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 Ilida

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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 Ilida

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 ⇒ 3 unknowns (3D translation)
- difference of horizontal angle origin ⇒ 1 unknown (rotation)
- instrument's lack of leveling ability ⇒ 2 unknowns (rotations)

Global Point Cloud Georeferencing
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 to maintain scan inner accuracy.

CCD Camera Image Acquisition and Pre-processing
By external cameras, 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 conditions/filtration

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

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<tr>
<th>2D</th>
<th>3D</th>
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<td>Appropriate for objects when reference planes (surfaces) exist whose points have bi-univocal relation with the object's points.</td>
<td>Appropriate for objects when reference planes (surfaces) whose points have bi-univocal relation with the object's points does not exist.</td>
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Mesh Generation / The Need for Segmentation to 2D meshing for different reference planes

Texture Application on Generated Mesh

- Best Textures come last!

Results / Ortho Photo Diagrams