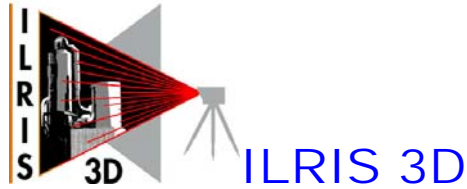




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Intelligent Laser Ranging and Imaging System



ILRIS-3D is a complete, fully portable, laser based imaging and digitizing system for the commercial survey and industrial market. It is a compact and highly integrated package with digital image capture and sophisticated software tools that address the needs of commercial users.

A field ready system, ILRIS-3D is carried by a single operator and requires no specialized training for deployment. About the size of a motorized total station, with on-board digital camera and large-format LCD viewfinder, ILRIS-3D has a virtual interface similar to that of a digital camera. Typical working range is 3 - 350m.

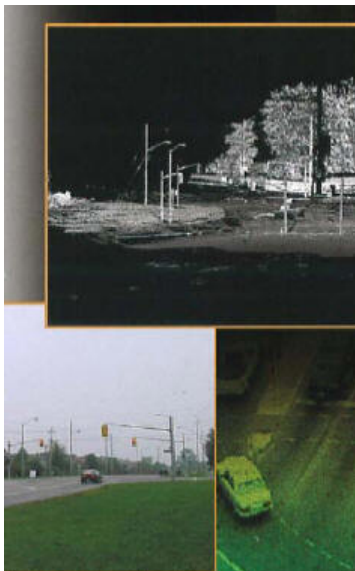
Field deployment is made extremely efficient by ILRIS-3D high data rate - point cloud data are captured at 2,000 points per second. A typical scene with adjacent point spacing can be fully scanned in 10-15mins capturing a remarkable 1.2 to 1.8 million points.



The ILRIS 3₆D has an Industry Leading 360° x 360° field of view

ILRIS-3D is completely eye safe in all modes of operation, even when its beam is viewed directly through binoculars.

ILRIS 3D setup is rapid and simple. No leveling required. The system is controlled via a hand held PDA or lap top. The target area and the scan status are displayed locally on screen, and data is written directly to an on-board removable flash card. An embedded Pentium processor controls all functions.



Survey scene and point cloud data of an intersection

The Scan data is processed by another software bundled with ILRIS-3D such as Polyworks software from InnovMetric. The data set consists of XYZ and intensity point cloud data, a digital image of the captured screen, and field notes entered during the scan by the operator. Files can be output quickly and efficiently in a variety of formats.

The ILRIS-3D is ruggedly designed for field use, based in Optech experience in designing and manufacturing laser-based industrial level monitors, object positioners and mining equipment. It is rated from 0 to 40 degree centigrade and is weatherproof for use outdoors.



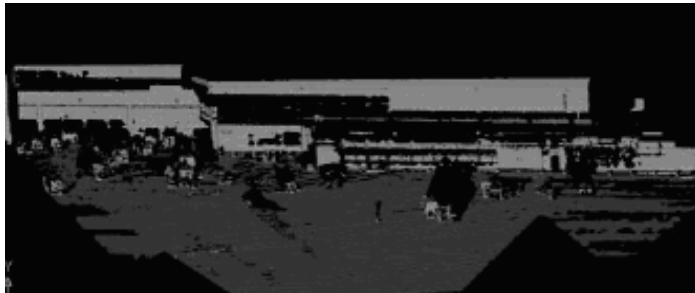
Convenient & easy traveling case

Case 1: Topographical Survey (Airport Tarmac Analysis):

In May 2001, the Greater Toronto Airport Authority (GTAA) contacted Toronto-based Northway-Photomap Inc., a survey and mapping company employing Optech's ILRIS-3D lidar scanner, to complete a survey of Pearson International Airport's Terminal 3 tarmac (apron). A safety issue had arisen at the airport when it was noticed that travelers embarking or disembarking a plane would often sidestep puddles or wet areas on the ground, potentially stepping into hazardous jet exhaust or propellers.

As Pearson is one of the busiest airports in Canada, clearing the apron for a survey was extremely difficult. Because of this the GTAA needed a quicker and more efficient method to detect the low-lying areas causing puddles. Both the GTAA and Northway-Photomap felt the process could be significantly improved using the ILRIS-3D laser scanner. The methodology of the project was:

1. Use ILRIS-3D to collect a significant amount of xyz data by "painting" the scene with laser shots.
2. Complete a survey using a GS50+ Dual Frequency GPS System to position the data in the NAD 83 Co-ordinate System.
3. Generate contours depicting the low-lying areas.
4. Deliver the project data to the GTAA in an understandable, clearly defined format.



