RISPLS 2015

LiDAR

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ScannerJammer

This term comes from a University of Alabama football slogan that we discovered during the training session for some of the equipment and software we use.

ScannerJammer

We can keep this session on the light side and have some fun while reviewing some pretty heavy topics.

Have a question? Raise your hand, cough, interrupt or even say “Hey You! What about this?” With luck we can answer the question, without luck we will be flustered and simply answer ScannerJammer!

Christian San Martin

Project Manager at ESE-LLC with over 18 years of experience in RI, MA and a little place called the World.

Proficient in Surveying, Civil Engineering, GPS, CAD (the Autodesk Flavor), GIS, LiDAR, SoDAR

Assists clients in many aspects of the profession with Planning, Implementation, Calculation, Design, Layout, Inspection.

May not have a fancy name but gets things done!

J. Thaddeus Eldredge

BA in Theoretical Mathematics, Colby College

PLS Certificate from Wentworth Institute of Technology

PLS 46471, MA

Soil Evaluator, MA

Certified Floodplain Manager, USA

Has a fancy pants name; goes by Thadd.

What is LiDAR?

Laser Radar

Light Detection and Ranging

Scanning

Lidar (also written LIDAR, **LiDAR** or LADAR) is a remote sensing technology that measures distance by **illuminating a target with a laser and analyzing the reflected light.** Although thought by some to be an acronym of Light Detection And Ranging,[1] the term lidar was actually created as a portmanteau of "light" and "radar".[2][3] Lidar is popularly used as a technology to make high-resolution maps, with applications in geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, remote sensing, atmospheric physics, airborne laser swath mapping (ALSM), laser altimetry, and contour mapping. (wikipedia)

SURVEYING!!!

Terms

Scanner – a LiDAR unit or a magic box with laser(s) and possibly camera, compensator, compass, GPS, height sensor or other options.

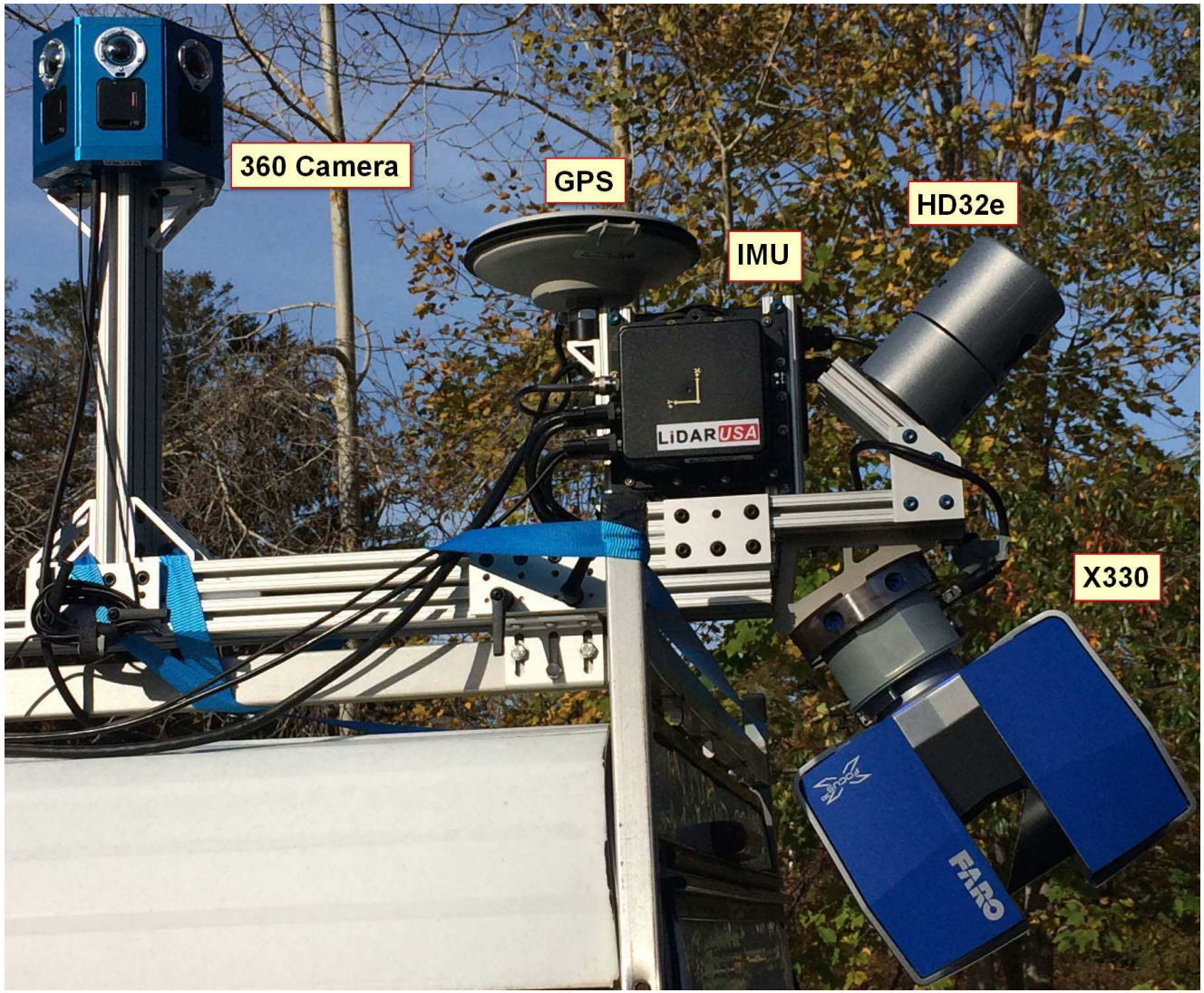
Registration – The adjustment of raw scan data or point clouds. This can include stitching two clouds together or adjusting clouds onto known control.

Registration Sphere – aka Ball. An awesome round target that is a great method for scan registration.

Terms

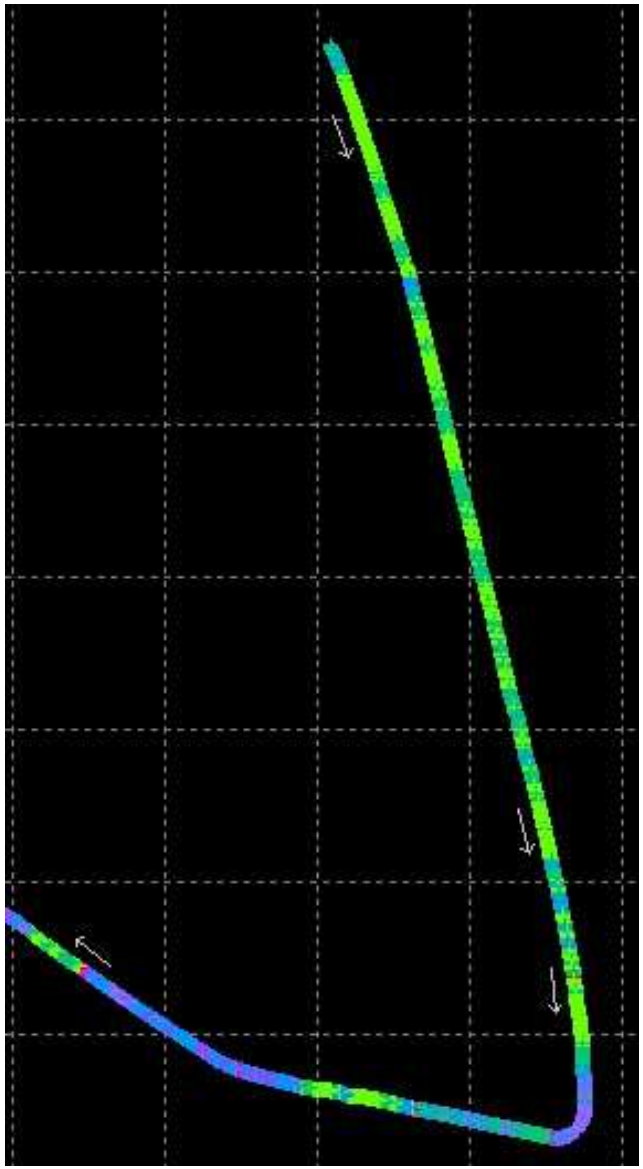
GPS – Geographic Positioning System or a magic box that tells you where you are based on satellite signals.

