THE American Surveyor

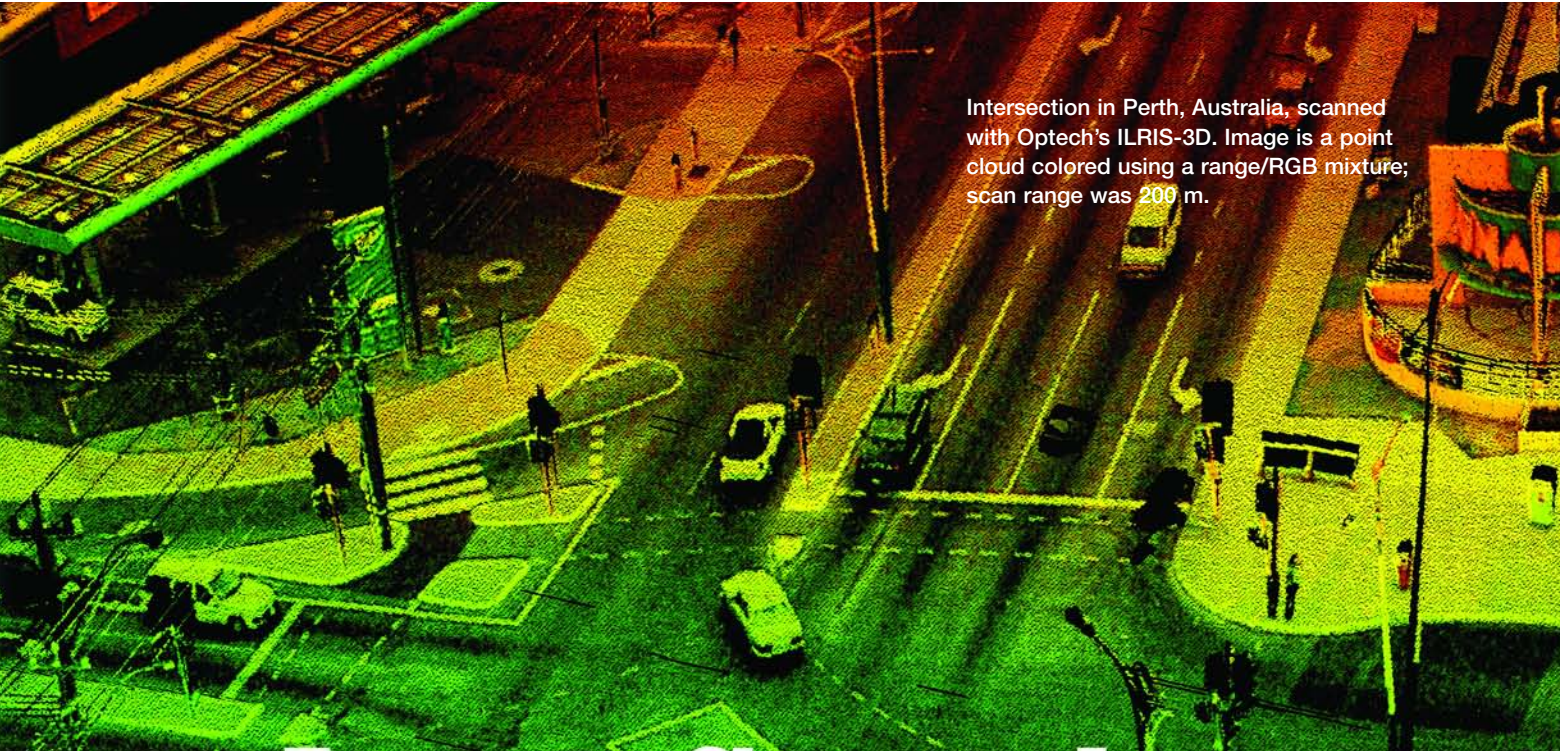
A Foot In The Past... An Eye To The Future

July/August 2004

# Surveying New Mexico

## Plus

Double Monumentation
Mr. Chicago Steel Tape
Rapid Response Mapping
Ronald Reagan & Surveyors



Intersection in Perth, Australia, scanned with Optech's ILRIS-3D. Image is a point cloud colored using a range/RGB mixture; scan range was 200 m.