A point cloud image of Terminal 3 containing four scans with >1.6 million points. f

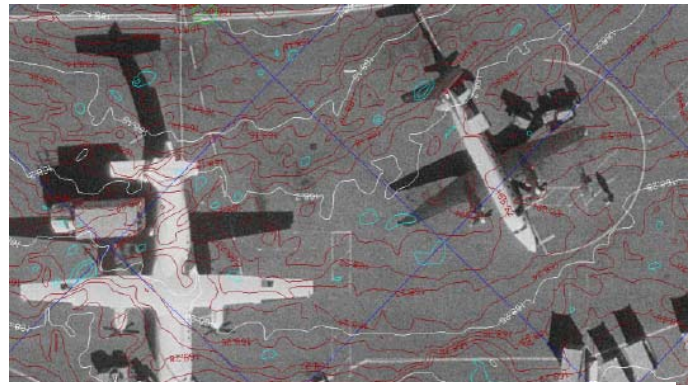


An aerial orthophoto of Terminal 3.

Four scans of approximately 14 minutes each were completed with an xyz point total of 1,680,000 points per scan. The data points were spaced 10 mm apart based on a mean target distance of 55 m. The individual scans were aligned together as a single scene, resulting in a file with 5,794,322 survey points. GPS survey data was collected and used to position scans through a co-ordinate transformation to an absolute reference to the NAD 83 Co-ordinate System. The data above the ground was removed partly by software processing and partly by manual editing. Owing to limitations in present contouring software, the data was re-sampled (decimated) to produce a smaller collection of data points to a final output of 974,320 points. Terramodel© software was used to produce a normal 10-cm grid of data points on the ground surface. The final output and end-deliverable was a digital orthophoto image (from archives) draped with a 1-cm contour.

Stage	Time
ILRIS-3D - Four scans including setup	4 hours
Processing time, (edit and alignment)	3 hours
GPS survey	4 hours
Orientation of scan data to NAD 83 Co-ordinate System	2 hours
Production of contours and final product	2 hours
Total Time	15 hours

Passenger and ground personnel safety was enhanced with higher density apron profile data.



Final Product: digital orthophoto image (from archives) draped with a 1-cm contour

Case 2: Forensic Survey Accident Reconstruction

Accurate documentation of the "crash environment" is vital for these experts. To determine the most probable scenario leading to the accident, physical elements such as skid marks, road settings, potholes and shoulder conditions are analysed. Guard rails and utility poles are also included in the assessment. Weather and lighting conditions (which can contribute to an accident) also need to be included in the assessment, but these conditions can hinder traditional data collection methods. Lidar technology is currently being deployed by police organizations and surveyors alike for a variety of applications, including accident reconstruction.



Digital images of the accident site taken with ILRIS-3D



Crash scene evidence, featuring five scans merged into a single point cloud dataset

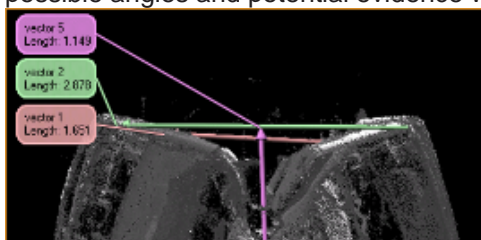


Digital images of the accident site taken with ILRIS-3D

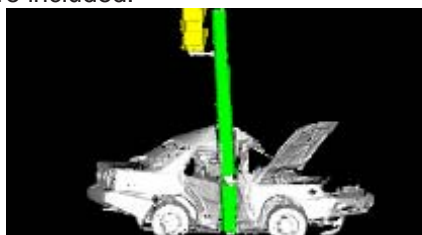
Since an accident can happen at any time, rain, snow and darkness can limit traditional data collection methods such as photogrammetry. Lidar scanning units that are rated to operate in inclement weather as well as independent of ambient lighting are ideally suited for quick, accurate and efficient on-site data collection in virtually any circumstance. With the advent of ground-based lidar scanners as an acceptable form of fast and accurate 3D data collection, the Toronto Police Force is investigating the possibility of using lidar technology to assist them in accident scene reconstruction. On September 1, 2002 at 20:00 Northway-Photomap Inc., a Torontobased survey company employing Optech's ILRIS-3D laser scanner, was contacted by Toronto Police to assist them in an accident scene investigation. A crash had occurred at a busy intersection involving a single car and a traffic signal pole. A three-dimensional digital image of the scene was required in the least amount of time possible. Both the police and Northway-Photomap felt the survey could be conducted more efficiently using ILRIS-3D. As such, ILRIS-3D was used to collect survey points of the scene for reconstruction and forensic analysis.

