Fusion of laser scanning and Photogrammetric data for the documentation and VR visualization of an archaeological tomb complex

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Goal: 3D Digital Reality with large coverage and sub-mm resolution

¹ Cooperation with Department of Ancient Civilizations, University of Basel, SNSF grant 162967, https://lhtt.philhist.unibas.ch/sheikh-abd-el-qurna
Approach

- Fusion of TLS, Photogrammetry and close-up scans
- Selective coverage with highest resolution
Example: Narrow vertical shaft

Challenge:
Upper part not accessible with the scanner

Solution:
- 8 scans of the shaft (ladder)
- 98 pictures with SLR camera mounted on a long pole for upper ¼
- Feature-based registration of photogrammetric and TLS point clouds (overlap only 15%)

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Workflow

TLS point cloud

Photogrammetric point cloud

Coarse scaling

Keypoint extraction (Harris3D)

Keypoint matching (K4-PCS)

Coarse alignment

Fine alignment and scaling (ICP)

Registered point clouds
Results
Results

2 m

horizontal cross section

5 mm RMS

vertical cross section
Example: Funerary Chapel

Challenge

Fully textured 3D model despite poor illumination, surface roughness, and parts with little texture

Solution

- TLS for geometry (80 scans)
- RGB pictures (7000) with SLR camera and flash for texture
- Fusion of TLS and photogrammetric point clouds after color adjustment and dense matching

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Workflow 1 (Geometry)

TLS point cloud

Coarse scaling

Keypoint extraction (Harris3D)

Keypoint matching (K4-PCS)

Photogrammetric point cloud

Coarse alignment

Fine alignment and scaling (ICP)

Registered point clouds
Workflow 2 (Texture)

1. Oriented and calibrated images
2. Creation of texture atlas
3. Textured TLS mesh
4. TLS mesh
Texture Atlas
Workflow 3 (Reduction of resolution)

Challenge:
Resulting textured model too large for RT visualization (25M faces)

Solution:
- Decimation of TLS mesh
- Calculation of bump maps
- New texture atlas: Shading from bump map plus original texture
Workflow 3 (Reduction of resolution)

decimated resolution (22k) with bump map from the original resolution
Conclusion

- Multi-modal data acquisition for generation of 3d models with appropriate properties
- Variety of sensors for obtaining point clouds and colors
- Key are coregistration and blending
- Presented herein purely data driven approach for scaling and registration
- RT visualization using techniques from gaming industry and CG