IMU – Intertial Measurement Unit or a magic box that calculates moving position based on the forces of motion.



Terms

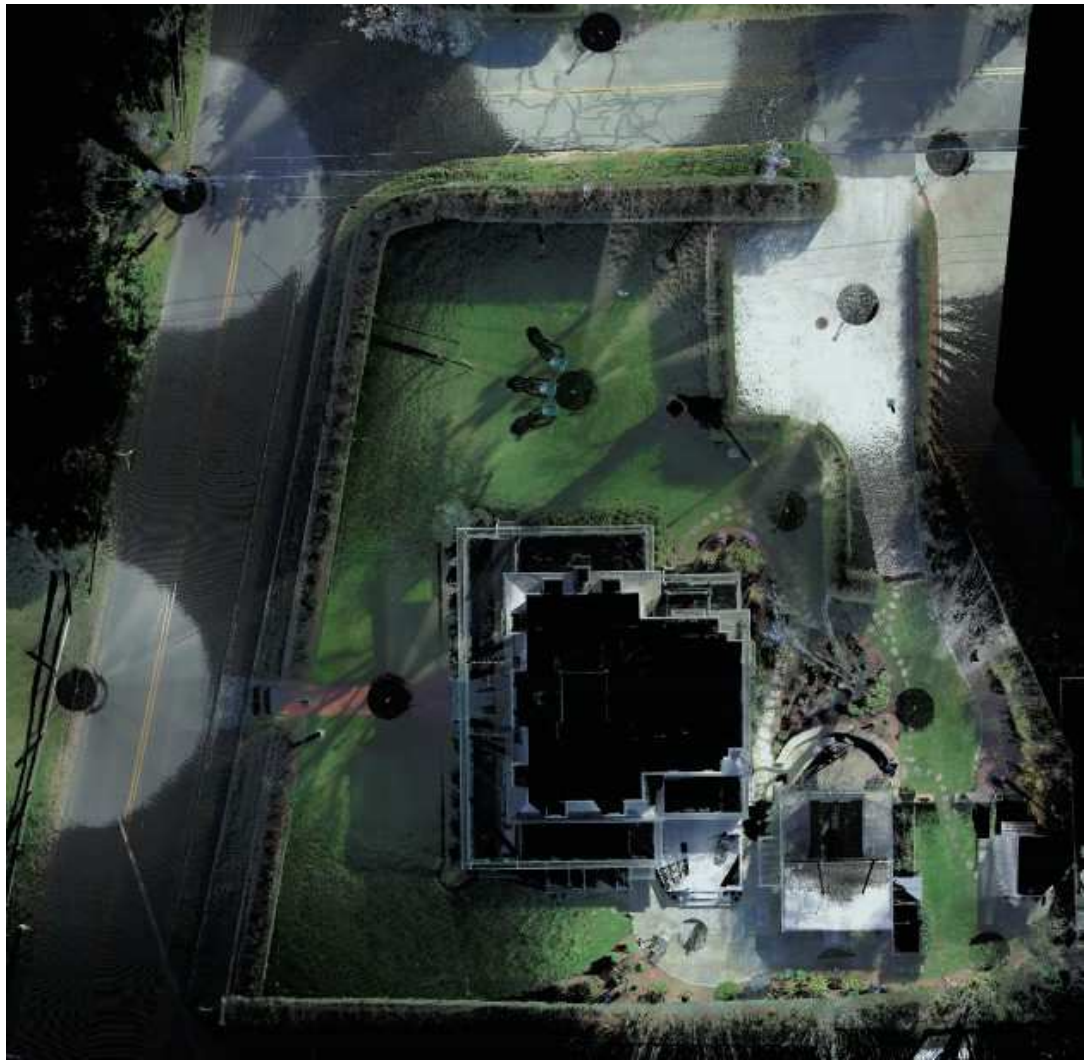
Trajectory – The measured path that a GPS & IMU follows. Where a typical point list has PNEZD (point, northing, easting, elevation, description), a tractory has STTXYZOPK (station, time (GPS seconds of the week), time (GPS week), easting, northing, elevation, roll, pitch, yaw. Basically it is the location and angle where the unit is situated and facing at a specific point in time. The output can also include statisitcal components associated with the measurements.



Station	GPSTime (sec)	Week (week	Easting (usft)	Northing (usft)	H-MSL (usft)	Omega (deg)	Phi (deg)	Kappa (deg)
3-K	567070.400000	1851	1079514.209	2712384.789	51.360	-0.9504185654	2.6644130045	301.7670569503
3-K	567070.405000	1851	1079514.208	2712384.791	51.360	-0.9168609802	2.6733211137	301.1019981206
3-K	567070.410000	1851	1079514.208	2712384.792	51.360	-0.8984867699	2.6780191848	300.7289272731
3-K	567070.415000	1851	1079514.208	2712384.793	51.360	-0.8804958925	2.6827868666	300.3671540414

Static LiDAR

A laser scanner is mounted on something solid. The scanner rotates, spins or otherwise maneuvers its focus to send and receive laser pulses that reflect off most objects within range and view. Targets are typically set to register the clouds by rotating and translating the raw data to control points and to other raw data sets.

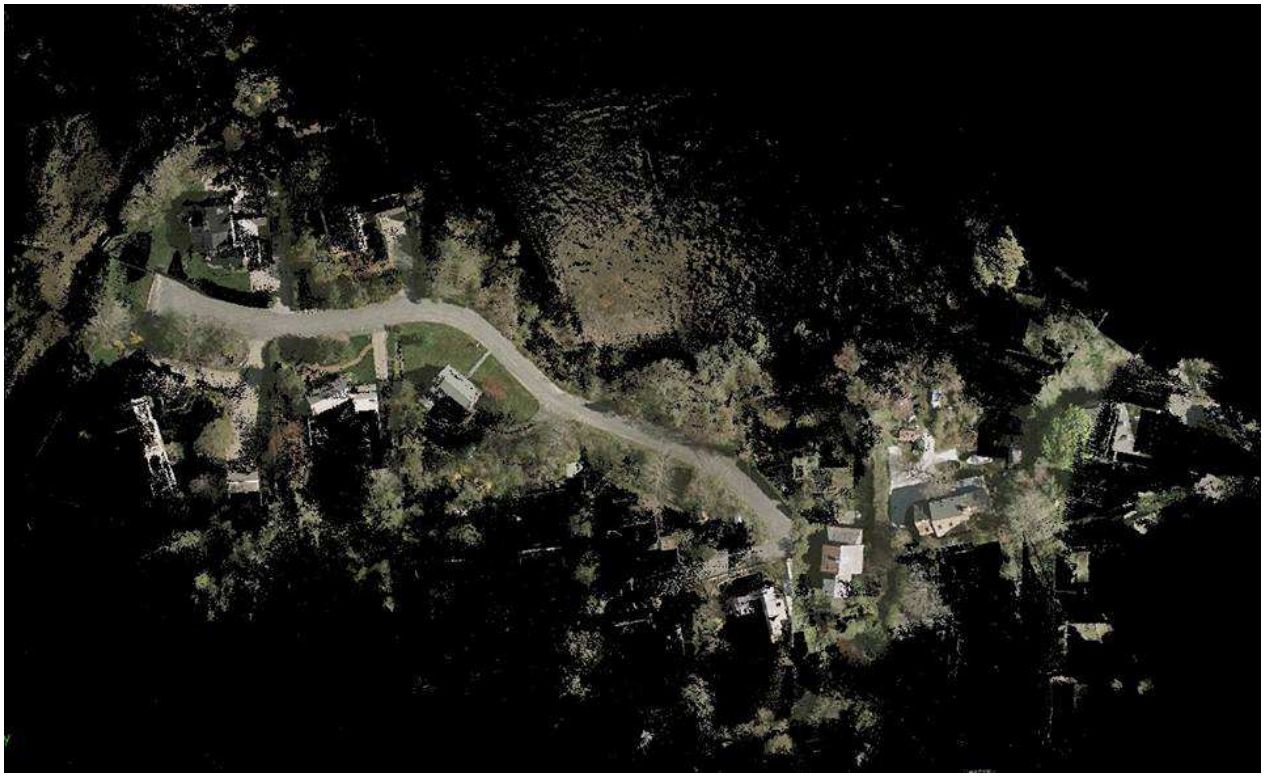


Aerial LiDAR

Laser scanners are mounted to a plane with GPS and IMU units. The plane is flown, the scanner acquires data, the GPS and IMU acquire the trajectory and everything is processed into a point cloud. Like aerial imagery, there are data overlaps and control targets on the ground that help to register the clouds.

