3D VISUALIZATION – USING HIGH RESOLUTION MULTI.SENSOR DATA

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KEY WORDS: 3D, visualization, high resolution, multi-sensor data, throne hall of Neuschwanstein castle

ABSTRACT:

This is an approach creating a three dimensional virtual world by using high resolution multi-sensor data.
The throne hall of Neuschwanstein castle was visualized three dimensional with the help of multi-sensor data records. The high resolution multi-sensor data was based on laser scanner data and panoramic/matrix camera images. It is illustrated how multi-sensor data can be processed, achieving impressive results. It is also presented the state of the art concerning technologies and software solutions and approaches for future activities.

1. Introduction

In the last years the 3D visualization of larger objects, for example in the architecture, has found, owing to the development in hard and software, ever more interests and applications. In particular by digital photography and measurement sensors the 3D visualization with photo-realistic textures became more and more possible.
In the following it will be reported how the 3D visualization of the throne hall of the castle Neuschwanstein took place with the help, the use of multi-sensor data records and commercial 3D-, picture- and visualization-software.
In the last year the multi-sensor data records of the Neuschwanstein castle, (which were) produced by laser scanners and panorama camera, were already contents of the Workshop. (literature 1)

2. Used sensors

The used laser scanner was the Imager 5003 of the company Zoller and Fröhlich (Fig. 1) with a maximum field of view of 360° x 270° and a maximum number of pixels from vertical (270°) 15000 * horizontal (360°) 18000. The scan time (scanning time) for 8000 x 8000 pixels space cutout amounts to approximately 140 seconds (literature 2).

Fig. 1: Imager 5003 by Zoller und Fröhlich

The digital panorama camera EYESCAN M3metric of the company KST (Fig. 2) distinguishes through its high picture dimension, of 10296 RGB pixels vertical and through its metric accuracy (literature 3).

Fig. 2: EYESCAN M3metric

Additionally a matrix camera Fuji FinePix with 8 megapixels was used.

3. Data processing

The raw data of the laser scanner, so called zfs format, were oriented and calibrated by the software of the company Illustrated Architecture. After that the laser scanner data were present in the OSC format. With programs of DLR these data can be read, visualized and converted/transformed into other formats. In this work the original data had to be converted and stored as VRML format, also called WRL.
The data of the panorama camera were present in the raw format (3 x 16 bits). After corrections and calibration in the DLR they were stored as standard TIF format.

4. Used software

For the treatment of the 3D data and the production of the 3D model, based on the laser data of the laser scanner, which were

present after transformation in VRML/WRL format, the commercially available program Maxon Cinema 4D version 8.5 took place.
In the 3D-Modelling range all tasks of standard can be solved professionally with this program. (With this program all tasks of standard can be professionally solved in the 3D-Modelling range.) With Cinema 4D the production of simple 3D-texts or logos, the visualization of complex 3D object/models and complex animations with camera and object movements become possible.
This product/program offers versatile possibilities as for example the producing of parametric objects, the modelling of nonlinear and polygonal objects, modelling with HyperNurbs, different options of producing an animation, the setting of light/lighting and high-quality rendering.

For the treatment of the photo panorama data and the further use as textures for the 3D model and the 3D objects the program Photoshop by Adobe was used.

5. Production of the 3D model

The produced 3D model of the laser scanner, in the converted format VRML/WRL, is a mesh and contains many mesh partitions.

Fig. 3: Cutout of the 3D-mesh-model

Fig. 4: Cutout of the 3D-mesh-model

This 3D model could not be used for the further treatment/processing because it contained too many mesh partitions. The Mesh was copied by primitive 3D-objects. The laser scanner data were used as local coordinates, they indicated the dimensions (length, width and height) for the individual objects and the complete throne hall. After these dimensions the 3D model was built out of simple objects.

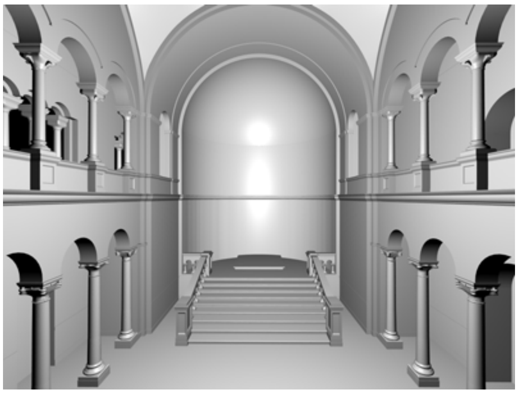

Fig. 5: throne hall without texture

6. Mapping – processing of the photo data

In Photoshop the panorama and matrix camera data were treated in such a way that it could be further used for the mapping on the 3D objects in the program Cinema 4D.
For that the data of the panorama camera, presented in TIF or JPEG format, were transformed into parallel perspective (Fig. 5). Parts of the pictures were cut out and distorted geometrically. In this format they could be used for the mapping as textures on the objects in the 3D program Cinema 4D (Fig. 6).

Fig. 6: transformed cutout of a panorama picture

Fig. 7: 3D model with textures from the panorama pictures

The paintings at the rear walls or the floor for example were built up from many individual photos of the matrix camera (Fig. 8) to one picture (mosaiking) (Fig. 9), after appropriate transformation and radiometric reconciliation.

Fig. 8: individual pictures

Fig. 9: example for the mosaiking

In the 3D program Cinema 4D a new material, a new texture will be produced. Into this material, which is empty at first, without colour and without texture, the produced photo/picture will be imported/loaded. More exactly the path indicates from where Cinema 4D should fetch the picture/ the texture.