The objective was to collect as much data as required as quickly as possible, in order to re-open the roadway. Unlike photogrammetry, ILRIS-3D is an active sensor and the time of day and low light level was not a factor. The scene was scanned and data captured to sub-centimetre accuracies from distances out to 250 metres. Multiple scans were taken and joined to create a "virtual reality" crash site. Owing to ILRIS-3D's long-range capabilities, a substantial amount of collateral data was also collected including neighbouring trees, poles and curbs, all of which can prove vital in forensic review. In the post-processing software, the data was analysed with attention paid to the skid marks and point of impact. Through vector placement and other measurement techniques, the dynamics of the collision were determined.

The total on-site time required for this exercise was approximately 1 hour, allowing for the rapid re-opening of the intersection. Five scans were taken, consisting of 3,506,402 points, and later aligned and merged in post-processing software. All data was viewed on-site to ensure full coverage, and all possible angles and potential evidence were included.



Complete merged data set of the crash sceneshowing the dynamics of the collision through vector placement.



An AutoCAD model was generated for evaluation and documentation for court presentations.

ILRIS-3D delivered higher quality, quantitative evidence with reduced roadway inconvenience.

Case 3: Bridge Scanning: Two bridges, one day, surveying made twice as easy

On May 27, 2002, Purdue University undertook a project with Optech to scan two bridges in Indianapolis, Indiana. The purpose of the project was threefold:

1. To ascertain the speed at which such a project could be completed.
2. To document the process of scanning a complex structure such as a bridge.
3. To verify that dense, accurate data could be generated within a reasonable time.



ILRIS-3D scanning the survey scene & a profile view point cloud.

The bridges that were scanned were the Bridgeport Road bridge and the Six Points Road bridge, both over Interstate 70, immediately southwest of the Indianapolis Airport. This area is scheduled to become an entrance to new airport terminal facilities. The goal of the data collection was to provide detailed as-built information to the design team under contract to the Indiana Department of Transportation (DOT). Scanning each bridge presented several challenges. The scans had to be done from several locations in order to ensure coverage of the entire structure, and a fine balance between data collection time and point density had to be maintained. Extreme oversampling would increase the data collection and processing times, but the point density had to be adequate for the application.

The most difficult challenge in the project was aligning scans from the top of the bridge to scans from the



Photo of one of the surveyed bridges.

sides and bottom. Since alignment requires common points to align multiple scans, several tripods were placed on the surface of the bridge.

Each tripod held a different geometric object ranging from a GPS antenna to Styrofoam spheres. These worked well because they were visible on all scans and could be used for the alignment process.

It was determined that each bridge would require 12 scans at a resolution of approximately 1 inch. This resulted in a data collection time of approximately 3 hours for each bridge, including 2 hours of scanning (10 minutes per scan) and 1 hour of setup time (5 minutes between each scan). In the end, both bridges were scanned in one business day.



During each scan cars were continually passing into the field of view of the scanner. As a result, each scan needed to be edited individually before the scans could be aligned together. This was accomplished in a matter of minutes for each scan using the 3D viewing ability of PolyWorks. Following that, the scans were aligned to generate a complete dataset. Using the features visible on the top of the bridge made this relatively easy (approximately 2 hours for each bridge). The final process for this phase of the project involved the generation of solid models and cross sections from the datasets. Using PolyWorks, approximately 20 MB solid models were generated in 1 hour for each bridge. Once the solid models were complete, the generation of cross sections was simple. Cross section intervals were decided upon and the cross sections (dxf format) of each bridge were generated in minutes.

High resolution solid models and cross sections were provided in the span of 24 hours. This project proved that a high resolution structural survey can be completed and processed at unprecedented speeds. Also, due to the high point density, the user is able to provide products that are unavailable from conventional methods. Not only was time saved, but a better, more complete product was provided to the client.

PROJECT SUMMARY	Bridge A	Bridge B
Total Data Collection Time	3.5 hours	3 hours
Total Data Processing Time	3.25 hours	3.25 hours
Total Time per Measurement	0.0045 seconds	0.005 seconds
TOTAL TIME TO GENERATE FINAL PRODUCT	~7 hours	~6.5 hours

**Better data in half the time
 PRODUCTIVITY DOUBLED**