Mobile LiDAR

Laser scanners are mounted to a vehicle with GPS and IMU units. The vehicle is driven, the scanner acquires data, the GPS and IMU acquire the trajectory and everything is processed into a point cloud. There are data overlaps and control targets on the ground that help to register the clouds. The vehicle can be just about anything: car, truck, boat, wagon, train, golf cart, backpack, drone, shopping cart, beefy remote controlled car, lawnmower, tractor, etc...



Points

The largest single 'traditional' survey project I have run had about 125,000 points and took 24 surveyors 6 weeks to acquire.

What was the density? 6 miles of road, 60' average corridor width plus 24 acres of woodland =~ 2,950,000 S.F. or one point every 24 S.F. This averages to a grid with one point every 5', but we all know it does not work with a uniform spacing.

The aerial point clouds have a point every 2-3 feet and they are not all that dense. 10-100-1000 points per square foot can happen and we start to look at reducing the density.

VELODYNE STREAM

- We use the Velodyne HD32e.
- 32 lasers acquiring up to 700,000 points per second (in a tunnel).
- Beach Trail
- Rural Highway

Where Do You Stand?

Everybody stand and say hi.

Now for some Polls:

Who is Not technical?

MicroStation? AutoDesk?

IntelliCAD? ARC? Carlson?

TS? GPS? Transit & Tape? Chain?

Who scans?

Point Cloud

Point Clouds are simply point files. Text files. Sure they make some fancy formats just like how Carlson makes a CRD. Sure, they hold millions of points. They can all be converted to a slow, clunky Text file.

BEWARE! Point Clouds do not exist within the Survey Realm. Sure, we can use them, but get used to XYZ or Easting Northing Elevation.

Point Cloud

Text	rapidlasso	ASTM
*.txt	*.las	*.e57
*.xyz	*.laz	

There are some proprietary formats out there as well, for example:

Pointools	Leica
*.pod	*.pts
	*.ptx

There are more.

Point Cloud

XYZ – It'd be a little hard to have a point in 3-space without a 3-tuple (ie a Coordinate).

i – Intensity is a common return from the scanners. How reflective is the surface? Highly reflective surfaces have the tendency to send the lasers off to space or some other object.

RGB – The points can be colorized from imagery, the color data can be stored in the cloud file.

Values can range all based on 2 to the power of something. 256 and 65,536 being fairly common.

Point Cloud

T – Time, usually GPS Time in seconds of the week with GPS week. The GPS Week Number count began at approximately midnight on the evening of 05 January 1980 / morning of 06 January 1980.

C – Classification. There are several standard classifications: Ground, Building, Vegetation (low, med, high), Water, Utilities and so on…

A – Attributes. Oh yes, you can add other things. It is usually better to let the computer handle all this as the task would overwhelm any person.

Build Your Own?

Yes, you can build your own cloud file. Just sit down and start entering coordinates.

Or take a list of points and reduce it to XYZ, turn it into a TXT file and rename it .XYZ

No point number needed or wanted. It would just get in the way.

These are dumb points as opposed to smart points.

Point Cloud

Surveyed Points (smart)

- Specific targets – That point is along that edge of pavement and that one is at the building corner.
- Described – Even when the descriptor is cryptic, there is still something there.

Scanned Points (dumb)

- Unspecific targets – That point is on an object and I don't know if it is at the edge of the pavement or right at the building corner.
- Undescribed - That point is on an object and when I look at the 2000 points around it plus the imagery, I see a bush.

Classification

- There are many programs that will classify the points.
- Most of the free aerial clouds come partially classified with ground, water and unclassified.
- The bulk of the work involved is completed by the computer. Let it go, but keep an eye on it.
- Cloud Compare – This software compares the shapes in the cloud with a library to classify. It looks slick if you figure out how to get it to work.
- Global Mapper – This software uses several algorithms to classify the ground, vegetation, buildings and utilities. The rest is performed manually.
- Yes, there are more.

Extraction

- Even classified points have no business in CAD. You have to extract the CAD out of the cloud.
- Hard edges are determined by intersection lines or planes.
- Sections are helpful.
- Autoextraction of features exists.

Extraction

They are working on automation.

It will be here any day.

Along with a robot to serve you a drink.

Any day now.

No need to learn the software of today though you may get thirsty waiting for that drink.

Do you want to play?

- Boost your system. Most programs have some minimal minimums but we all know how well other software works with minimal computer components.
- Run through the free software out there. Learn the navigation. Many of the free softwares do little things you will find useful with the full versions.
- Run through some demos of the full softwares. Have fune with tutorials, videos, demonstations and practice.

So What is Out There?

- Free

Quick Terrain Reader

- Fast (Quick)
- Great for navigating
- Some information can be pulled – like some elevations.
  - When you get the call from the client who wants to know about an elevation certificate, you can pull up an aerial tile and know the +/- 0.5' elevation near the building.

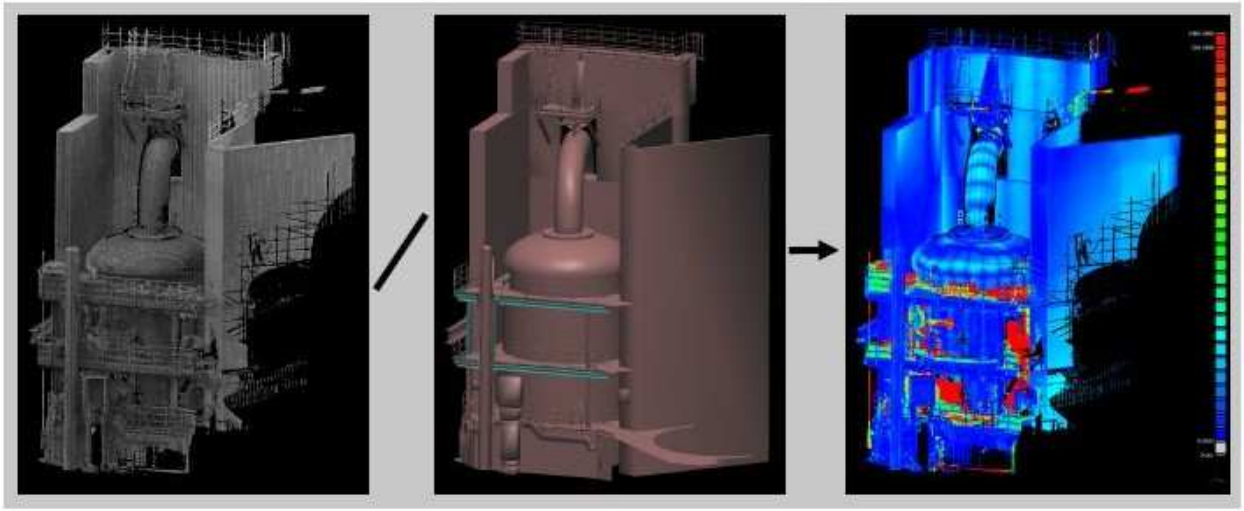
Fugro Viewer

- Great for aerial
- Allows POI and AOI with exports to SHP
  - Point of Interest - point
  - Area of Interest – polygon
  - SHP = ESRI Shape File
- Allows visualization of surfaces and contours

Cloud Compare

CloudCompare is a 3D point cloud (and triangular mesh) processing software. It has been originally designed to perform comparison between two 3D points clouds (such as the ones obtained with a laser scanner) or between a point cloud and a triangular mesh. It relies on a specific octree structure that enables great performances in this particular function. It was also meant to deal with huge point clouds (typically more than 10 million points, and up to 120 million with 2 Gb of memory).

