

## RECONSTRUCTION OF THE APPEARANCE OF SCHLOSS HERBORN BACK TO 1540 AND ITS MULTIMEDIA PRESENTATION

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### **Abstract:**

Based on today's „as-found“ model of Schloss Herborn virtual rebuilding could be done according to the investigation and research in the castles history. Photorealistic renderings, stereo image pairs, calculated panoramas for a complete scene description, walk-throughs and fly-overs in different time periods are included in the interactive presentation. A time-laps animation shows the mutilation of the castle over 500 years. The complete documentation is presented as a CD-ROM. Access to the material is given via Internet as well. Techniques and tools used for the description are amongst others: HTML, CSS and Javascript. Flashpix image format enables high resolution image distribution via Internet.

Auf der Grundlage eines „wie vorgefunden“ erstellten CAD- Modells von Schloss Herborn konnte eine virtuelle Rekonstruktion entsprechend der historischen Nachforschung erstellt werden. Photorealistische Abbildungen, Stereobildpaare, berechnete Panoramen für komplette Szenenbeschreibungen, Durchgänge oder Überflüge in unterschiedlichen Zeitperioden bilden zusammen die interaktive Präsentation. Eine Zeitrafferanimation dokumentiert bauliche Veränderungen über 500 Jahre. Die komplette Dokumentation ist auf CD-ROM verfügbar. Zugriff ist auch über das Internet gegeben. Zur Aufbereitung der Daten wurde u.a. HTML, CSS und Javascript eingesetzt. Mit dem Flashpix-Bildformat ist die Publikation hochauflösender Bilder über das Internet verwirklicht.

### **1 INTRODUCTION**

Schloss Herborn is first mentioned as „Burg“ in 1350. It strengthened the defences of the town Herborn and provided an additional residence for the Nassau family. Schloss Herborn had been demilitarized in 1570. In this year count Johann had ordered the demolition of its tall main tower. From 1780 onwards there was a campaign of renovation and simplification of the whole structure. Several details typical for the gothic appearance of the castle were chopped off or mutilated, including the gate of the inner court with its twin towers.

Since the city of Herborn is celebrating its 750th jubilee in the year 2001 the municipal appointed the Universities of Applied Sciences Bochum and Bielefeld to document the main changes of the structure of Schloss Herborn in its history. Together with the documentation of the old historic city, including large scale aerial images and a VRML description of the city, the results are published on a multimedia CD-ROM.

This paper focuses on the recording of the castle using hybrid surveying techniques including aerial and terrestrial photogrammetry and the Internet presentation methods like animations, stereo images and panoramic image technology. The huge aerial images are stored in FPX format to enable zoom viewing and delivering of highest resolution via Internet.

A DTM and the roofing of the castle were first measured from aerial stereo photogrammetry. Flight elevation was 400 meter, photos were taken with a Rolleiflex 6006 metric camera with a 80 mm focal length. The camera platform was GPS / INS stabilized. High resolution scanning with 4000 ppi provided digital images for evaluation on a LH workstation. Additional measurements were taken from the ground with a total station and by means of close-range photogrammetry. From all those measurements the DTM and the geometry of the castle were constructed. Textures for photorealistic renderings are given by the terrestrial photogrammetric images.

## **2 DATA ACQUISITION**

### **2.1 Terrestrial Measurements**

Detailed geometric information about the building was derived from total station measurements and close-range photogrammetry. The network of points measured by electronic tacheometry was used for modeling the geometric shape of the building and for getting control points to support image orientation. Images were taken in a multi-image arrangement. After orientation of the image bundles, object points and photo positions are known. With known image positions and object geometry scaled bitmaps can be calculated by means of orthophoto processing and image rectification. Those rectified images build the library for texture mapping of the as-found structure. For getting a unique image resolution, the object resolution was selected with 0.025 m. A surface of 10x10m is then given with a resolution of 400x400 pixel. It is important to take the final object resolution into consideration during film scanning. The scan resolution of the Rolleiflex 6006 metric images is sufficient with 1000ppi for the multi-image process. Scan resolution for texture maps results from image scale and predefined object resolution. Refer to references [ 1] and [2] to cover this topic.

