TLS Data Products & Analysis
C. Crosby, UNAVCO
Data volume – 10s of GB of data per day of scanning

Scanner technology far outpaces most software available for data processing, management, and analysis.

Complex, multi-software workflows

Commercial ($$) software

How do you get from 10s or 100s of millions of X,Y,Z points to science?
Point Cloud

- 3D “point cloud” of discrete locations derived from range and orientation of scanner for each laser pulse.

- XYZ position in cartesian coordinates plus associated point attributes: intensity, RGB, etc.

- 3D point clouds are the basis for subsequent analysis and used to create CAD or GIS models

- Typically **ASCII XYZ** + attributes or **LAS**

- UNAVCO **standard deliverable** = merged, aligned, georeferenced point cloud in ASCII or LAS format.
TLS Processing Workflow – Overview

Field data collection + data post-processing

Merged, aligned, georeferenced point cloud

Data cleaning & thinning

Vegetation filtering & classification

Surface generation (DEM etc)

Analysis & science!

Raster data products (DTMs & DSMs)
Digital representation of topography / terrain
- “Raster” format – a grid of squares or “pixels”
- Continuous surface where Z (elevation) is estimated on a regular X,Y grid
- “2.5D”

Grid resolution is defined by the size in the horizontal dimension of the pixel
- 1 meter DEM has pixels 1 m x 1m assigned a single elevation value.

Source: http://www.ncgia.ucsb.edu/giscc/extra/e001/e001.html
Interpolation Methods

- Inverse Distance Weighting (IDW)
- Natural Neighbors
- Kriging
- Splines
- TIN
  - linear
  - quintic
- ...

Isenburg, et al., 2006
Vegetation is a headache is geoscientists

• *Our noise is someone else’s signal*

• How to get good ground model? - Automated vs manual?

Dumay Slip-Rate Site, Enriquillo Fault, Haiti
P. Gold, UCD
Typical approach ⇒ despike algorithm

Approach:

1. flag all points as ground

2. repeat:
   - build TIN (triangulated irregular network) of ground points
   - identify points that define strong positive curvatures
   - flag identified points as not-ground

3. Iterate until no or few points are flagged

Modified from: R. Hagerud, USGS
Start with mixed ground and canopy returns (e.g. last-return data), build TIN
Flag points that define spikes
(strong convexities)
Rebuild TIN

R. Hagerud, USGS
Flag points that define spikes (strong convexities)

R. Hagerud, USGS
Rebuild TIN
Flag points that define spikes (strong convexities)
Rebuild TIN

R. Hagerud, USGS
Despike algorithm

Benefits:

- It works
- It’s automatic
  - Cheap(!)
  - All assumptions explicit
- It can preserve breaklines
- It appears to retain more ground points than other algorithms

R. Hagerud, USGS
Despike algorithm

Problems:
- Removes some corners
- Sensitive to negative blunders
- Computationally intensive
- Makes rough surfaces
  - Real? Measurement error? Misclassified vegetation?

Cross-section of highway cut

R. Hagerud, USGS