It will also use comparisons to classify points. (Once you figure it out and create some libraries.)



MeshLab

The system is aimed to help the processing of the typical not-so-small unstructured models arising in 3D scanning, providing a set of tools for editing, cleaning, healing, inspecting, rendering and converting these kinds of meshes.

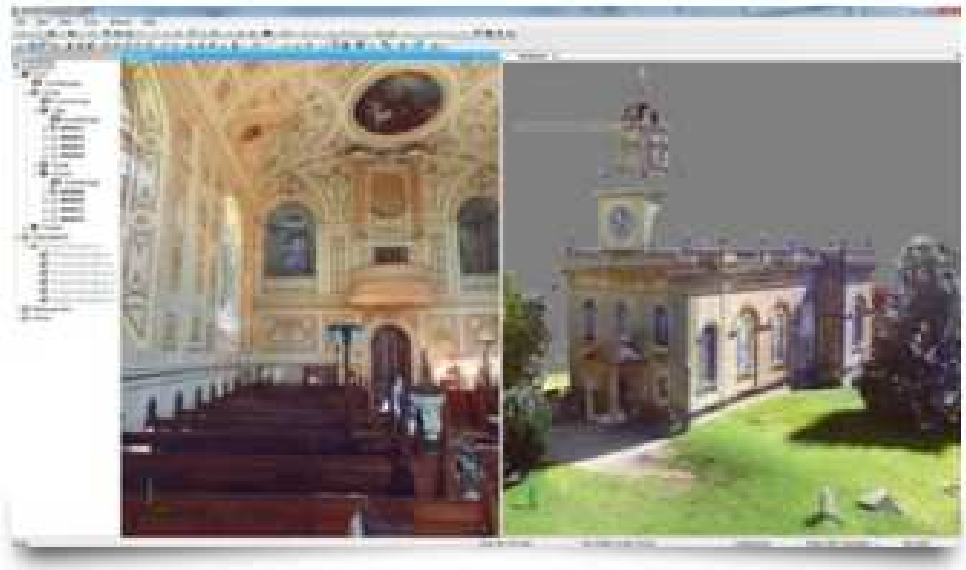
Faro Scene LT

SCENE LT is a free viewer that enables the professional user to view existing FARO scans and workspaces. It is able to import CAD models in VRML format in order to compare them with the scan points.

Supports multiple scan types

Adaptive point size

Export scan project into ReCap format – that is for the Autodesk enthusiasts in the audience



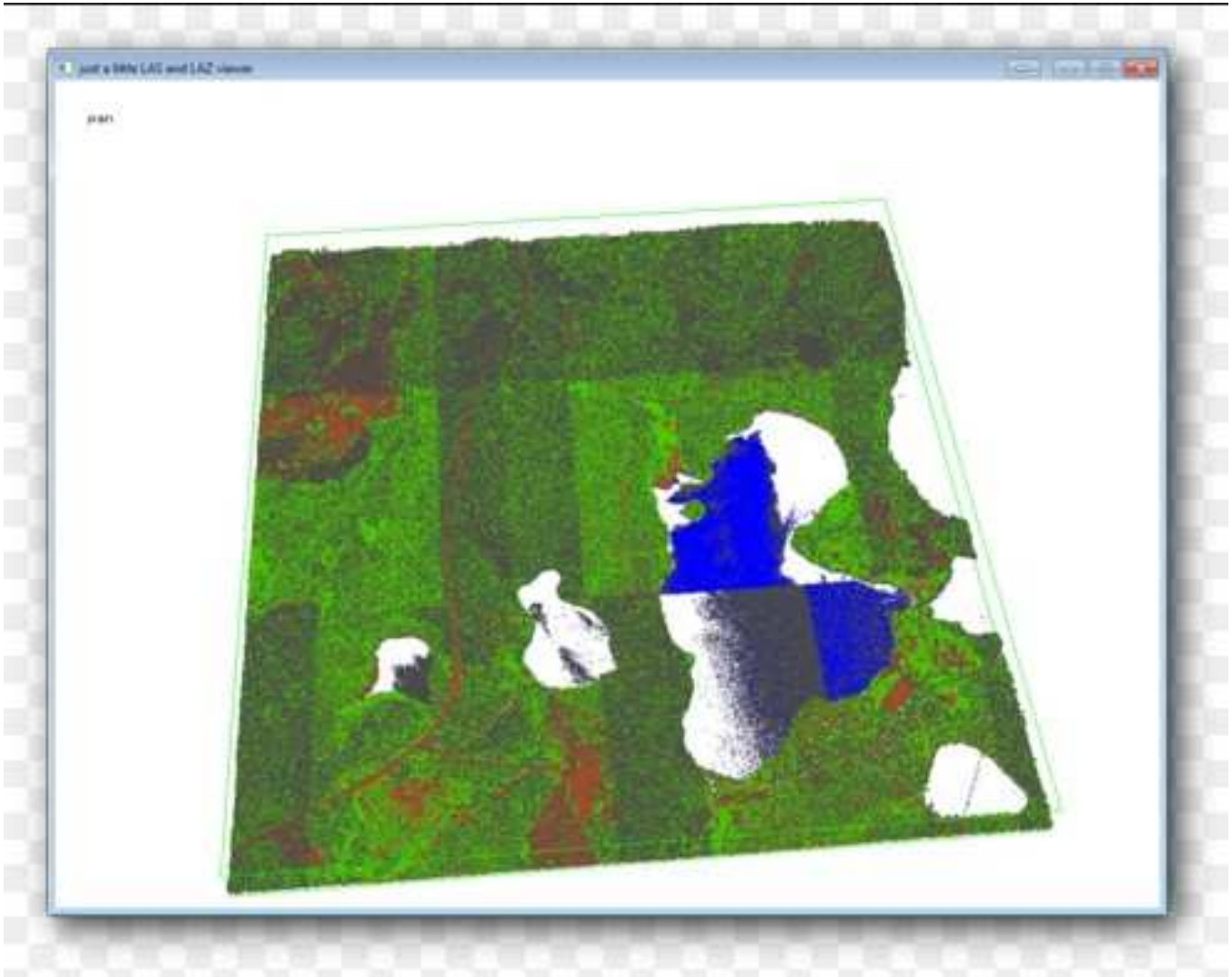
Leica TruView

Leica Cyclone PUBLISHER publishes point cloud data for web-based sharing and viewing allowing access from anywhere in the world. Using the FREE Leica TruView panoramic point cloud viewer, users can view, zoom in, or pan over point clouds naturally and intuitively. Using a simple "panoramic" or "bubble" viewer approach, you see High-Definition Survey™ point clouds on the computer screen just as if you were standing right where the laser scanner captured the scan data.

In TruView, users can extract real 3D coordinates and accurately measure distances. Results appear right on the point cloud image. Markups are also easy to create, save and share with your peers, your service provider, or with clients for more effective communications.

QGIS – GRASS GIS

- There are some plugins and tutorials.