### **2.2 Use of GPS**

The possibilities of GPS applied in three ways for the Herborn image flight:

- support of the flight navigation
- determination of the co-ordinates of the image positions
- determination of ground control point with high precision

In the present case the co-ordinates of the image positions were determined by a postprocess utilizing the DGPS principle. Operating a 12 channel receiver Leica MX 9400 resulted in an accuracy of 0.5 m for the image positions. The automated image orientation process benefits from this accuracy.

Orientation of the image bundle was further supported by 18 ground control points determined by carrier phase measurement within centimetre accuracy. The points were distributed over the whole city area. Natural targets like man holes or traffic marks were used.

### **2.3 Aerial Photogrammetry**

In co-operation between University of Applied Sciences Bochum, Environment Consulting Hattingen and IBF Freudenberg the aerial recording system LEO was developed. This local earth observation system was fixed in an aircraft Cessna 172 Rocket (owner LSV Freudenberg). LEO is equipped with a very precise stabilized camera platform.

The platform is controlled by three servo-motors. Precise position angles are determined by a DGPS supported inertial navigation system. The main components of these systems are gyroscopes and acceleration detection. The combination DGPS and INS delivers position data with very high precision.

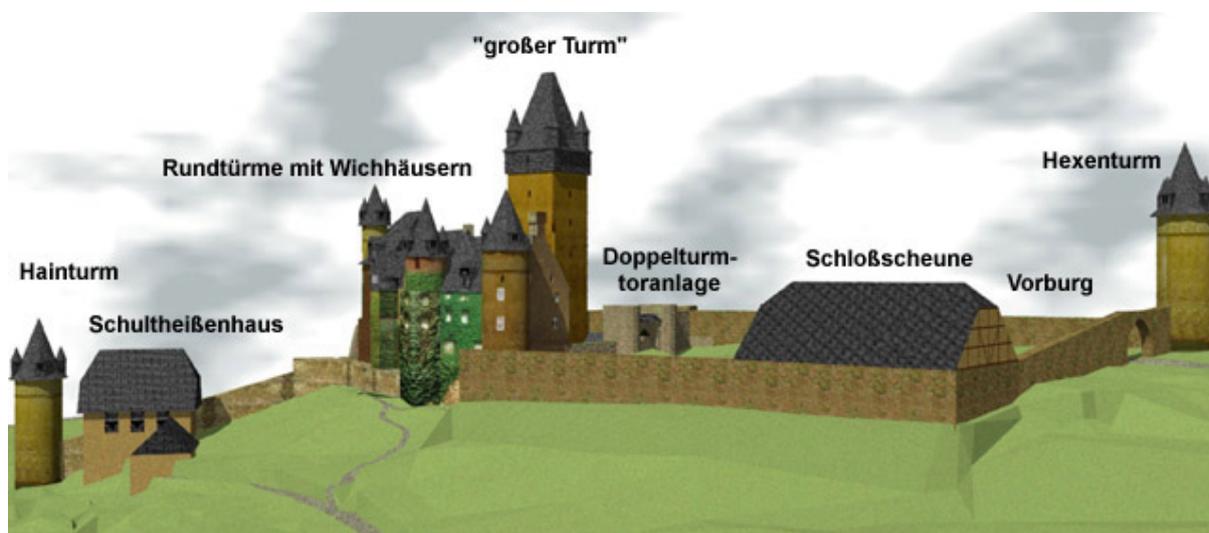
The flight management system of LEO is responsible for image flight planning, flight guidance and camera release at the presetted position and delivers the image overview after the flight.

