DEFORMATION NETS FOR THE REFLECTIVE CONICAL ANAMORPHOSES

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Abstract. This paper considers the possibilities of geometrically aided design and composition of the reflective conical anamorphoses.

Keywords: reflective anamorphic images (=mirror anamorphoses), conical anamorphoses

1 Introduction

This paper is a continuation of the works presented earlier ([6],[7]). The goal of the research conducted by the author is to determine geometrical principles for construction of deformation nets that will help to discipline deformations received in anamorphical transformations. The work [6] provides classification and unification of the nomenclature for the superficial and for the reflexive (=mirror) anamorphoses. Based on the provided classification, the principles for the geometrical construction of deformation nets for several types of the anamorphic images has been elaborated in the earlier publications. This publication, which is the next in a series, will focus on the nets constructed for anamorphic images belonging to the group of the conical reflective anamorphoses, which we obtain by reflection either in a concave or in a convex conical surface. In order to illustrate the complexity of a problem two examples of extremely interesting conical reflexive anamorphoses together with their restituted images have been provided below (Fig.1, Fig.2). The circle drawn in the center of the drawing represents the position of the reflexive conical surface, while the image situated inside the circle represents the reflected image.

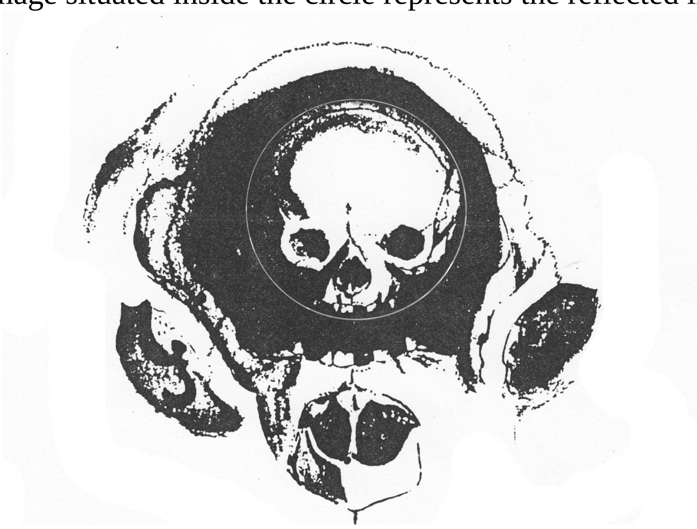

Figure 1: Author unknown; 17th century, convex reflexive conical anamorphic image: „ The skull"

Figure 2: Jean F. Niceron, 17th century, convex reflexive conical anamorphic image “Girl with a bird on a leash”

In Fig.2 we can see the anamorphic image that has been composed and placed within a ring surrounding the internal circle (see Fig.2). There are many fascinating deformations which will be finally seen when reflected in the cone as a picture of a girl with a bird on the leash. This resulting image has been placed inside the circle which represents the base of the reflecting cone.

Both exemplary images provided here show us how complicated are the relations between the obtained image and the anamorphic images in terms of geometrical sizes and deformations.

It should be also mentioned that the earliest research work and some comments on cylindrical and conical anamorphic images have been published by Jean-Louise Vaulezard [5] in 1630 and later confirmed by Jean Francois Nicéron [5] in 1638.

2 Deformation net for a convex, reflective conical anamorphosis

In order to construct a deformation net for the convex, reflective conical anamorphosis we will assume that we construct a mesh of concentric circles with a constant increase of radiuses and whose centers’ all coincide with point S”. The radiuses (r_1'', r_2'' r_3'', r_4'',...) of the consecutive circles create an arithmetic sequence as the distance between the consecutive terms is constant. The circles will additionally be divided by a bunch of evenly distributed straight lines. The lines create the polar array with the center positioned at point S”.