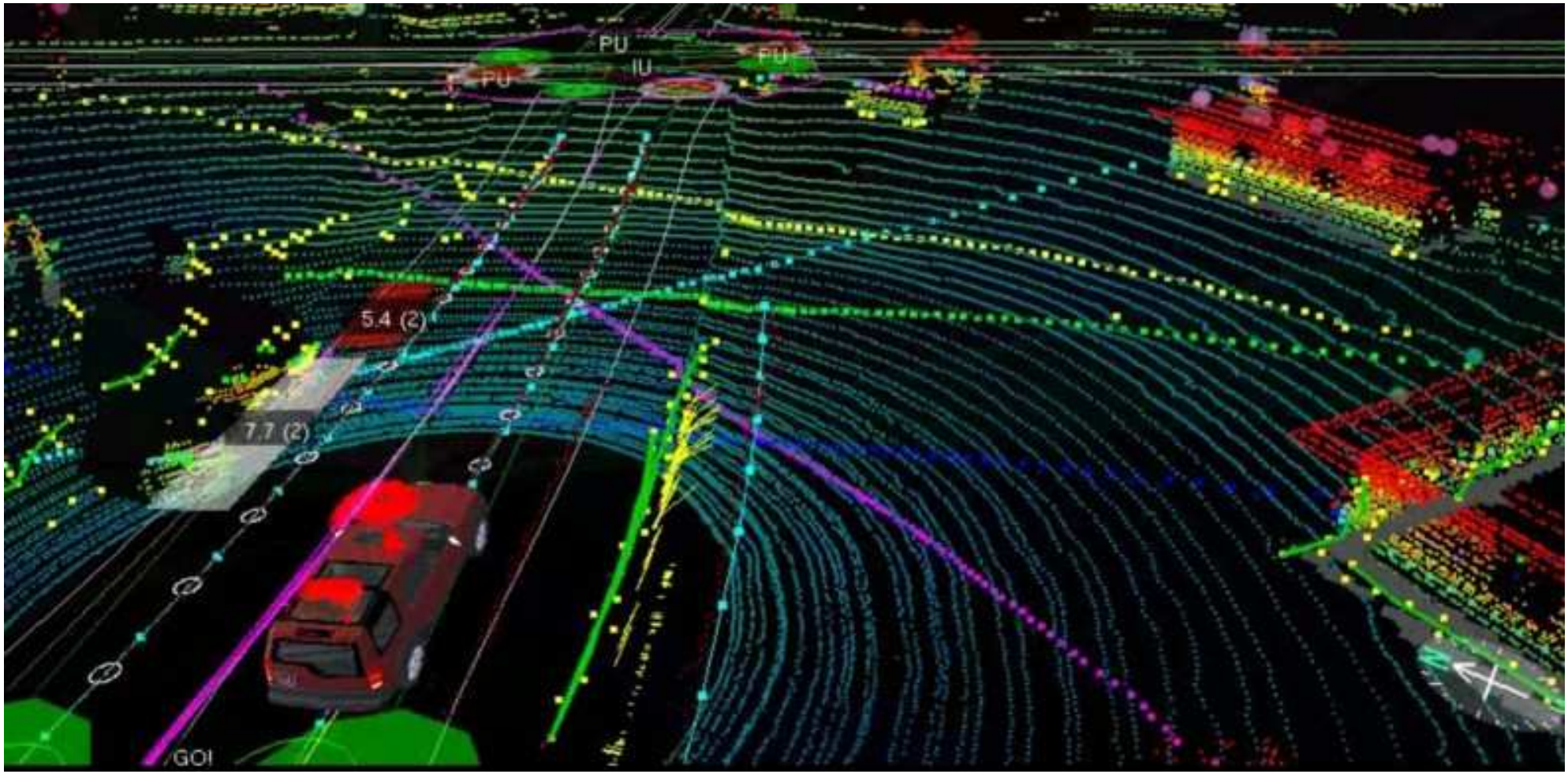


And there are MORE

Keep looking and you will find many viewers.

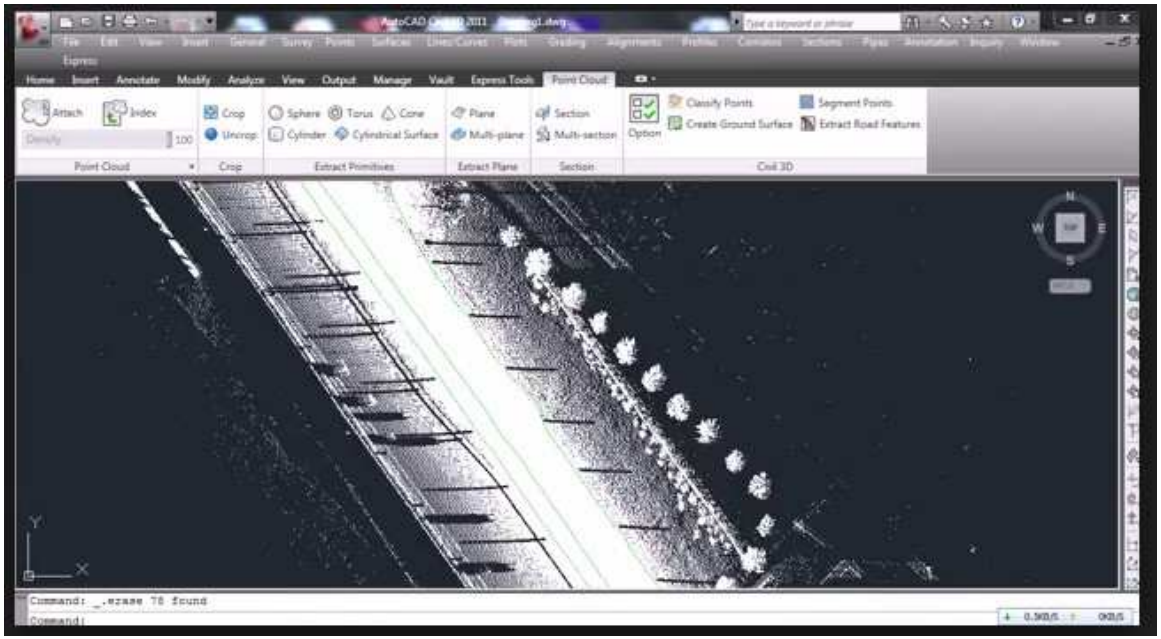
You May Already Have Some Software

- Check out your documentation and verify your licenses.



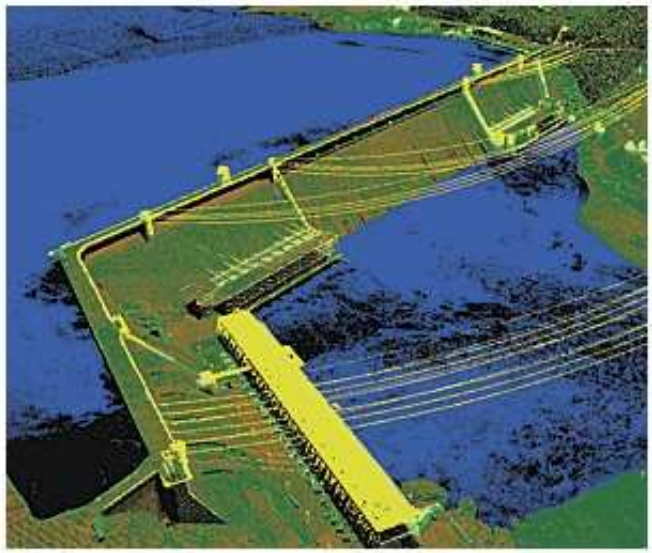
AutoDesk Civil 3D

- Limited to 10 million points.
- Converting with ReCap will allow you to use 20 million points.
- Minimal extraction tools, you can make a surface.
- Looks like ReCap is where AutoDesk does all the real cloud work.