### 3 CAD-MODELING

#### 3.1 Modeling the castle

To explain Schloss Herborn's architecture and its present appearance, a photorealistic CAD model of today has to be modified back to 1640 and 1500. In 1570 Schloss Herborn was demilitarized by the demolition of the big tower. This removed a very important, dominating feature from its skyline and a large shadow from the inner court. Two other major campaigns of renovation and modernization took place in 1630 and 1725. From 1780 onwards there was a campaign of renovation and simplification of the whole structure. Several details typical for the gothic appearance of the castle were chopped off, including the gate of the inner court with its twin towers..

Construction of the CAD-model is supported by point measurements using total station measurements and multi-image close-range photogrammetry. Surveying of the roofing is done by aerial photogrammetry. The textures are given from the rectified photogrammetric images. The photorealistic renderings present the model „as-found“ instead of „as-built“. In case of no structural changes the castle could look as in figure 1 today.

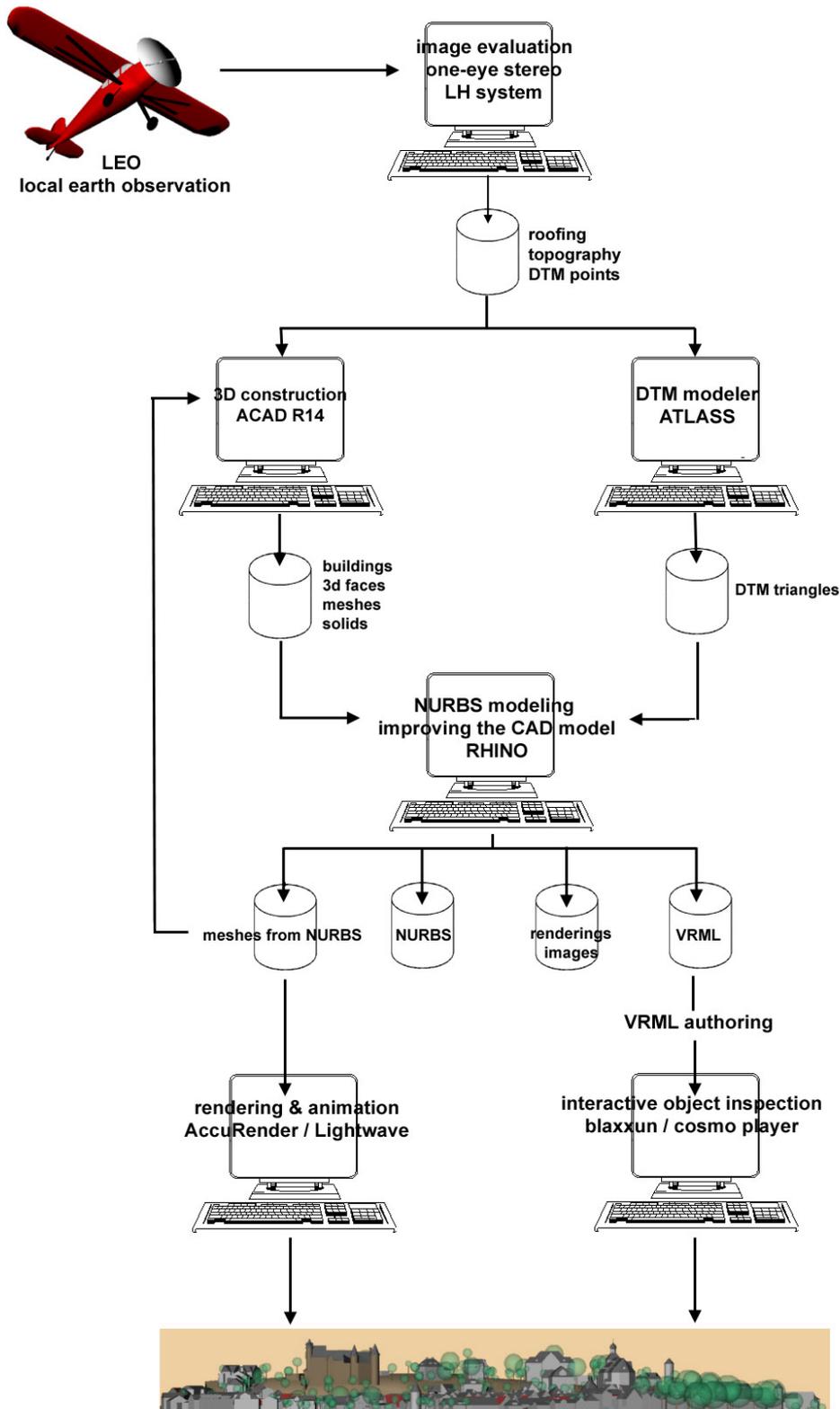


