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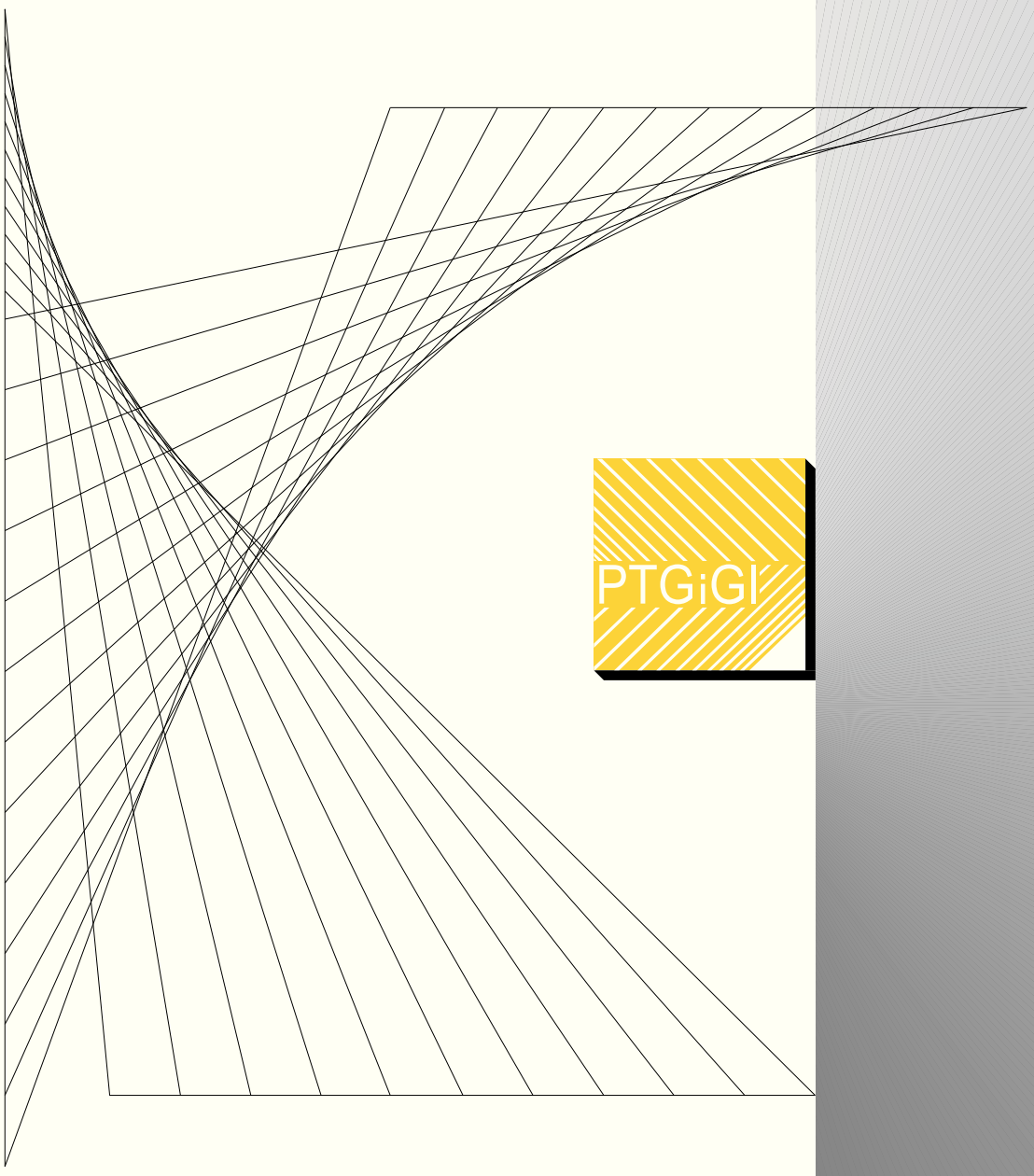

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THE OBJECT PANORAMA CONSTRUCTION WITH COMPUTER AID

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Abstract. The paper is a sequel to the author's previous study dealing with an inverse cylindrical perspective creation. It presents an object panorama creation with computer aid. The object panorama is considered as a kind of an inverse panorama with a special object location. It is constructed as a flat panorama on an unrolled cylindrical surface. The object panorama can take different forms dependently on the base assumptions defining an apparatus of the representation. The paper shows several examples of the object panorama.