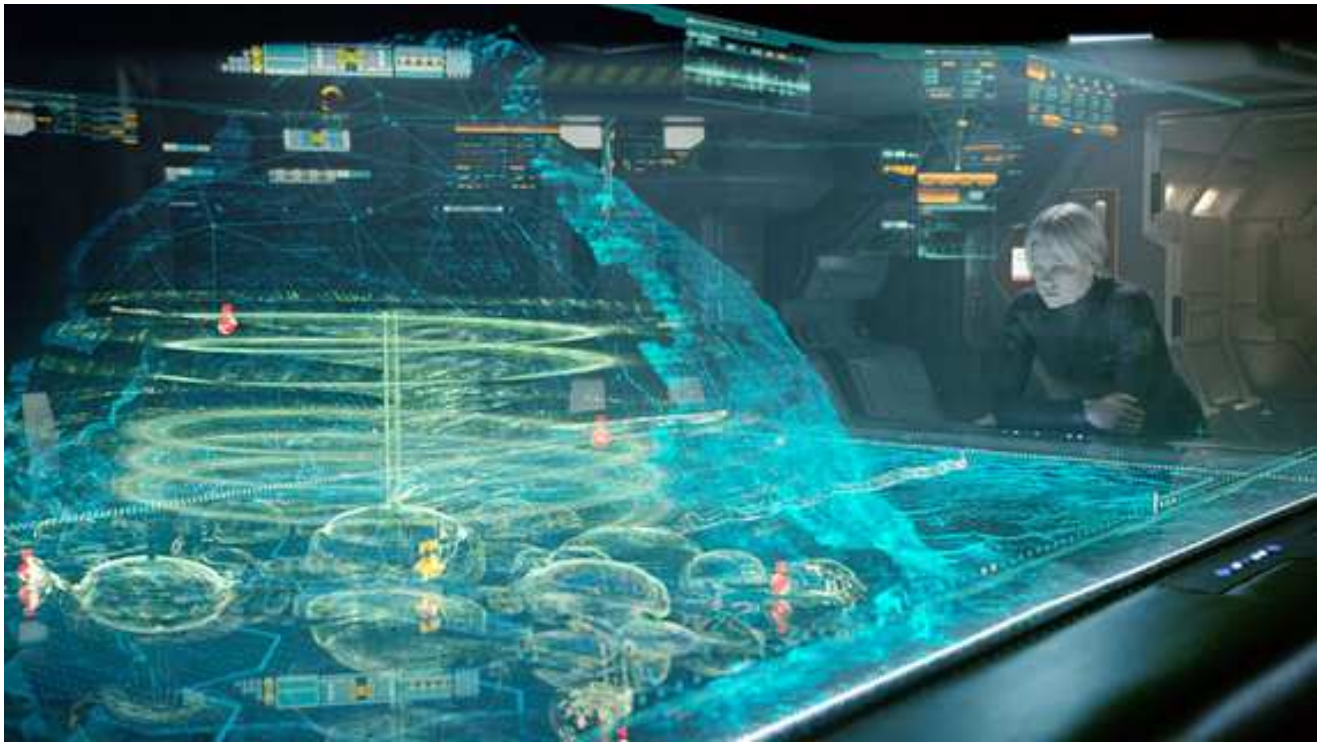
ESRI-ARC 10.1

- You will have to get your data into LAS format.
- ESRI has a variety of web results to help you through.
- Sadly, I have a seat of 10.1 and I have not yet tried it.



There ~~may~~ will be more

Many companies are realizing that scanning is one path that is being taken by many. If SciFi movies tell us anything, it is that laser scanning will be here for a while.



Paid Software

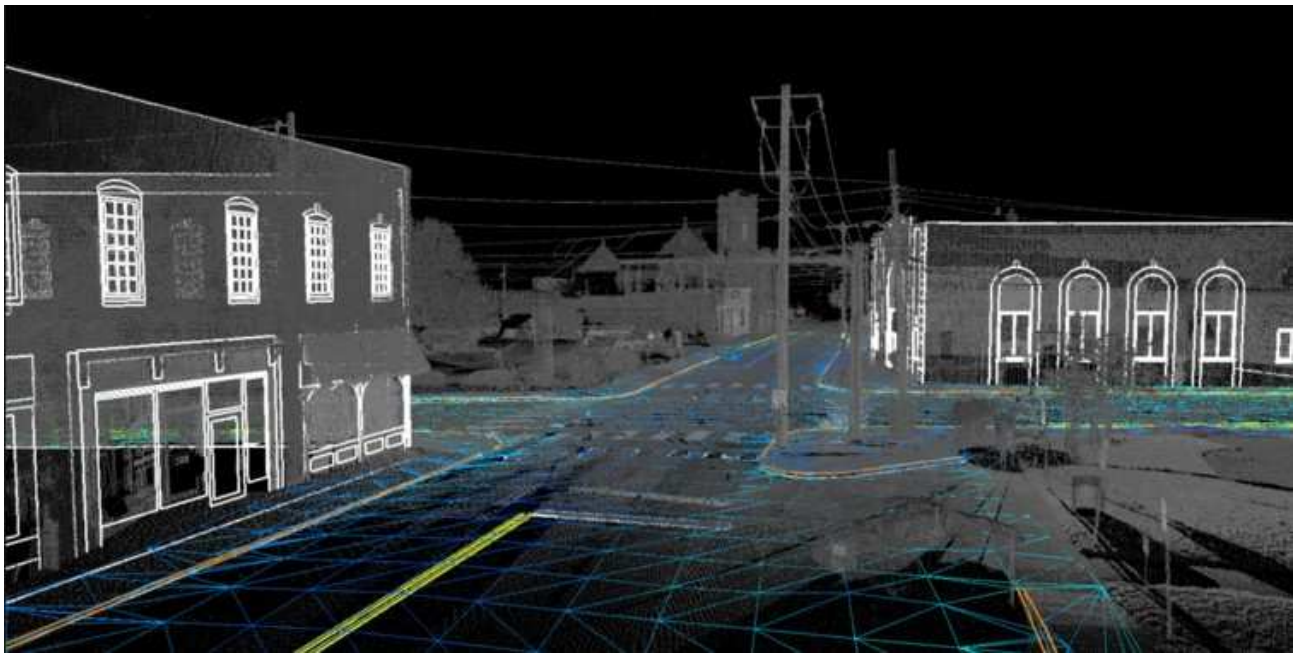
Most have that inconveniently short demo period. You may think you have enough time to resolve some workflow and you find that you do not… Be sure to call for web demonstrations. Watch videos before you download the software. Make sure you have the time to understand what the software does:

Every software is a tool and None that I have seen do it All.

They want you to have a full toolbox.