**Figure 1:** Schloss Herborn around 1500. Showing the big tower, the twin tower gate in the inner court and some other important details which are chopped off today.

#### 3.2 Modeling today's environment

In addition to a detailed model of the castle its environment is shown today by a digital town model. Figure 2 is a principal drawing of interfacing the different programs used during the modelling process. The incoming digital aerial images are evaluated by a one-eye stereo system from Leica-Helava. The evaluation provides unstructured points and lines for the roofing, topography and the DTM. While the CAD-structure of the roofing and topography has to be constructed manually, the DTM can be calculated by a DTM program.

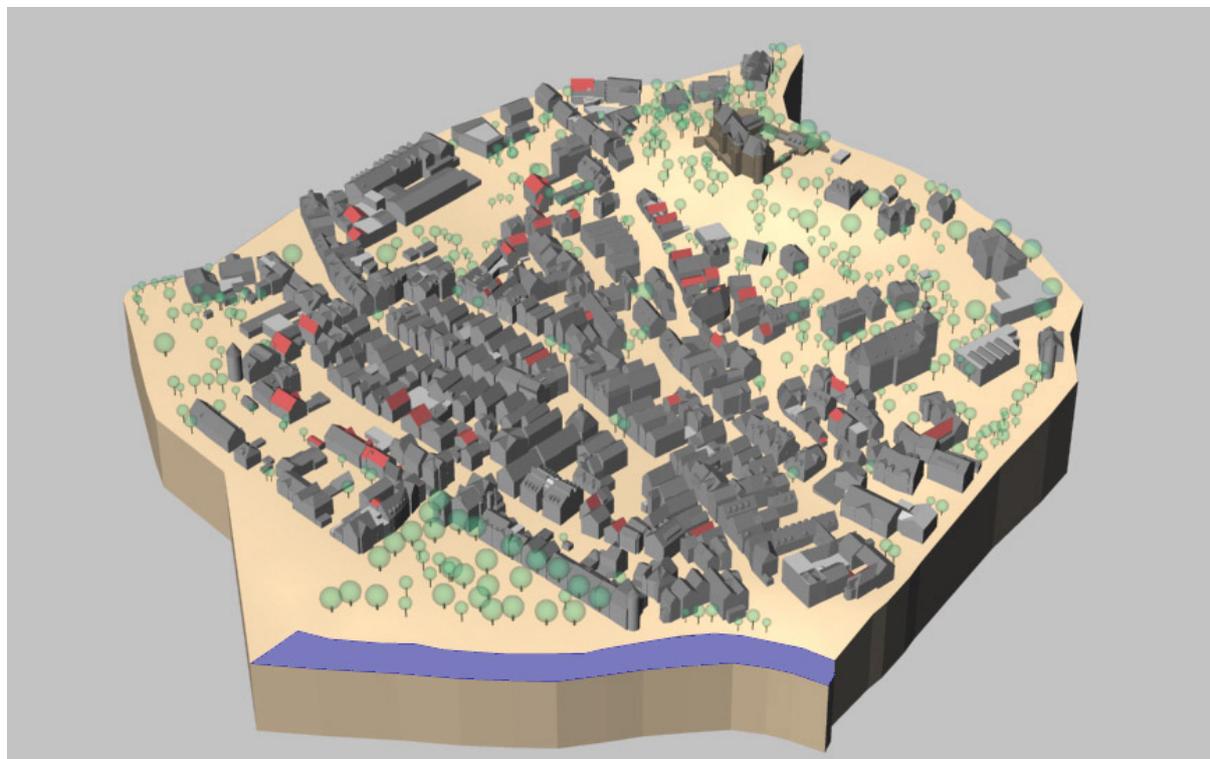
Modelling with NURBS is today's most unrestricted method for constructing any kind of geometry and its further processing. Therefore the complete model was imported into the NURBS modeler RHINO from McNeel. Smoothing of the DTM's surface, constructing trees and intersection of surfaces are carried out to finish the model. Figure 3 shows the final result, rendered inside RHINO.



