Anamorphic Images – a Combination of Art, Physics and Mathematics

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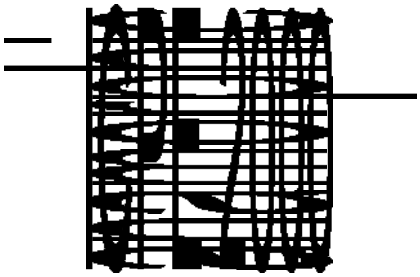
Anamorphic images are distorted images. You all know the fun children have in museums or at fairs when they see themselves distorted in big concave or convex mirrors. There are many types of anamorphic images. I will describe only two of these here.



Here are some distorted words in Latin letters (made with CORELDRAW). Try to recognize what is written here. It is possible but not clear at the first look. However, if you view this image at a very shallow angle, you will recognize it. The first view reveals 'ICPE 2000' at the bottom; then the view perpendicular to the first view reveals 'anamorphic'. This type of simple perspective anamorphic distortion can be find in many places: in paintings, wall paintings, drawings, underground stations or on the streets. This type of anamorphosis was closely related with the development of perspective in the fifteenth and sixteenth centuries. And of course you can describe this in mathematical terms as a relatively simple form of linear transformations.

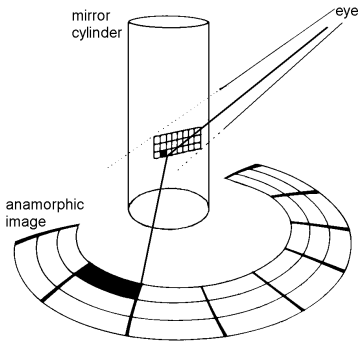
The so-called cylindrical anamorphoses were not developed until quite a time later. The pictures appear correctly when observed with a cylindrical mirror. Mainly artists used this form of anamorphic pictures, not only in Europe but also in Chinese culture, and they used it without thinking in physics or mathematical terms. With anamorphic images you can hide the content. If you know the trick of how to resolve the image, you can see them normally. Therefore these images have a certain magic aspect. And this is fascinating, not only for children.

Here is a drawing which shows the basic construction of anamorphic grids. The observer is at a finite distance from the cylindrical mirror. One reflected ray is drawn in a thick line. The construction uses only the law of reflection, which means that the angle between the incident ray and the perpendicular to the cylinder surface must be the same as the angle between the perpendicular and the reflected ray.

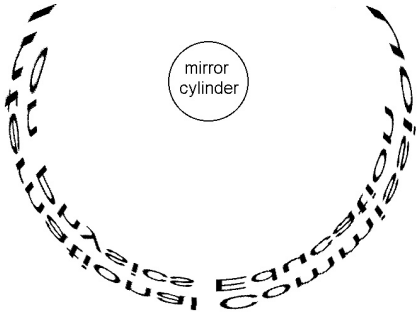
With a computer you can develop now formulas to calculate any anamorphic picture pixel by pixel.

I have looked for available programs but have not found anything in the internet or any other reference in literature. If any of you know of such a source, please let me know.

One method of calculating anamorphic images is the so-called raytracing. In raytracing anamorphic images, a virtual slide projector with the non-distorted, original image is assumed. From the eye a ray goes through the original image pixel by pixel and hits the mirror, where it is reflected and then hits the plane or another surface in a pixel. The color of the pixel is the same as in the image.



The German student Friedel Ulrich developed a program for anamorphic images with the raytracing method as a thesis during the college-level at his German Gymnasium in Pfaffenhofen in Bavaria. The structure of his program is simple: a camera, a mirror object (cylinder, cone or sphere) and a plane can be selected and positioned. A digitalized image, e.g. from a digital camera, can be inserted. The program calculates the anamorphic image. The file ANAMORPHUENGLISH.ZIP with the program ANAENGL.EXE and a short help-file can be downloaded from the internet (URL: http://www.e20.physik.tu-muenchen.de/~cucke/ftp/anamorph/ulrich/anamorphuenglish). With a Pentium 400MHz processor you need several minutes to calculate the anamorphic picture.



This example - a cylindrical anamorphosis - was calculated with this program. I have to mention that anamorphic images are normally turned upside down, which makes it even more difficult to recognize the content. Take a cylindrical mirror (easily available from chromatized syphon tubes, bended reflecting mirror foils or other sources) and view the anamorphic image. Perhaps you will have to enlarge the image with a copy machine.

Make your own and very special greeting card for the next millennium either as a linear or as a cylindrical anamorphic image.