Keywords : object panorama, central projection, CAD

Introduction

The capturing of panoramic 360° images has become a very popular photographic technique. These images are composed of the set of photographs stitched together and can be presented on a cuved cylindrical surface or on a flat unrolled cylindrical surface [4,5]. In the case, when an observer is located outside of the cylindrical surface being a projection surface, we achieve an inverse panorama [2,3]. The object panorama considered in the paper is a particular case of an inverse panorama.

Geometric characteristics of an object panorama

The representation apparatus of the object panorama is the same as the apparatus of an inverse panorama presented in [1] and the image of any point is received as an intersection point of the projection ray with the projection surface (Fig.1).

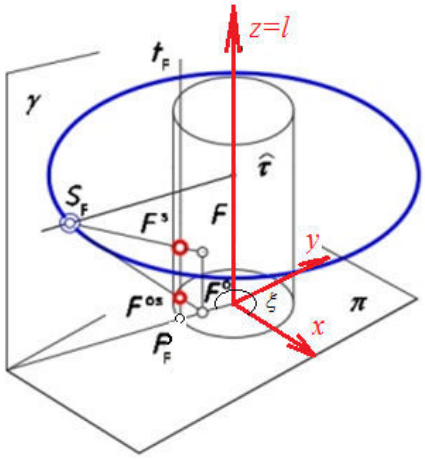


Figure 1: Object panorama projection of any point *F*

However, to obtain the object panorama, the represented figure should be located towards the apparatus in a special way. Namely, the axis of the cylindrical surface – (real or virtual) should intersect the given figure (Fig. 2).

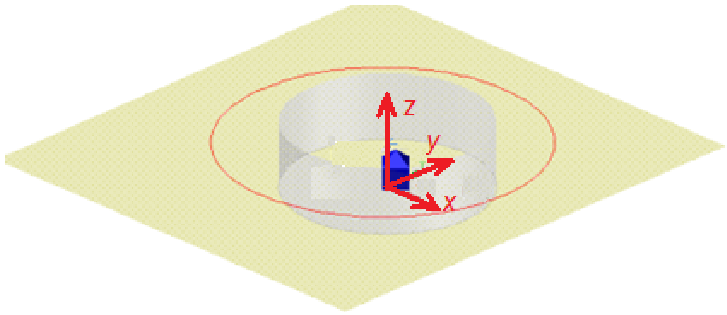


Figure 2: An object location in order to obtain object panorama

In this way we can achieve a full inverse panorama of the given figure – object panorama. It is worth noting that we can obtain an object panorama by the camera/viewpoint rotation around the surface axis, which means its moving along a horizontal circular path or the panorama can be obtain by object rotation around the axis (Fig. 3). Both panoramic images are the same.

a) b)

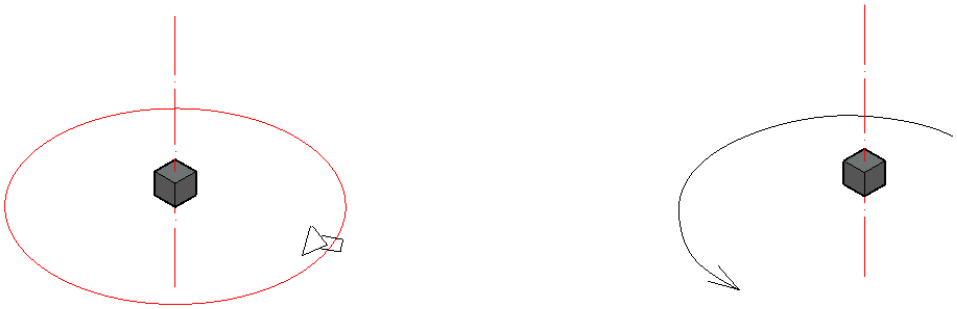


Figure 3: Creation an object panorama by: a) a camera rotation, b) an object rotation