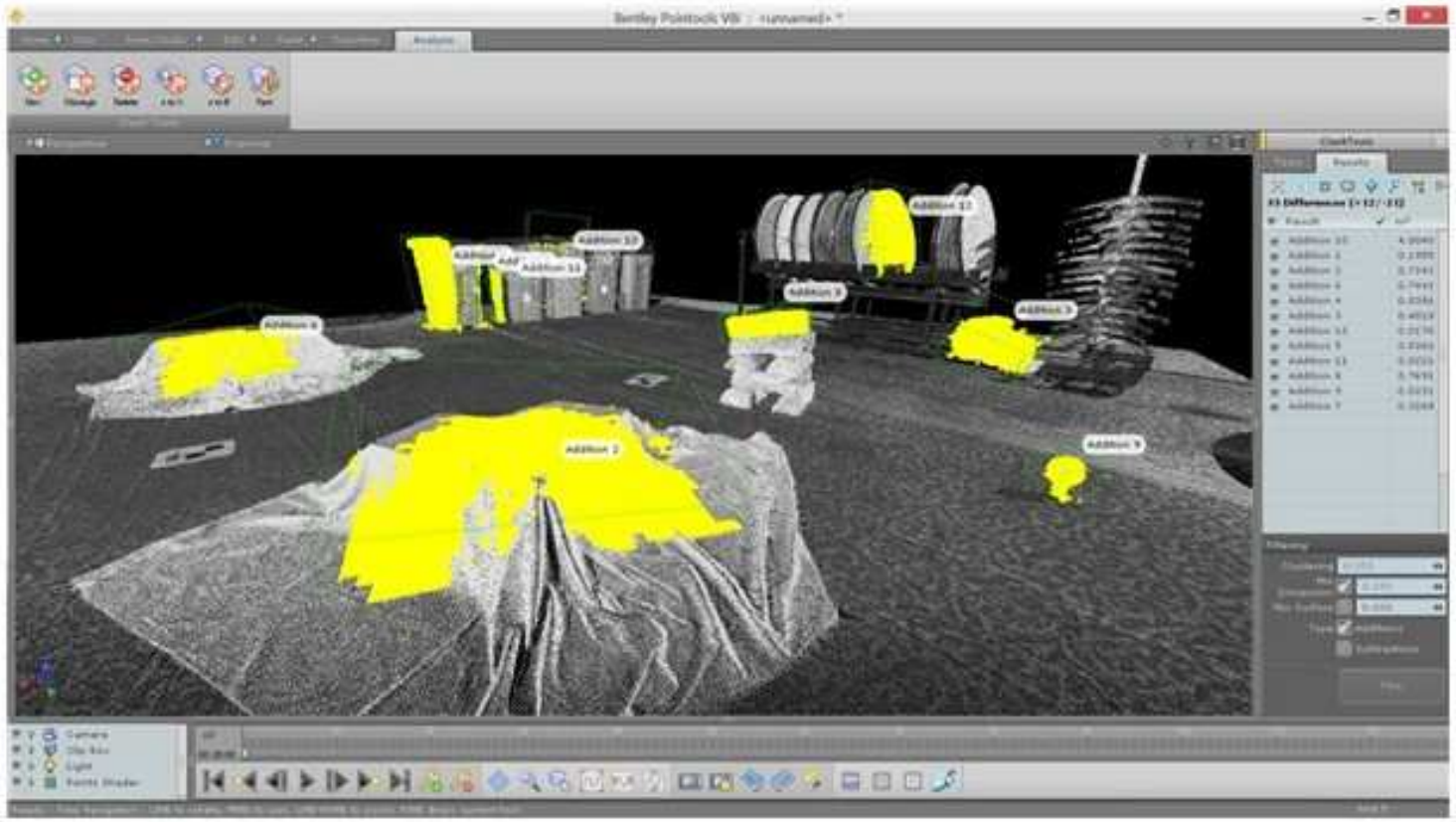
Leica

- Cyclone and Cloudworx and TruView
- I do not know much about these, but if you go with Leica you will get some experience.
- I heave heard good things and the HDS scanners look slick.



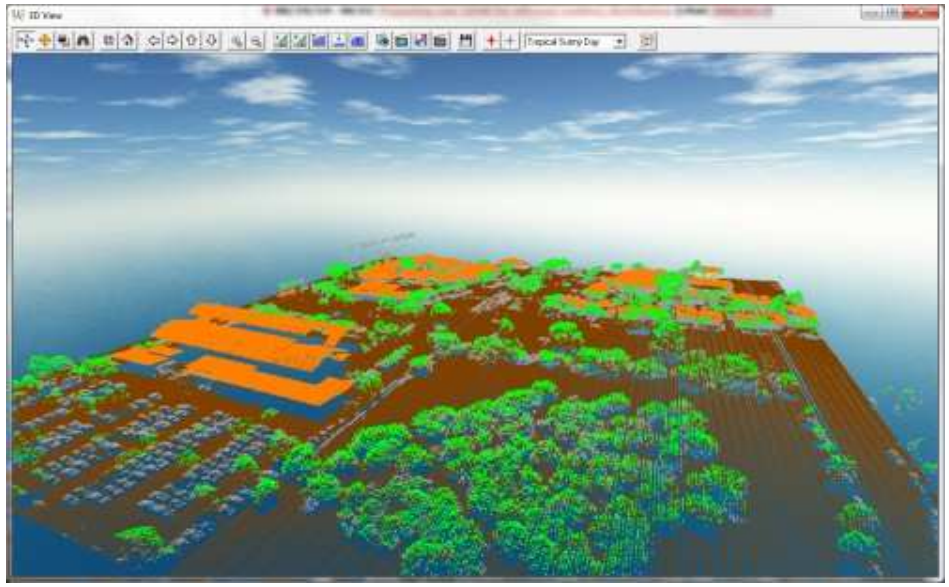
Pointools

- Bentley Product (Those MicroStation Folks)
- I have used an older Pointools Engine that could handle 1 Billion points



Global Mapper

- The normal version will bring in clouds
- The LiDAR Module will add some great functionality
- Great with aerial, OK with mobile / static
- Heavily into classification of points with some automation
- Good suface modeling, decent linework extractions
- Excellent tool for surveyors looking for stone walls, ridges, roads, ditches and other sometimes difficult to find features (But Fugro helps there as well)

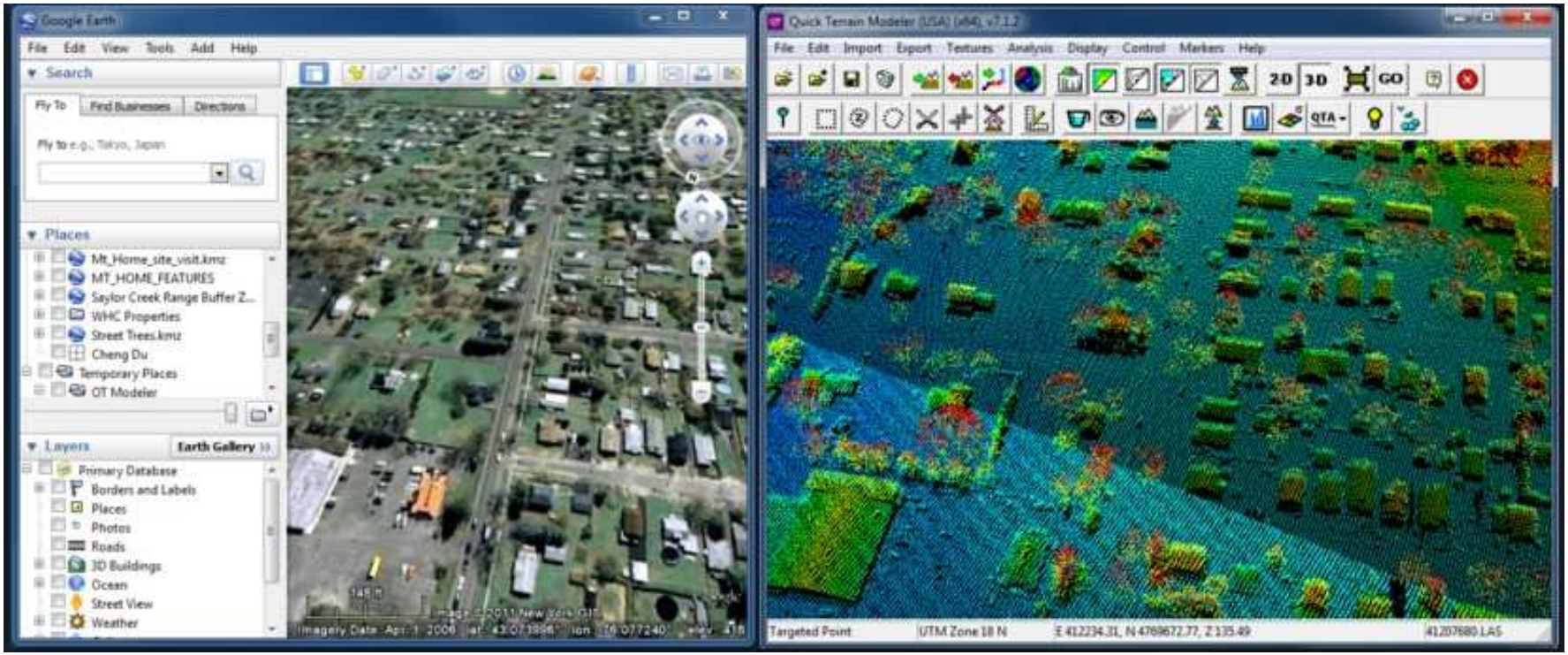


OrbitGT

- This looks excellent for Mobile Mapping Applications
- There are multiple modules available