Now this material can be mapped on any object (Fig. 10,11, 12). It also can be selected different kinds of mapping (Spherical-, Cylindrical-, Flat-, Cubic-, Frontal-, Spatial-, UVW-, Camera-Mapping or Shrink Wrapping). The selection of the way of mapping depends completely on the form of the object on which this material should be mapped (Fig. 13, 14, 15).

Fig. 10: individual object with textures

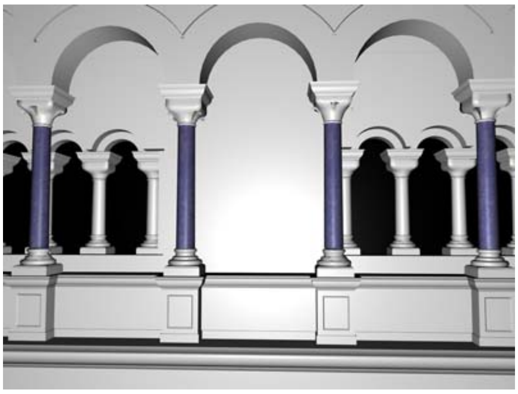

Fig. 11: individual object with textures

Fig. 12: individual object with textures

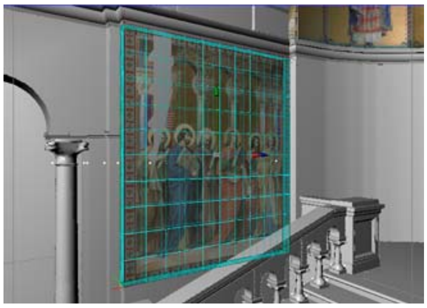

Fig. 13: demonstration of mapping options

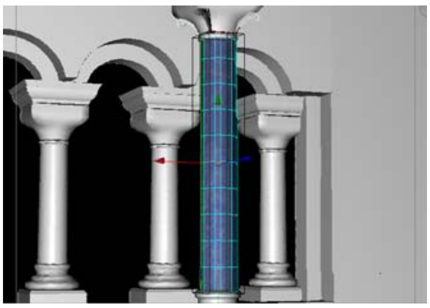

Fig. 14: demonstration of mapping options

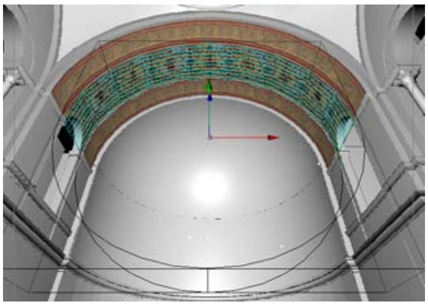

Fig. 15: demonstration of mapping options

7. Result and Assessment

The project can be stored into different 3D formats (3D Studio, Cinema 4D XML, Direct 3D, DXF, FBX, Quick Draw 3D, Shockwave 3D, STL, UZR, VRML1, VRML 2 and Wavefront). The illustrations show different rendered views of the throne hall (Fig. 16, 17, 18).

In order to be able to work with the project on an up-to-date PC the picture dimension of the used pictures had to be reduced. This meant that the resolution of the texture had to be reduced. Otherwise it was no longer possible to render pictures from this 3D model.

Further working with Cinema 4D resulted, that without optimizing the polygons of the individual objects (for example the columns) they (these objects) could not be duplicated (3 GB RAM was not sufficient).

Also problematic was the processing of the 3D-model data of the laser scanners in the program Cinema 4D.

The noise of the laser scanner data, particularly on smooth surfaces leads to highly dimensional meshes, whose further processing/treatment was not meaningful within Cinema 4D. It would be necessary to optimize the laser scanner in such a way that the data records could be processed/treated simply and fast.

Equipment would be desirable that can take up 3D laser scanner and high resolution graphic data together at the same time with metric accuracy and could be evaluated with standardized software.

Fig. 16: rendered view of the throne hall

Fig. 17: rendered view of the throne hall

Fig. 18: rendered view of the throne hall (high resolution)

8. Literature

Literature 1:
DATA FUSION AND VISUALIZATION OF PANORAMIC IMAGES AND LASER SCANS
Karsten Scheibe, Martin Scheele, and Reinhard Klette
'Panoramic Photogrammetry Workshop'
Dresden, Germany
19-22 February 2004
INTERNATIONAL ARCHIVES OF PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCIENCES
ISSN 1682-1750
VOLUME XXXIV, PART 5/W16, 2004

Literature 2:
LOCAL POLYNOMIAL RECONSTRUCTION OF INTENSITY
DATA AS BASIS OF DETECTING HOMOLOGOUS POINTS
AND CONTOURS WITH SUBPIXEL ACCURACY
APPLIED ON IMAGER 5003
'Panoramic Photogrammetry Workshop'
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Literature 3:
Scheibe, K., Korsitzky, H., Reulke, R., Scheele, M., Solbrig, M., 2001: *EYESCAN – A high resolution digital panoramic camera.* Robot Vision 2001, LNCS 1998 (Eds. Klette/Peleg/Sommer). Springer Verlag, pp. 87-83

Schneider, D., Maas, H.-G., 2003a: *Geometrische Modellierung und Kalibrierung einer hochauflösenden digitalen Rotationszeilenkamera.* Photogrammetrie, Laserscanning, Optische 3D-Messtechnik – Beiträge der Oldenburger 3D-Tage 2003, Wichmann Verlag, pp. 57