

Geosensing Engineering and Mapping (GEM)
Civil and Coastal Engineering Department
University of Florida

ILRIS-3D Ground Based Laser and PolyWorks

GEM Center Report No. Rep_2004-06-002

A. Mamatas, M. Starek, K.C. Slatton

June 3, 2004

© 2004, GEM. All rights reserved

Point of Contact:

Prof. K. C. Slatton

University of Florida; PO Box 116130; Gainesville, FL 32611

Tel: 352.392.0634, Fax: 352.392.0044, E-mail: slatton@ece.ufl.edu



ILRIS-3D Ground Based Laser and PolyWorks

1.0 Introduction

Intelligent Laser Ranging and Imaging System (ILRIS)-3D is a tripod-mounted, 3-dimensional, terrain laser scanner developed by Optech for high-resolution engineering and mapping applications. The system is designed for static, ground perspective surveys, not flight surveys, and the data can be fused with other data sets such as airborne laser survey data for high-resolution analysis, Figure 1 below. The following is a basic presentation on ILRIS including system specifications, scanner control and operation, data retrieval and processing, and the *PolyWorks* software.

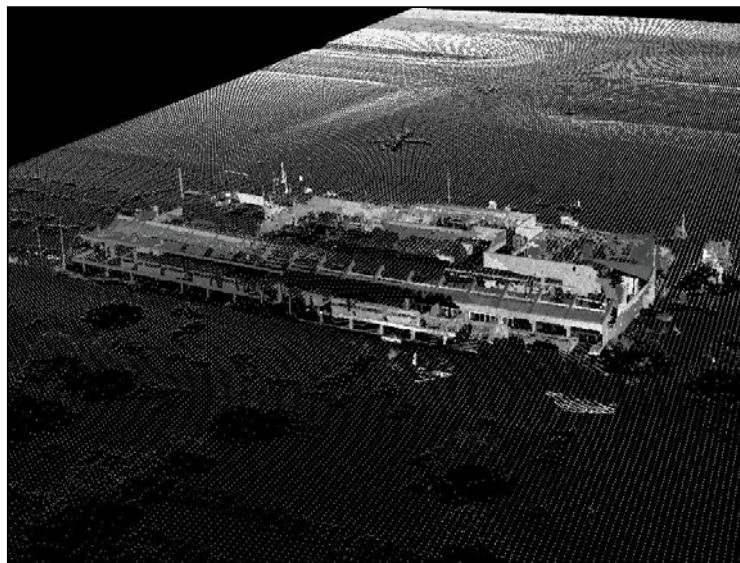


Figure 1: Fusion of ILRIS and Airborne Laser Data

2.0 ILRIS Features

Key specifications include [2]:

- Scanning range of 3m to >1000m
- 2,000 pulse-per-second scan rate
- 1,547 nm laser (eyesafe at all distances including binoculars)
- Max field-of-view is 40° horizontal and vertical (20° half angle)
- Spot size 29mm @ 100m
- Modeled output accuracy in the range of 5 mm
- 640 x 480 pixel color digital camera
- 17cm VGA viewfinder for targeting
- Power: 24 VDC battery; 24 V rechargeable
- Control interface: palm pilot, laptop, or compatible PDA
- Scan size: range from a few megabytes to 10+ megabytes in size
- Memory: ATA flash cards (128mb PCMCIA flash cards in current use by GEM)

Key benefits include [2]:

- Resolves small features at long range
- Short scan time: scene with 1.2 to 1.8 million points can be fully captured in 10-15 minutes
- Easy to use, no extensive training, easy to set up
- No leveling, retro-reflectors, or mirrors required
- Portable and compact, deployed by a single operator
- Battery-operated
- Edit out intermittent objects during data processing
- Digital data directly compatible with GIS programs



Figure 2: View of ILRIS

2.0 ILRIS Control and Operation

Scanner control and setup is managed by control software that is stored either on a palm pilot, laptop, or compatible PDA. Currently, GEM utilizes a palm pilot for set up and operation of the ILRIS via control software developed by Optech to run on *Palm OS* (i.e. the palm pilot's operating system). The palm pilot can be operated in wireless infrared mode or directly connected to the scanner. Figure 3 displays a standard operating mode utilizing the palm pilot.

