

ANAGLYPH IMAGES – STILL A GOOD WAY TO LOOK AT 3D-OBJECTS?

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ABSTRACT

During the recent years, a rapidly growing market of photogrammetric low cost systems has drastically increased the number of applications of photogrammetry. Besides maps and plans, the modern systems provide the user also with 3D-models. At the same time, the WWW allows to offer these models to a world-wide audience. There are several techniques available, to publish 3D-models in a way, that the reader can view them also in 3D. However, most of them require special devices, as stereoscopes, polarising glasses etc. One of the cheapest methods is the anaglyph image which can be viewed with a red and a green transparency in front of the readers eyes. In this paper, we want to show cheap ways of producing black and white as well as coloured and animated anaglyph images.

1. INTRODUCTION

The market of photogrammetrical hard- and software has been developing more and more rapidly during the last decade. One of the main reasons for this is today's Personal Computer, which on the one hand has become affordable for most people and on the other hand can perform tasks we never dared to dream about ten years ago.

At that time, photogrammetrical solutions, as for example bundle adjustments or digital photogrammetry, were confined to extremely expensive workstations. Today, most of these tasks can be handled by a modern PC and several companies are offering cheap and easy to use photogrammetrical software for this platform. Consequently, this makes photogrammetry affordable also for fields like archaeology, where due to limited budget photogrammetry was usually only applied within prestige-projects.

Besides maps and plans, these modern systems provide the user also with the possibility to create 3D-models. These have become very popular during the last years. They allow the scientist to create virtual photorealistic 3D replica of the recorded structures which can be looked at and investigated from any viewpoint. However, these models are always depicted on 2D-media, be it the computer screen or the page in a publication. This reduces the 3D-model to a two-dimensional image. By now, only a few solutions are available to solve this problem. Most of them can be applied only using digital media and a computer screen while only

a very few can be used for printed publications. In this paper, we want to concentrate on one of these techniques, which we think is still one of the cheapest ways for 3D-viewing, both for the producer and for the viewer – the anaglyph image.

2. STEREOSCOPIC VISION AND VIRTUAL STEREO

Due to the eye distance the two images, which will be received by the human eyes, are different from each other. The two perspectives result in a spatial imagination depending on the integration ability of the human viewing system. Basic for any stereoscopic vision is the evaluation of these differences of perspectives. The physiological value for perception of depth is the disparity, which photogrammetrists call the stereoscopic parallax (Ning Qian, 1997).

The detectability of depth differences decreases with the squared distance from the observer to the object. Its capacity is very high with the object close to the observer.

Spatial imagination can be produced when images are displayed separately to the respective human eye (left – right). They have to fulfil the requirements to natural viewing. Perspective projections with parallel viewing directions and identical image content are required (Fig. 1). This condition is called the "normal case of stereo-photogrammetry". The principle of detectability of depth differences is also true for these kind of images: enlarging the stereo basis and

* Unfortunately, it was not possible to have colored figures in this publication. However, the anaglyph images mentioned in this text can be viewed via World Wide Web under: "http://cipa.uibk.ac.at/projects/karlsplatz_anaglyph.jpg" and "<http://www.univie.ac.at/Luftbildarchiv/exhib/tempel/intro.htm>".

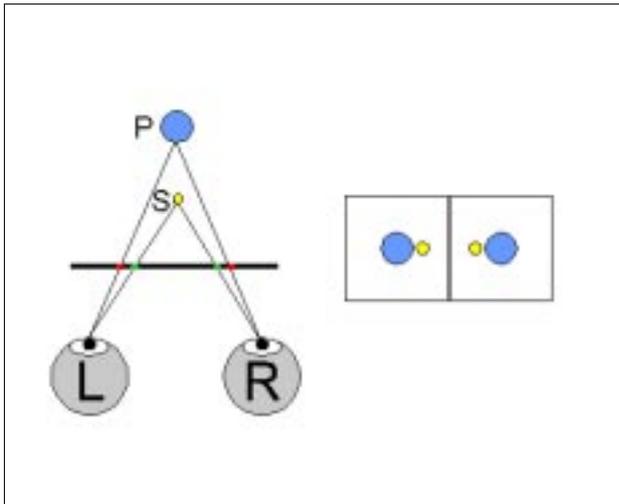


Figure 1 : principle of stereoscopic viewing and disparity (parallaxes of points) in images

enlargement of images can increase the stereoscopic imagination.

If the object is really existing the images can be exposed as 2 photographs. But objects of virtual reality for photorealistic renderings can also be derived artificially using the same idea: perspective images, parallel direction and a ratio of base to object distance that lies around a value of 1:30. Many rendering software packages support the setup of cameras and perception of stereo images this way.

3. STEREOSCOPIC VIEWING SYSTEMS

If two images have been produced using the rules of the normal case, the overlapping image area can be viewed in 3D. Hereby, the left eye has to view the left and the right eye the right image, as already mentioned above. This can be done also without device, if the two images are lying next to each other. However, this is not very comfortable since the viewing direction of both eyes has to be parallel (as if one was watching objects in a far distance) whereas the accommodation has to be done to a short distance. This requires a certain degree of practice.