**Figure 2:** Flow chart of the modeling process, documenting the application programs used

Export of the NURBS-model results in meshes from NURBS for further processing with the more sophisticated rendering program AccuRender or for animation programs like Lightwave for example.

Beside several other export formats the VRML format for interactive object inspection via Internet is important for this application.



**Figure 3:** Rendered Image from NURBS-Modeler

## 4 DATA FORMATS AND TECHNIQUES FOR INTERACTIVE PRESENTATION

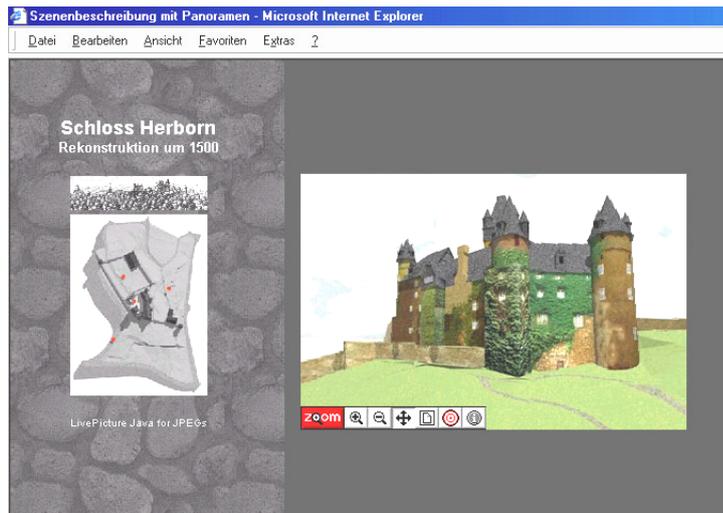
Solving the problem of displaying large structures for interactive viewing with a Web browser is the main task of writing the interface to access the complete scene description. The data base consist of text, images, 3D-models and animations. Some techniques used are briefly described in this chapter.

### 4.1 Flashpix File Format

Flashpix is a hierarchical image file format that provides multi-resolution imaging for fast image presentations. The initial view is shown in a selected resolution. During zooming in, higher resolutions are requested to show greater levels of detail. The base of the image pyramid represents the full image resolution. The following levels are splitted into tiles each 64x64 pixels. Flashpix images can be generated with Adobe Photoshop using the LivePicture plug-in. In order to use FlashPix images on the Internet, the Web server must be running the LivePicture Image Server. For further information visit [www.livepicture.com](http://www.livepicture.com)

## 4.2 Panoramic Image Calculation

The use of the panoramic image technology enables interactive viewing by selecting the direction and the distance to the objects projected onto an image cylinder or sphere. Calculation of virtual models is performed by changing the viewing direction and by still using the same viewing position. The single images are stitched together by using warping and blending functions. Complete scene descriptions of panoramas can exist if they are linked together. Figure 4 shows a small scale map of the castle in the year 1500. The red dots mark the „hotspots“ to link different panoramas. While viewing a panorama it is possible to change from one directly to other panoramas. Refer to [ 6]



**Figure 4:** Scene description with panoramas.

## 4.3 Image Objects

Since a panorama puts the viewer into the center of a scene an image object can be inspected by rotating and zooming. The viewer is located outside the object and can move to any position. Single images are calculated by changing the viewpoint using a fixed viewing direction to the center of the object. The sequence of images is stored in one file. Presenting panoramas or image object needs for example Quicktime VR or the LivePicture viewer, available as a JAVA version or plug-in.