# Laser Scanning

## What Matters, What Doesn't Matter, and What Matters Some of the Time

As a service provider, choosing to add a new product to support your clients' needs is a big decision. Choosing to add a product based on a relatively new technology, such as laser scanning, can be an even more important decision.

There are currently a multitude of choices in the tripod-mounted laser scanner market. While the output is fundamentally similar among all of the manufacturers, operational functionality can vary greatly between products. When choosing a laser scanner, the expected application will influence the priority of particular features. But more often than not, you must make a difficult choice regarding which features are practical and which features are superficial.

When TVGA began researching the laser scanner market in 2001, we quickly recognized that this technology had the potential to dramatically change the way current measurements were being taken as well as open the doors to measurement services in areas that previously had not been practical or cost effective. 3D laser scanning and modeling technology offered a unique opportunity for TVGA to broaden its range of services and customer base, and improve its competitive position in the marketplace.

TVGA spent a large amount of time and effort in gathering information pertaining to the various laser scanners that were available. The difficulty we encountered was that scanner manufacturers were quick to provide convincing reasons why we should purchase their system, yet conversely, our current service providers were hesitant to provide any information that could potentially create new competition.

Some of the questions we asked included:

- Does the scanner really require a 360º field of view?
- How often will we use the long-ran ing capability of the scanner?
- Are there any safety issues when working with a laser scanner?
- What are the physical dimensions of a laser scanner?
- How important is a manufacturer's experience in developing laser systems?

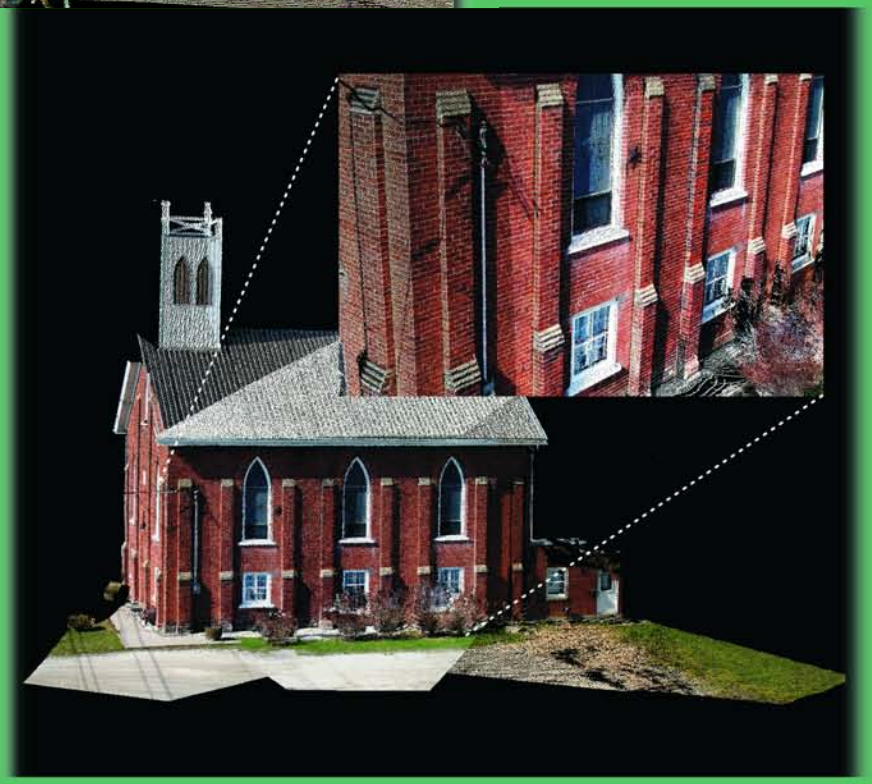
So when it comes to the purchase and implementation of a laser scanner, what matters, what doesn't matter, and what matters some of the time?

### Field of View

There is a misconception that the scanner's field of view must be 360º x 270º. Unless

>> By Roman H. Figler III, LS

Point cloud (with RGB color) of a barn in Germany, scanned with ILRIS-3D at a range of ~30 m.