There are some facilities, which make the stereoscopic viewing much more comfortable. Basically, these can be grouped into stereoscopes and mixed images.

If a **stereoscope** is used, the light rays coming from both images are paralleled by its lenses. Therefore the eyes can – as they are used to – have parallel viewing direction and accommodate to a far distance. Depending on the size of the images, smaller lens or pocket stereoscopes or a larger mirror stereoscope are available. The advantage of this method is, that the images are easy to publish. Additionally, colour images can be viewed. The disadvantage lies in the fact, that every viewer needs a stereoscope.

In a **mixed image**, both pictures of the stereopair are put

together into a single image. Viewing the images, the eyes can comfortably be converged and accommodated as they are used to. However, both parts of the mixed image have to be separated. This is usually done by filtering the light coming to the viewer's eyes using spectacles. If both images are looked at without filters, the viewer will get a blurred instead of a stereoscopic impression.

Mixed images can be produced in different ways:

They can be separated by the **polarisation method**. Here, both images of the stereopair are projected using polarising filters, where filters of opposite polarity are placed in front of the left and right projectors. The viewer wears a pair of spectacles with corresponding filters. Although viewing of polarised 3D-models is very comfortable the main disadvantage lies in the fact, that they cannot be printed. Additionally, special expensive equipment is needed (projectors or hard- and software, glasses with polarising filters).

A second method is the **stereo-image alternator**. If the 3D model is viewed on the computer screen, both images of the stereopair are shown alternating, where both images have to be flickered with a speed of more than 25 Hz. Here, the viewer needs spectacles with liquid crystal lenses. These are synchronised with the Computer by an infrared emitter. The signals cause the liquid crystal shutters to switch in synchronisation with the alternating left and right images on the screen. In this way, each eye sees only the image intended for that eye. The disadvantage of this system again lies in the required medium and devices (software and liquid crystal glasses with infrared emitter).

Another possibility is the **anaglyphic system**. Here, the left image is drawn in red and the right in cyan (or green) colour or projected using a red and cyan (or green) filter. If the viewer then looks at the mixed image through a cyan-filter in front of his right and a red-filter in front of his left eye, each complementary coloured image is filtered away. This results in a stereoscopic view, where each part of the stereopair is viewed only by the corresponding eye. The advantage of this method is, that anaglyphs can be produced easily on all kind of media. Additionally, the viewing devices are very cheap and can be produced by anybody. The disadvantage lies in the limited possibility of viewing coloured 3D-models and in a considerable light loss.

4. IMAGE PROCESSING, COLORED ANAGLYPHS AND ANIMATED GIFS

Any image processing software can produce anaglyph images easily. Both images have to be loaded, converted to grayscale and back to RGB color mode. Then the trick is to remove the red channel of the right image and replace it by the red channel of the left image by simple cut and past operations. After a slight adjustment of parallax to get the best view of depth, the result is an anaglyph of the original stereo pair.

In principle also colored photos can be converted to anaglyphs this way. But there are some problems. Colors other than red, blue and green pass through both filters and

successfully combine in the 3-D image, e.g., white, yellow, brown, gold, bronze, silver. Full red, green and blue create deep shadows through rejection by their opposite viewing filters and should not be used. The rejection of pale red, blue and green gives rise to light shadows and results in degraded colors; pale red becomes a rust color, pale green becomes olive green and pale blue becomes lilac or purple.

Another possibility is the animated anaglyph. Here, software for rendering animations and for video post-processing is required.

This technique is best explained by an example. In 1998 we made a 3D-model of the Theseus-Temple in Vienna using "low-cost" equipment and software. The Theseus Temple is located in the "Volksgarten", a public garden in the first district of Vienna next to the "Burgtheater". It was built in the 1930ies.

The temple was recorded using simple amateur cameras and the "3x3 rules". For the modelling procedure, PhotoModeler®, developed and distributed by EOS Systems, Vancouver, Canada, was used. After the model of the temple was at a satisfying level of detail, the data were exported to 3D Studio Max™. Here, a short animation of 100 frames - a flight on a circular path around the temple – was rendered. In the video post processing, which is realised within the same software, the animation was doubled. Consequently, one frameset was coloured in red, the other in green with 50 % transparency. Then, both animations were copied together again. To get a stereoscopic impression, the frames of the second film were shifted by two, so that the first frame of the original animation was copied together with the third frame of the copied version resulting in a slightly convergent "normal case". The result is an animated anaglyph, which can be viewed at "<http://www.univie.ac.at/Luftbildarchiv/exhib/tempel/intro.htm>". If the flying path would not be circular, two animations using the same camera on two parallel flying paths would have to be rendered and copied together in the way described above.

5. CONCLUSION

There are several techniques available, to publish 3D-models in a way, that the reader can view them also in 3D. However, most of them require special devices, as stereoscopes, polarising glasses etc. Still one of the cheapest methods is the anaglyph image which can be viewed with a red and a green transparency in front of the readers eyes. It can be used with all kind of media and easily be produced on a PC using image processing software. At the same time, the World Wide Web allows to offer these models very rapidly to a world-wide audience.

Therefore, we think that the anaglyph – although often underrated – is still a good way to look at 3D objects even today.

LITERATURE:

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