Optech

Field Notes

Power Dam and Retaining Wall Monitoring with ILRIS-3D: Safe, Accurate and Complete

A body of water extending for miles behind a hydroelectric dam exerts enormous pressure on the dam and its surrounding terrain. Whether the dam is constructed of gravel, earth or concrete, regular measurements must be made in order to detect any changes in the material holding back millions of tons of water.

Modern surveying instruments, such as total stations and GPS receivers, have made this task easier and less time-consuming than traditional methods, but still do not offer the required point spacing to deliver a comprehensive surface analysis. Three-dimensional laser imaging is the latest technology to be used in this essential monitoring process. Recent developments in computer speed and memory size enable rapid processing of data acquired by 3D laser scanners.

Instead of using several dozen "target" points to monitor movement, users can now rely on a "point cloud" consisting of hundreds of thousands or even millions of points to represent the structure being measured. Targets are not required for this purpose as the laser scanner measures points on any solid surface with a reasonable degree of reflectivity.

Creating solid models from the point cloud results in a very accurate rendering of the structure's surface upon which precise measurements can be made. Comparisons with previous scans can quickly and accurately indicate where changes have occurred on the surface of the dam and whether the structure remains within design and operating tolerances.

Korean Water Resources

Recently, Optech Incorporated undertook two projects that illustrate this new method of power dam monitoring.

Optech's ILRIS-3D laser scanner was used to scan the Hoengseong Dam in South Korea. The surrounding terrain was scanned with a resolution of 1 inch, as were the upstream and downstream sides of the dam. This work was done by one person in less than 4 hours, for a total of 12 scans in 6 set-ups.

Cross-sections derived from the point cloud.

The completely hands-off measurement method that laser imaging allows makes dam monitoring an extraordinarily safe and effortless procedure. No surveyors are asked to venture out on the sloping sides of the dam to position themselves over GPS target points or to hold prism poles on checkpoints.

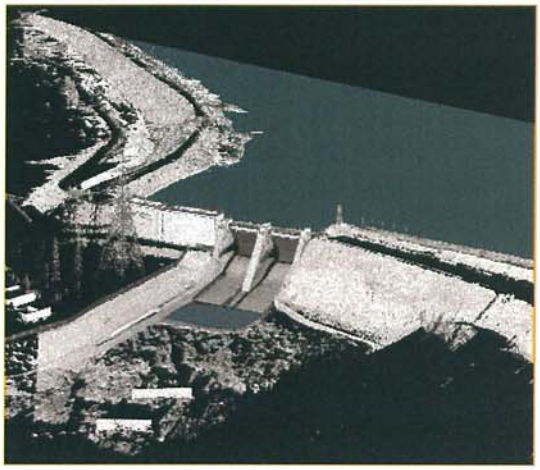
Aligned point cloud image of the hydroelectric dam.

Data Processing

The scanned images were then brought into the powerful InnovMetrics Polyworks IMAlign™ software module, where they were aligned to each other using only their own features — alignment targets were not required to complete this process.

Once aligned, the combined point cloud image can be brought into an inspection software (such as Polyworks IMInspect™) and used to measure distances between points, measure angles between surfaces, geo-reference the image, create cross-sections, extract contour lines and features and export data to the users' CAD software package in a wide variety of data formats. Additional software modules are available for the creation of refined solid models for further inspection and interpretation.

High resolution solid models and cross-sections were provided within 24 hours. This project showed that by using the ILRIS-3D laser scanner, a high-resolution structural survey can be completed and processed at unprecedented speed and with an unparalleled degree of safety. Additionally, due to the high point density, the user is able to provide data that are not available from conventional survey methods.

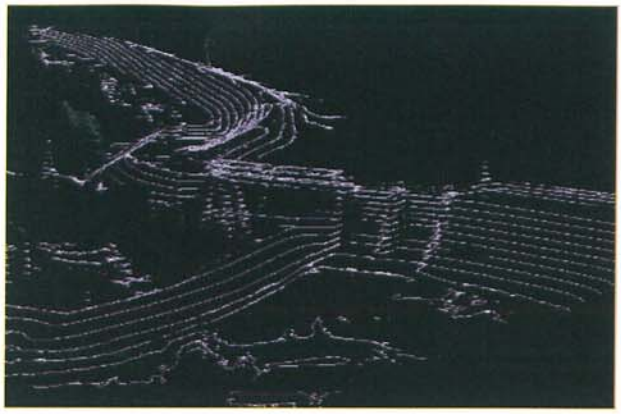


A point cloud image of the Porjus hydroelectric dam.

Porjus Hydroelectric Dam Project

The Swedish Power Authority, Vattenfall, recently commissioned Optech to undertake a feasiblity study to determine if the short and long-range capabilities of the Optech ILRIS-3D 1 laser scanner could be used effectively on some of their large dam projects in northern Sweden. With its unmatched dynamic measuring range capabilities (from 3 m to over 1,000 m), the ILRIS-3D is the only laser scanner on the market today that is capable of measuring a sufficient number of points, with enough precision, to produce an accurate image of the dam.

Due to the sheer size of the project (at 1.7 km, the Porjus dam is one of the longest dams in the world), more than 100 scans along the entire structure were required to complete the data acquisition phase of the project. Despite scan distances that varied from 20 m to over 700 m, one person was able to scan the entire Porjus installation in approximately 2 working days.



Two meter contours derived from the solid model.

Data Processing

number of scans. Measurements and feature extraction can now be done easily by any operator familiar with the software, and subsequent scans can be compared with the original scan to monitor the structure for movements down to the sub-centimeter level.

ILRIS 3D

ILRIS-3D Laser Imaging System

Dynamic Measuring Range:	3 m to 1,500 m
Accuracy:	Distance: ± 7 mm Angular: ± 170 micro-radians
Spot Resolution:	Minimum 26 micro-radians
Data Sample Rate:	2,000 points per second
Output:	- XYZ coordinates - Intensity (active laser photography) - Digital photo data - Operator set-up parameters - Notes
Operator Interface:	Digital camera - 4.0 megapixels (or higher) Viewfinder - 17 cm VGA Control interface - Palmtop PDA
Recommended Software:	Polyworks® software from InnovMetric™
Dimensions: Weight:	312 x 312 x 205 mm 12 kg
Environmental:	0 to 40°C operating / -20 to 50°C storage
Eye Safety:	Class 1, completely eye-safe in *all* modes

In both projects, ILRIS-3D provided more data than conventional methods, in much less time.

FM CE

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