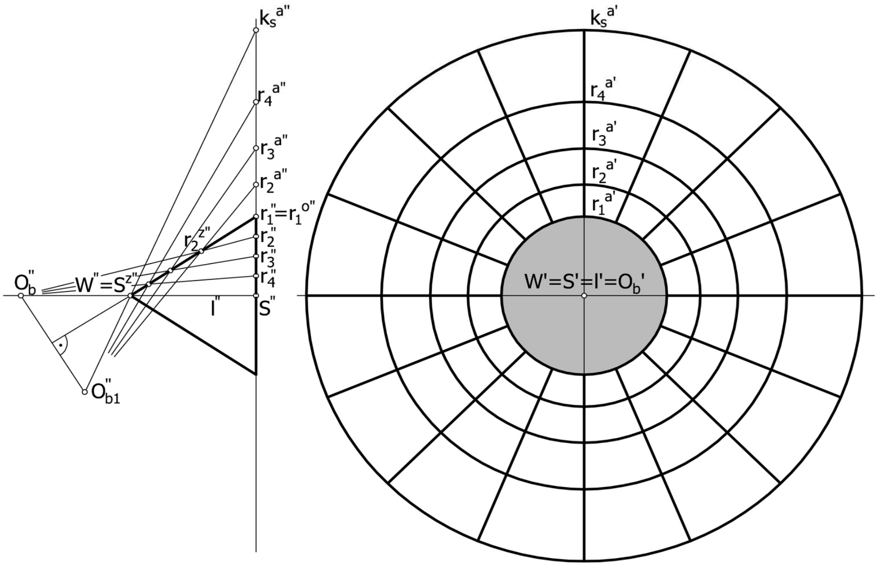

Figure 3: Geometric construction of a deformation net for a convex, reflexive conical anamorphosis

Let the reflecting cone be a cone of revolution with the vertical axis. Let us centrally position the deformation mesh in the base plane of the reflective cone (Fig.3). This plane will be unified with the anamorphic picture plane. Construction of a deformation net (=mesh) for the reflective convex cone will be provided by superposition of two geometrical transformations: 1) central projection of a concentric circular mesh from the center O_b” which belongs to the cone axis l” onto the cone surface; we get the circles ($r_2^{z''}$…...), 2) image determination of the reflected respective circles (and their radiuses) in the anamorphical picture plane with the use of point O_{b1}'' (Fig.3). The radiuses ($r_1^{a''}$, $r_2^{a''}$, $r_3^{a''}$, $r_4^{a''}$, $k_s^{a''}$ …) will define the subsequent circles in the deformation net and together with the images of the chosen generatrices of the cone they will create the deformation net for the convex, reflective conical anamorphosis.

Deformations which are created on account of the image reflection in the conical reflective mirror show highly interested if not astonishing distortions on the edges of the anamorphic picture. This graphically spectacular impression results from geometrical transformation of the center S. The image of the point S will be represented as the circle k_s^a , which in consequence will become a bordering line of the anamorphic image. Thus it is important to remember that in the anamorphic transformation the image of the center of the deformation net S will be stretched into the circle k_s^a.

3 Deformation net for a cocave, reflexive conical anamorphosis

In this case, the cone of revolution with a vertical axis will be positioned as if “upside-down” if compared to the previous problem. Let us assume that the plane α^a of the anamorphic image will be perpendicular to the axis of the cone. The anamorphic picture plane will be limited by the circle which is the line of intersection between the plane α^a and the conical surface (Fig.4). The interior of the circle will only be taken into account. Restitution of the anamorphic image will be created through the use of the internal part of the reflective surface belonging the truncated cone.