## 4.4 Stereoscopic Images

The use of stereoscopic images for computer visualization becomes popular again. Stereoscopic displayed data is far more effective for visualization than a flat presentation. Two methods of image separation are common. Temporal separation viewing the images with shutter glasses in interlaced mode or the low cost solution by colour filtering with anaglyph glasses. Web browser plug-ins are available which can convert the stereo image formats JPS, BMS or PNS to the viewing mode available. An alternative solution which can be recommended is the use of a JAVA applet named „stereoscope“. Stereoscope is provided free by the author, refer to [www.stereofoto.de](http://www.stereofoto.de)

## 4.5 GIF-Animation

GIF animations provide simple but efficient solutions for time laps animations. They can be an alternative to walk-throughs, fly-overs or to animations including moving objects. Because the latter requires large amount of data. GIF animation software is available as freeware or shareware. The structural changes of Schloss Herborn, described under 3.1 here, are shown in the presentation as a GIF animation. A photorealistic image, calculated with the same viewing parameters, for every time period is arranged in a GIF file including some text. The loop runs infinite. Between the images fading in and out is used to highlight the structural changes.

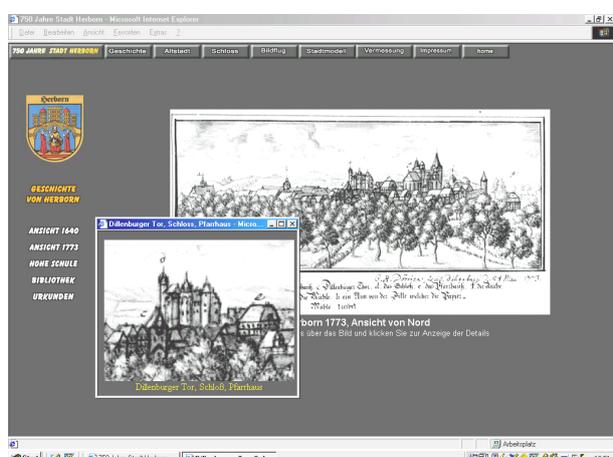
## 5 MULTIMEDIA PRESENTATION

The user interface of the doumentation is organized as a Web-site. Necessary is a Web browser, the LivePicture plug-in and a VRML browser like Cosmoplayer. Since the documentation will be published as a CD-ROM for the 750th jubilee of the city of Herborn some chapters are added to generate more interest. Information about the history of the city, a walk through the city today, aerial images and explanation about the used surveying methods are burned onto the CD. A VRML model of the city invites to a virtual walk-through. While walking through the virtual model some events occur like a visit of the church, a walk into the city hall and a visit of the museum.

The screen is organized in three frames: A headline, a menu and the main screen showing the requested information. Every chapter can be selected directly from the headline, the menu then shows the paragraphs. Mouse-over effects indicate the links. Javascript is used to link only two of the screens when changing between chapters.

Enabling viewing of Flashpix images is only possible while the FPX server is installed. Therefore some other techniques provide image enlargement on the CD. While using the mouse over an image, links to enlargements are indicated, see figure 5 a screenshot from the user interface. Aerial images are stored in resolutions of 512x512 and 2048x2048 pixel, a click into the image alternates the resolution back or forward.

Stereo image pairs are stored as anaglyph images or as interlaced images for the view with shutter glasses. Short sequences of video films and background sounds complete the multimedia presentation. Different language versions are installed on the CD. Access to a preview via internet is possible by visiting [www.imagework.de](http://www.imagework.de)



**Figure 5:** User interface of the CD-ROM, enlargement of image details utilizing image maps.

## 6 CONCLUSION

This paper documents the integration between photogrammetry and other surveying techniques and the demand to interactive multimedia presentation. Evaluation of the measurements fulfil multi purposes. Not only experts have to inspect the material. Every interested person should be enabled to browse through the database. It is necessary to explain the possibilities photogrammetry can supply for visual and virtual scene descriptions and modeling.

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