Close-up of church in Toronto, Ontario, showing architectural detail at a resolution of ~5 mm, with ILRIS-3D.

the vast majority of scanning is to be done indoors (at close quarters), a 360º scan will rarely be required. In reality, a 360º field of view does not guarantee full area coverage; in fact, it rarely does. Laser shadowing forces data to be collected from multiple angles for complete data coverage. A large field of view does not alleviate this requirement. Also, the angle of incidence of a measurement will have a profound impact on its accuracy and the resolution of the data in general.

Imagine surveying a long, flat wall. If the scanner has a 180º horizontal field of view it will be able to survey the wall in a single scan. Depending on the length of the wall, measurements may be collected from angles that approach 90º, but the reliability of these measurements will be very poor.

TVGA discovered that, in order to achieve consistency with accuracy and resolution, multiple scans will still be required along the length of the wall, even with a 360º field of view.

## Range

Don't underestimate ranging capability. In some cases, the lack of ranging ability will preclude the ability to do certain projects altogether. Consider, for example, a bridge that crosses a body of water. While the lack of certain characteristics (such as a 360º FOV) may force you to collect more scans, it won't prevent you from completing the project. On the other hand, the inability to range to the structure, with no provisional means of getting closer, will render it ineffective or useless for projects such as this.

It is also true that a survey will rarely be conducted at a range greater then a few hundred meters (except in cases similar to the above example). However, long-ranging capability has other benefits that are not immediately identifiable. At the extreme limit of a scanner's specified range, the accuracy of the measurements will begin to decrease in a non-linear fashion. For example, when scanning a structure from 150m away, the scanner that has a maximum range of 150-200m will struggle to collect the data. It may succeed, but the measurement quality will suffer and the dataset will contain a large number of "drop out" points (instances where no measurement was collected). Alternatively, the scanner that provides 1,000 m range will be collecting data from the ideal area of its total dynamic range, yielding data of optimum accuracy.

TVGA also discovered the importance of comparing ranging capability by examining manufacturers' range/reflectivity graphs. While Product A may appear to have the same range as Product B, the claim may be based on an 80% reflective target while Product B makes that claim based on a 20% reflective target. All things being equal, Product B has a much longer ranging ability.

## Eye Safety and Laser Class

When comparing scanners, the impact of laser eye safety should not be underestimated. According to the Laser Institute of America, a Class 1 laser device "denotes exempt lasers or laser systems that cannot produce a hazard under normal operating conditions," while a Class 3a laser device "denotes visible lasers or laser systems that

normally would not produce a hazard if viewed for only momentary periods with the unaided eye. They may present a hazard if viewed using collecting optics."

These differences may seem relatively subtle and unimportant–that is, until the issue of liability arises. What if the unit stops scanning for some reason? The laser could potentially hit someone in the eye repeatedly. What if someone accidentally looks into it with a viewing aid (such as binoculars)? This may seem far-fatched, but when working in a public place it's impossible to predict what a bystander will or will not do. With this in mind, we believe that a Class 1 laser is an important factor in choosing a laser scanner. The fact is many contractors simply won't accept the added liability of a higher laser class when other options exist, and as a result many RFPs and contracts are starting to mandate a Class 1 laser device.

## Size/Weight

The time-honored goal of technology is to increase efficiency while reducing the amount or cost of labor. Laser systems vary in size and weight, but we prefer a scanner that can be moved, set up and operated by a single user. Scanners that are compact, relatively lightweight and easy to use (meaning they don't require a laptop computer) can achieve this. As the unit increases in size, the ease of use decreases and the cost of labor rises.

TVGA believes that like GPS, the laser scanner is going to become a "tool of the trade." Based on our market research and careful consideration, TVGA purchased the Optech ILRIS-3D laser scanning and modeling system in June of 2002. In addition to particular instrument features that met our requirements, we also wanted a provider with a solid reputation. Optech has a 30-year track record and a strong support system for their products.

Ultimately, the importance of a particular feature will depend on your company's core applications. In our experience, a careful study and assessment of features, coupled with an understanding of the accuracy and resolution specifications provided by various manufacturers, gave us the necessary tools to make a sound selection. In the end, we discovered what matters, what doesn't matter, and what matters some of the time, and we're confident we made the best choice.

Roman Figler is Vice President/ Survey and Mapping at TVGA Consultants.