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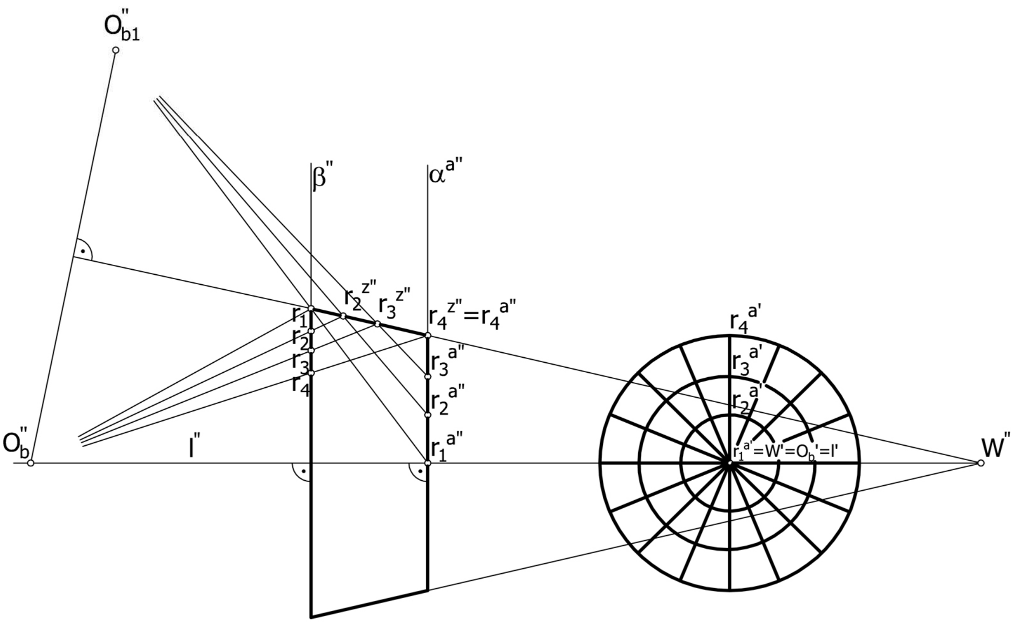

Figure 4: Geometric construction of a deformation net for a concave, reflexive conical anamorphosis

Let us position not deformed circular mesh in the base plane of the cone ß”. The center of the mesh belongs to the cone axis l”, while the plane ß” is perpendicular to the axis.

On the axis l” we randomly choose the point (O_b”). Let us first project the mesh from the point (O_b”) onto the internal (concave) surface of the cone and then, according to the law of reflection, let us determine the reflected image of the circles ($r_2^{z''}$…...) as projections from the observation point O_{b1}”. The deformation net can be either formed in a shape of a ring of concentric circles or can fill in the whole interior of the circle. The ordering of the circles forming the deformation net will always be reversed if compared to the original real-image net. When the deformation net fills in the whole interior of the circle then its central point will correspond to the most external circle of the real-image net.

It is obvious that the size of the anamorphic image directly depends on the size of the deformation net. The larger size of the anamorphic image is, the more difficult is to design and to construct a deformation net. The problem can be handled by placing the deformation net at a larger height or by bending the “frame” of a viewport in which we place the deformation net. The last activity may have a positive impact on the obtained image, as it can produce the image as if bound in anamorphic frames or the image of a flooring pattern.

References

[1] Bartel K.: *Perspektywa malarska*, Vol. II, F. Otto, PWN Warszawa, 1958.

[2] Cole A.: *Perspektywa – świadectwa sztuki*, transl. Bończyk A. , Wydawnictwo Dolnośląskie, Wrocław, 1995.

[3] *Figaroscope*, Supplement to Le Figaro 1995.

[4] Nicéron J. F.: *La Perspective Curieuse*, http://bibliotheque-numerique.inha.fr, 1638.

[5] Vaulezard J.-L.: Perspective cilindrique et conique, concave et convexe ou traité des apparences vueus par le moyen des miroirs, Paris, 1630.

[6] Zdziarski A.: *Classification and Nomenclature of Anamorphic Images*. The Journal BIULETYN of Polish Society for Geometry and Engineering Graphics, Volume 15, 2005.

[7] Zdziarski A.: *Deformation Nets for Plane Mirror Anamorphs.* The Journal BIULETYN of Polish Society for Geometry and Engineering Graphics, Volume 19, 2009.

SIATKI DEFORMACYJNE DLA ANAMORFOZ REFLEKSYJNYCH STOŻKOWYCH

W oparciu o klasyfikację obrazów dla anamorfoz powierzchniowych oraz anamorfoz refleksyjnych (Biuletyn PTGiGI, NR 15/2005), przedstawiano w poszczególnych opracowaniach konstrukcje geometryczne siatek deformacyjnych dla określonych grup obrazów anamorficznych.

Niniejsza praca podejmuje zagadnienia dla ostatniej grupy klasyfikacji, związane z geometrycznym określeniem konstrukcji tworzenia deformacyjnych siatek obrazów anamorficznych, dla anamorfozy refleksyjnej stożkowej, z uwzględnieniem stożka wypukłego oraz wklęsłego.