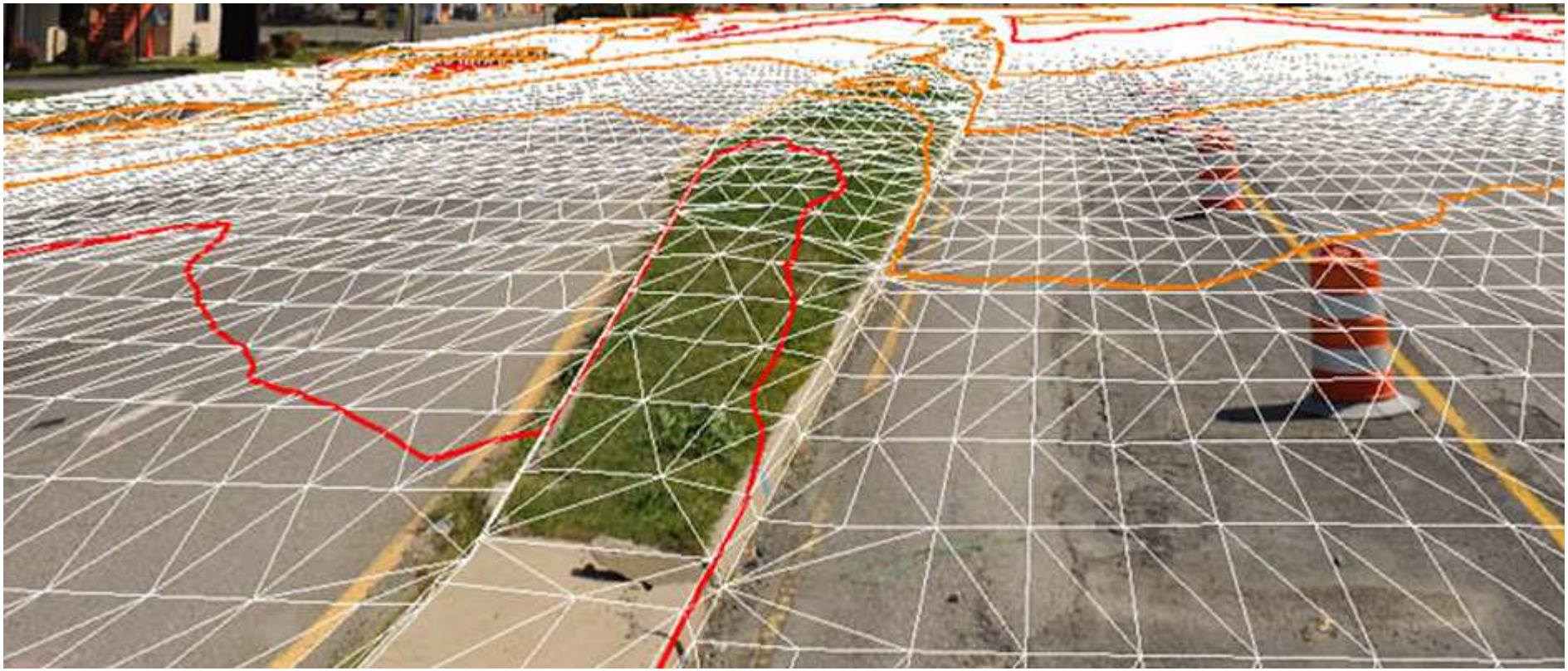
Quick Terrain Modeler

- Can handle many points
- Produces awesome movies
- Will create surfaces and will drape imagery overtop
- Will help with QA/QC and will help fine tune clouds
- Has flood tools
- Has sightline tools



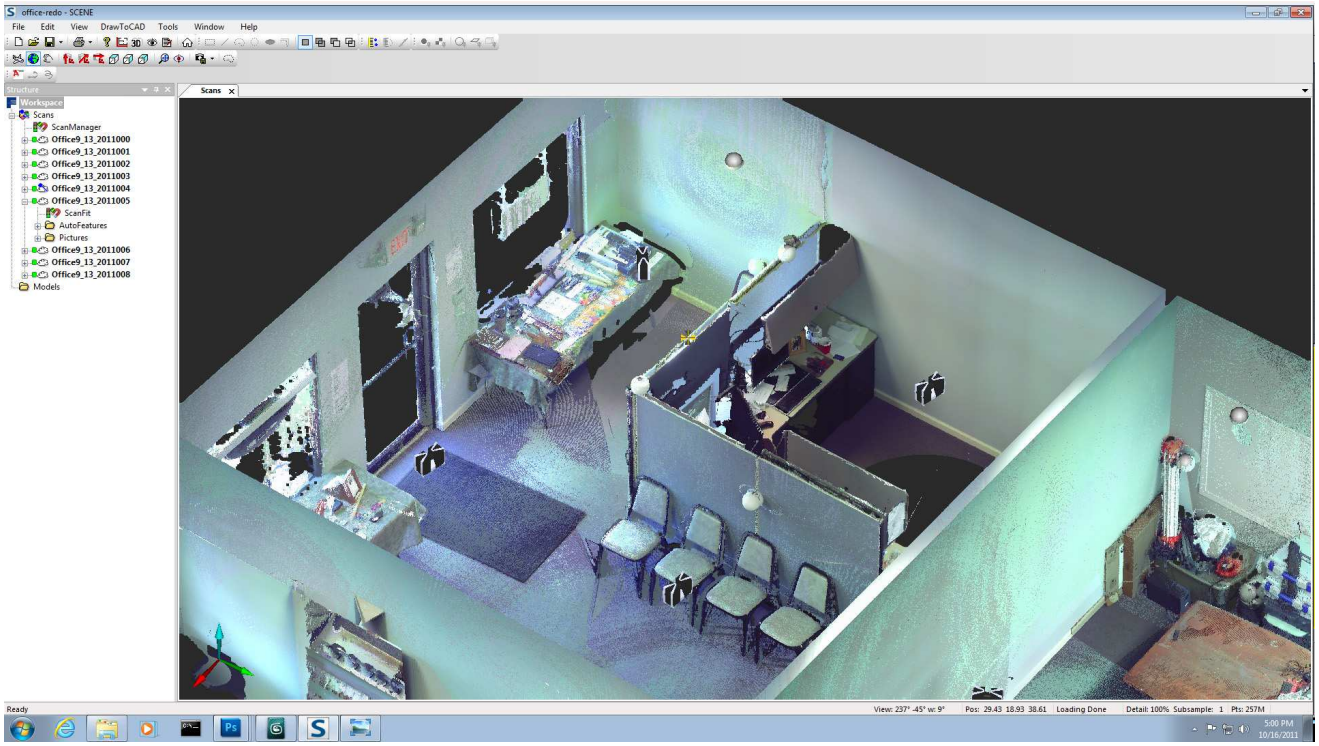
TopoDOT

- Works in MicroStation (Bentley)
- Up to 80 million points. It will break up bigger clouds (parse)
- Started in Riegl and now is Certainty 3d
- Great with mobile or static mapping



FARO Scene

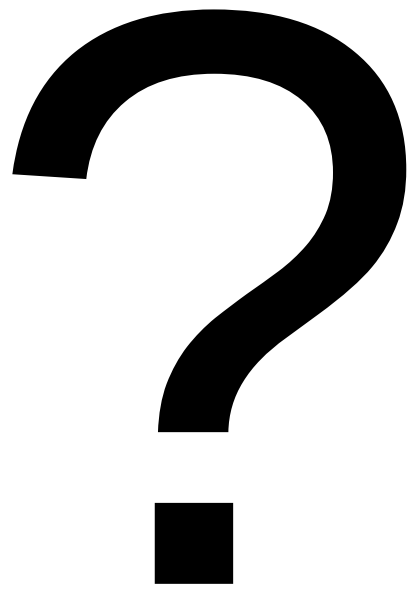
- Primarily used to stitch static scans together and to georeference the same
- Has a movie maker
- Renders clouds well
- Works with some other softwares for more extraction cababilities



Others

- There are many many many more software choices out there
- MeshLab, ThinkBox, Rhino, QGIS, Pointfuse, Photoscan, 123d Catch, Pix4dMapper, Dronemapper, PointSense, PointCab, Euclideon, CloudCompare, PCL, Trimble
- And there are more!

Questions So Far?



Carlson Point Cloud

- 2-3 Engines: Carlson (little), Pointools (old and only available if you had PC prior to 2016) and 3dtk (great move by Carlson)
- The old Pointools engine could handle up to 1B points. I have yet to max out the 3dtk engine. (Under 300 million points)
- Like all Carlson products, they are responsive to suggestions.
- Works in CAD or IntelliCAD like the Carlson Survey Module.
- We will get to more later.