The mapping of an object panorama on un unrolled projection surface

Similarly as in the case of an inverse panorama with any object position, the object panorama of the given figure can be drawn on an unrolled flat cylindrical surface [1]. In order to construct the object panorama on the flat projection surface with computer aid, we apply Mathcad algorithms for the inverse panorama construction [1]. Due to this fact, the projection of any point $F \in AB$ on the unrolled surface is given by two coordinates (v,d), These coordinates can be expressed in a following way (Fig.1):

$$v = r \cdot \xi \tag{1}$$

$$d(x_a, y_a, z_a, x_b, y_b, z_b) = \frac{[w(x_a, y_a, z_a, x_b, y_b, z_b) - h] \cdot [h - d_o(x_a, y_a, z_a, x_b, y_b, z_b)]}{h} + h \tag{2}$$

where :

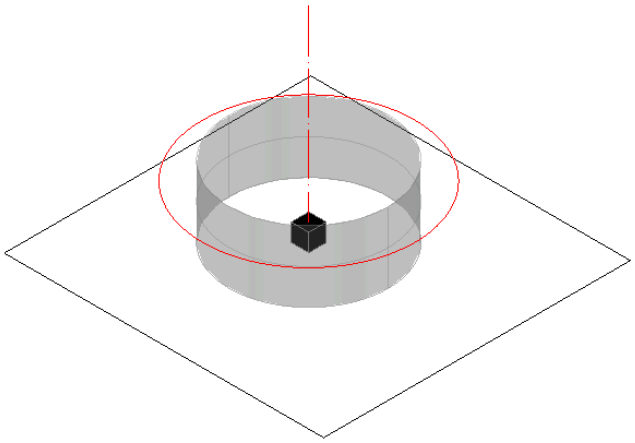
$$d_o(x_a, y_a, z_a, x_b, y_b, z_b) = \frac{h \cdot [k(x_a, y_a, z_a, x_b, y_b, z_b) - r]}{k(x_a, y_a, z_a, x_b, y_b, z_b) - r_S}, \tag{3}$$

r – the radius of base circle,
r_S – the radius of the circle of viewpoints,
h – the height of the horizon line,
k – the distance of the point ${}^{S}F^{O,S} = F^{O}$ from the centre of a base circle,
d_o – the distance of the point $F^{O,S}$ from the point P_F.

Due to the fact that, the parameters defining the apparatus of the object panorama representation are changeable in the algorithm, we can obtain objects views from different viewing positions.

In the Figure 4 and Figure 5 we present the object panorama of the cuboid drawn with aid of Mathcad Professional software. They are respectively a bird's eye view object panorama (Fig. 4b) and a frog's eye view object panorama (Fig. 5b).

a)



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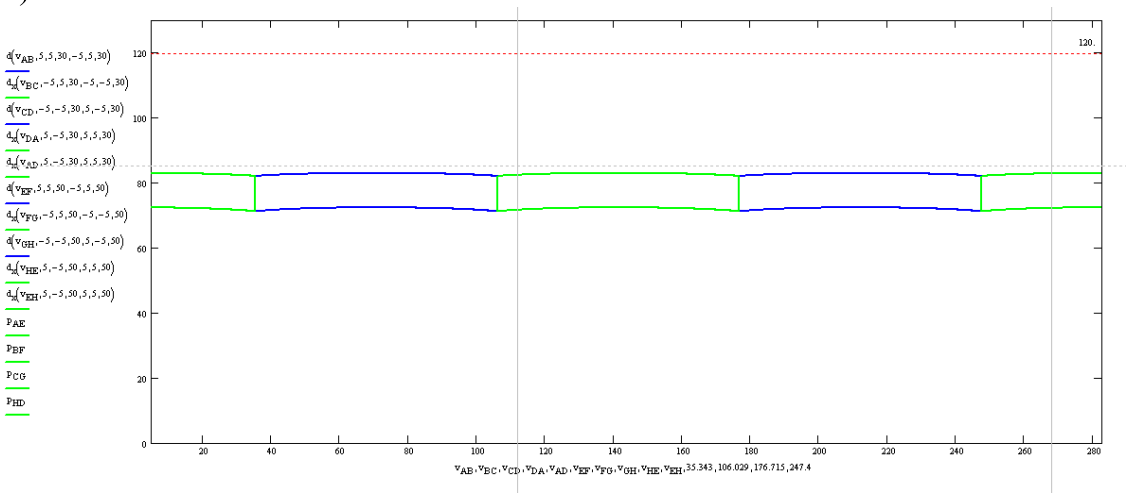
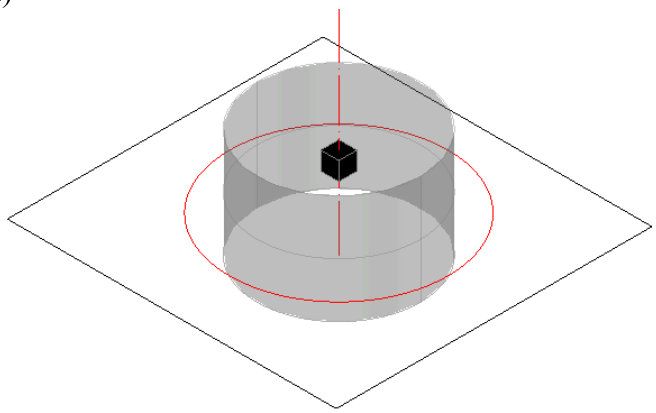


