

3D - Laser Scanning: Integration of Point Cloud and CCD
Camera Video Data for the Production of
High Resolution and Precision RGB
Textured Models: Archaeological Monuments Surveying
Application in Ancient Iliida

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Objective:

*Integration of the 3D Laser Scanner Geometric Data and RGB Images
for the production of true RGB textured 3D Models*

Case:

Ruins of Ancient Iliida



Nominal Processing Workflow

1. Point Cloud Editing
2. Individual Scan Point Cloud co – registration
3. Global Point Cloud Georeferencing
4. Image Matching (Establishment of Interior and Exterior Orientation)
5. Point Cloud Segmentation
6. Mesh Generation
7. RGB Texture Application on Mesh
8. Ortho – photo diagram, profiles and section generation

Individual Scan Point Cloud Co – registration

Determination of six parameters:
station position difference \Rightarrow 3 unknowns (3D translation)
difference of Hz angle origin (backsight) \Rightarrow 1 unknown (rotation)
Instrument's lack of leveling ability \Rightarrow 2 unknowns (rotations)

➡ *Cloud – Based:*
Determination of the relative geometry by means of significant common volumes of the local point clouds (without targets)

➡ *Individual Scan Georeferencing:*
Direct georeferencing of each single point cloud by means of known position targets

➡ *Local Point Cloud Co – registration:*
Relative geometry determination by means of sufficient number of commonly visible (scanned) targets between scans



Global Point Cloud Georeferencing

Determination of six parameters:

origin position \Rightarrow 3 unknowns (3D translation)
orientation \Rightarrow 1 unknown (rotation)
Instrument's lack of leveling ability \Rightarrow 2 unknowns (rotations)

By conventional surveying methods:

Target spheres as unknown vertices of terrestrial 3D network.

Caution:

Scale factor of map projection must be accounted for when georeferencing to state geodetic reference frame

Preferences:

First co – register individual point clouds, then georeference the entire global point cloud \Rightarrow maintenance of scan inner accuracy

CCD camera image acquisition and pre - processing

By external camera, because:

- Superior resolution (2500 x 2000 vs. 768 x 576)
- Freedom of point of view selection
- Freedom of time of shooting

Problems: Color discontinuities due to lighting condition differentiation



Solutions: Color balancing and brightness / contrast adjustments



CCD camera image acquisition and pre – processing (cont.)

Problems:

Insufficient image spatial acquisition



Solutions:

Careful Image Acquisition!



Interior and Absolute Orientation Parameters Estimation (Image Matching)

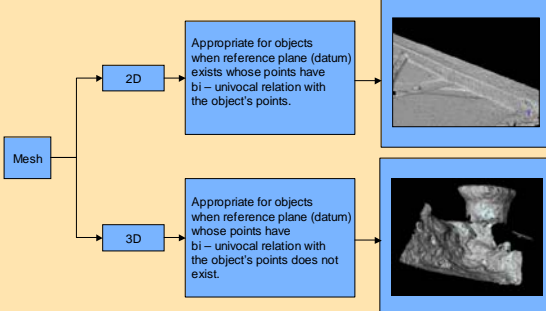
Purpose:

Establish the mathematical relation between 2D image coordinates and 3D position in space

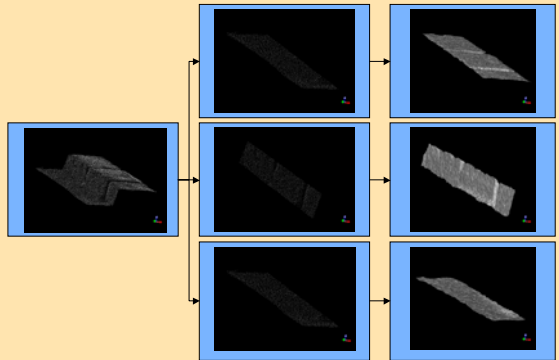
Hints:

- Avoid selection of photo control points lying on one single plane
- Do not use true color RGB point cloud coloring from previous coloring when selecting photo control points in 3D cloud
- When using wide – view angle lens cameras, avoid image corner proximity due to excessive radial distortion not accounted for by the software model

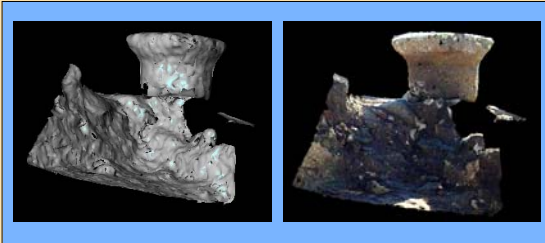
Mesh Generation / The Need for Segmentation to 2D and 3D meshing



Mesh Generation / The Need for Segmentation to 2D meshing for different reference planes



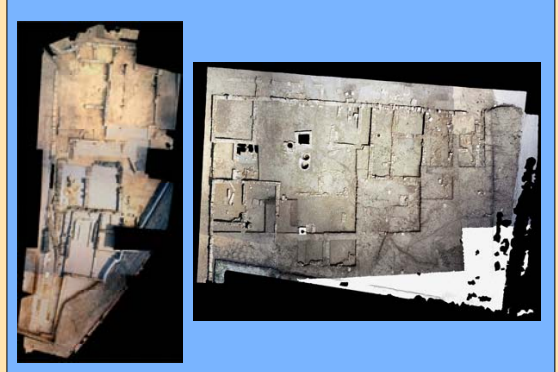
Texture Application on Generated Mesh



Hint:

Best Textures come last!

Results / Ortho Photo Diagrams



Results / Ortho Photo Faces



Results / Real Color RGB Textured 3D Models

