a customer calls, they can speak directly to the factory engineers.”

This is a company that literally gathers data from under the surface of the earth all the way to Mars. I have been very impressed with innovation we’ve seen from York University and other Canadian universities. More than two-thirds of Optech’s employees have university degrees, many of them up to the PhD level. Optech has progressed from a specialty systems integrator to a mainstream lidar product manufacturer, or, as Gelhar put it, “from a project-based technology company to a product-based technology company.” Without a doubt, we will be seeing more from Optech.

Marc Cheves is Editor of the magazine.