Figure 4: The bird's eye view object panorama of the cuboid: a) the object location, b) Mathcad Professional software mapping

a)



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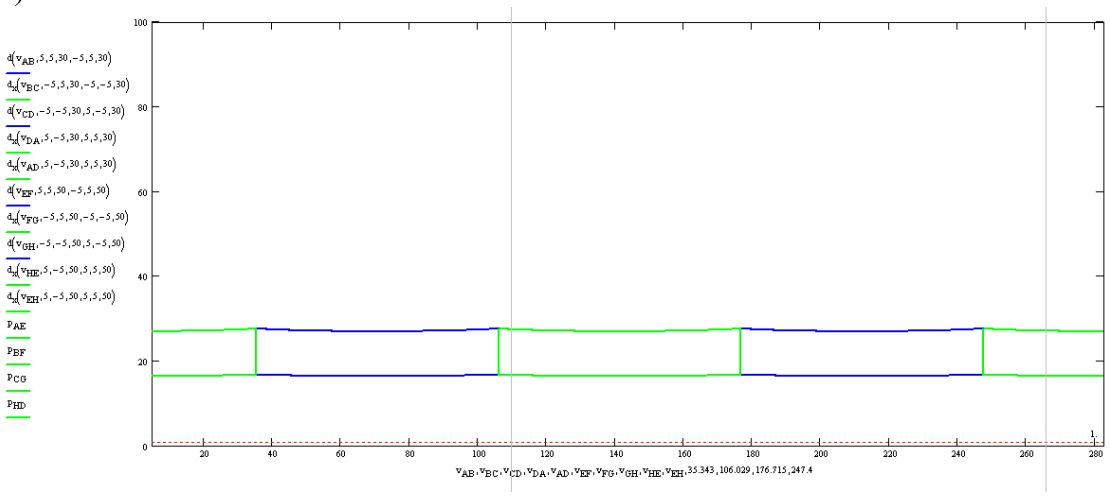

Figure 5. The frog's eye view object panorama of the cuboid: a) the object location, b) Mathcad Professional software mapping

Conclusions

The method of the object panorama drawing presented in the paper appears convenient and quick provided that we know the spatial coordinates of the represented figure vertices.

There can be some difficulties in understanding object's shape from a flat mapping of the object panorama. However, the important aspect of this flat mapping is the ability of analytical description of this mapping. It will enable object reconstruction, which is the reverse process to the object panorama creation.

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KONSTRUKCJA PANORAMY OBIEKTU PRZY WSPOMAGANIU KOMPUTEROWYM

W artykule pokazano możliwość bezpośredniego zapisu tzw. panoramy obiektu przy wspomaganiu komputerowym. Panorama obiektu jest uzyskiwana jako panorama zewnętrzna przy szczególnym usytuowaniu obiektu względem aparatu odwzorowania. Mianowicie odwzorowywany obiekt nie może być rozłączny z osią cylindrycznej rzeczywistej lub wirtualnej rzutni. Zapis panoramy zaproponowano przy pomocy programu Mathcad Professional. Analityczny zapis panoramy obiektu pozwoli na rekonstrukcję obiektu, jako procesu odwrotnego do rzutowania panoramicznego obiektu.

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