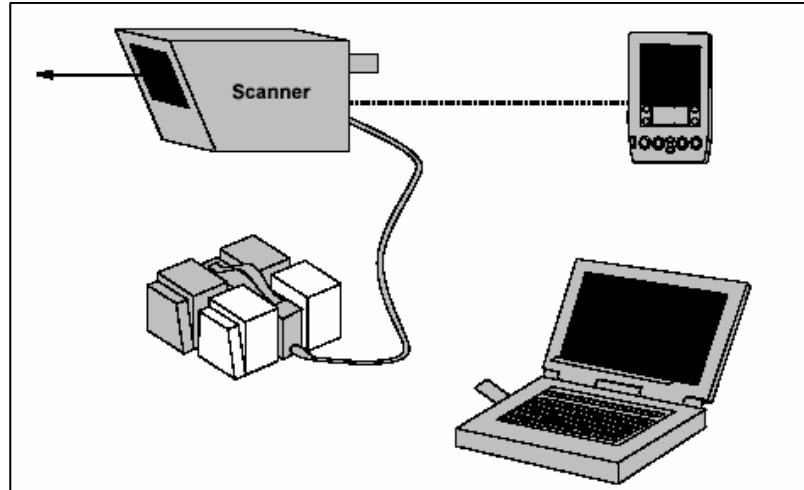


Figure 3: ILRIS Working Setup

Basic fundamental camera settings such as contrast, brightness, etc. are controlled via the control software. In addition, the control software allows one to see the camera's field-of-view (FOV) through the viewfinder and select regions to scan. The maximum range for the FOV is 40° horizontal x 40° vertical, and for a specific FOV, a single region or multiple regions can be selected to scan. The actual area of the FOV is slightly narrower than the scan region because the camera is not bore sighted and parallax is introduced between the camera and scanner. This difference is small and only noticeable at very close distances.

Adjustment of Point Spacing

The point spacing of the laser can be controlled and adjusted by the control software. During scanner setup, the control software computes the mean range for the selected scan region. It then calculates a theoretical plane orthogonal to the laser pulse at 0° and 0° to provide an estimate of the point spacing for that particular scene. Based on this estimate, adjustments to point spacing can be made to achieve desired resolution. However, it is important to indicate that this mean theoretical range for point spacing is simply a rough estimate and should serve only as a guideline for adjusting the point spacing. The actual point spacing will vary across each scan and from region to region.

Operating Procedures

The following is a simplified outline of steps taken to perform a scan with ILRIS:

- 1) Turn on the system by plugging in the battery power; there is no "on" switch
- 2) Connect the palm pilot, laptop, or PDA to the scanner and run control software
- 3) Position scanner to obtain desired FOV for scan object.
- 4) Select target/s to scan within the FOV
- 5) Determine mean range for point spacing
- 6) Adjust point spacing to achieve desired resolution for the scan

- 7) Start scan and wait to complete
- 8) Turn off ILRIS
- 9) Remove flash card and download scan data to desktop or laptop

3.0 Data Retrieval and Processing

The following data items are recorded during an ILRIS scan: raw survey metafile consisting of XYZ and laser intensity data (0-255), digital photo data, and a log file. The log file contains operator setup parameters and notes from the control unit (i.e. palm pilot) for the specific scan. This includes parameters such as point spacing, time of day the scan was recorded, etc.

All the data items recorded are integrated and stored into a single file format with a “.i3d” extension. “.i3d” is an Optech proprietary data format, and the file must be downloaded off the scanner flash card and parsed to a useable format before the survey data can be incorporated into *PolyWorks*, discussed in section 4.0, and/or other third-party software or applications.

ILRIS Parser

Optech provides standard software, the *ILRIS Parser*, to parse the “.i3d” data file into a useable format. With this software, the data can be parsed into a variety of formats including “PIF” and ASCII XYZ. For GEM purposes, “PIF” is the standard file format selected for export because this format is utilized by *Polyworks*. However, it is important to realize that the “PIF” file will be exported to a file with a “.pf” extension, not “.PIF”. Furthermore, there are many other software formats available for export with the *ILRIS Parser*.

Operation of the software is straightforward and simply entails selecting the “.i3d” file to parse and the desired export format, which is generally “PIF” for GEM applications. Once the file is exported to “PIF” format, it can then be incorporated into *PolyWorks* for further processing.

3.0 Polyworks

PolyWorks is a software package designed by InnovMetric for survey and manufacturing applications. It is a powerful point cloud software solution that processes data obtained from any short-range, mid-range, or long-range 3D scanner. *PolyWorks* provides scan alignment, georeferencing, measurement, feature extraction, and visualization capabilities to produce survey-accurate results and extracted elements for downstream software suites such as AutoCAD and MicroStation [1].

The main utilization of *PolyWorks* for GEM Center applications is the registering of multiple scans together to produce one, large scene. Within *PolyWorks*, a single scan or multiple scans can be georeferenced and registered. For georeferencing, three points in the scan that are easily identifiable and presurveyed are required to reference the scan.

In addition to registering scans together and georeferencing, *PolyWorks* provides measurement tools for measuring within models, and it provides tools for fitting primitive shapes to point clouds. A triangulated irregular network (TIN) can be generated to fit the surface of a point cloud. The TIN can then be exported for use in other applications.

PolyWorks is not a single program; it is composed of several modules including IMAlign, IMInspect, and IMCompress. IMAlign is the module used to register scans and georeference. Additionally, IMAlign provides statistics on the processes. IMInspect is the module used to perform measuring tasks, and IMCompress is the module used to make a triangulated irregular network (TIN) surface of a point cloud.

Appendix A

Table of Software:

Software	Maker	Application
Palm OS	Optech	Control software for operation of the scanner.
ILRIS Parser	Optech	Parsing of “.i3d” file into a useable format; usually parsed to “PIF” for incorporation into PolyWorks
PolyWorks	InnovMetric	Registering of multiple scans together for generation of a large scene, georeferencing, measurement, and generation of TINs

References

- [1] InnovMetric, “PolyWorks,” <http://links.umen.ca/innovmetric/english/home.html>, accessed June 2004.
- [2] Optech, “ILRIS-3D Benefits and Features,” <http://www.optech.on.ca/ilrisfeatbens.htm>, accessed June 2004.