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MODELS OF COMPUTER GRAPHICS OF SPECIAL CURVED LINES LYING ON A CURVED SURFACE

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Abstract:

This paper discusses the use of special curves lying on a curved surface in the construction of molds for the formation of thin-shell spatial coverings with curved surfaces and the use of special curves lying on the surface in the repair of architectural monuments.

Keywords: sphere, tsilind, model, Viviana curve, parameterization, axonometric, radius, geometry, coordinate, horizontal, frontal, projection, graphic arts.

In the repair of architectural monuments, special lines lying on the surface are used. This scientific article discusses the problem of finding the line of intersection of a straight circular cylindrical surface with a diameter equal to the surface of the sphere and its radius in the method of computer geometry and computer graphics. The surface of a sphere of radius R and the circle of a circle of base R / 2 are set in a right-angled coordinate system of cylindrical surfaces. In this case, the centers of the bases of the cylindrical surfaces are shifted from the center of the sphere along one of its axes, at a distance of R / 2.

The main part

- The horizontal and frontal projections of a sphere of radius R lying at the point O (x, y, z) are constructed.
- Horizontal and frontal projections of a cylinder with height h and radius R / 2 of the base are constructed.
- The line of intersection of spherical and cylindrical surfaces in the above-mentioned position is found by the method of intersecting planes of descriptive geometry.
- To solve this problem in the method of computer graphics, move from the model of descriptive geometry to the model of computer geometry. To do this, we write the equation of a spherical surface in the following form:

$$(x-a)^2 + (y-b)^2 + (z-c)^2 = R_c \quad (1)$$

We write the equation of a straight circular cylinder as follows:

$$(x-a)^2 + (y-a)^2 - R_ц = 0 \quad (2)$$

If the coordinates of spherical and right circular cylindrical surfaces are calculated from the beginning, their equations are written as follows:

$$\begin{cases} x^2 + y^2 + z^2 = R_c^2 \\ x^2 + y^2 - R_ц = 0 \end{cases} \quad (3)$$

To form the parametric equation of the curve formed by the intersection of the surfaces, we write the equation of a straight circular cylinder in the following form:

$$(x - \frac{R}{2})^2 + y^2 = (\frac{R}{2})^2 \quad (4)$$

henceforth,

$$x^2 + y^2 = R_ц$$

we find, then we enter the notation x - R / 2 = R / 2 * cos t. In that case,

$$y = R / 2 * \sin t.$$

If we put x and o values in the equation of the sphere, we get the following equation:

$$\frac{R^2}{4}(1 + \cos t)^2 + \frac{R^2}{4} sin^2 t + z^2 = R^2$$

where z = R * sin t / 2. This equation is the equation of the Viviana curve lying on the surface of the sphere and we write it as follows:

$$\begin{cases} x = \frac{R}{2}(1+\cos t), \\ y = \frac{R}{2}\sin t, \\ z = R\,sin\frac{t}{2}. \end{cases}$$

Here t is a free parameter that can take an arbitrary value. The Viviana line is reminiscent of the number eight. Its rings are located on different sides of the x0u plane. In the repair of architectural monuments using this line, the shapes of molds are made in a spherical shape and used. If, t = 0 to t = p, the upper part of the curve, if t = 2p to t = 4p, the lower part of the curve can be determined:

If we say that t / 2 = u, then the new parametric equations of that curve are formed:

$$\begin{cases} x = a\,cos^2 u, \\ y = a\,sin\,u\,cos\,u, \\ z = a\,sin\,u. \end{cases}$$

Using the 3D-studio program, we determine the line of intersection of these surfaces in the style of computer graphics as follows:

- Find the surface of the parametric sphere and the right circular cylinder from the library of surfaces.
- a cutting axiomatic relationship is established between the surface of the sphere and the surface of a straight circular cylinder.

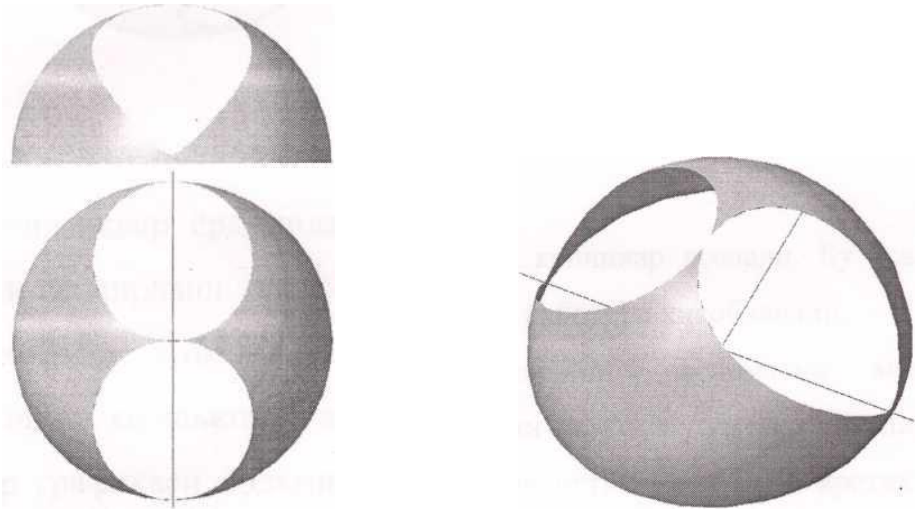

Figure 1.

- By entering the values in the computer memory into the spherical surface radius R and the radius R / 2 of the right circular cylinder, we create the line of intersection of the intersecting, spherical and right circular cylinders along the Viviana line (Figure 1).
- By inserting a rotary motion into the position of a straight circular cylinder, we create different variants of the Viviana line on the surface of the sphere.
- the motion parameters that change the positions of the spherical surface and the straight circular cylinder are entered.
- We create different view variants of intersection lines (Figure 2).

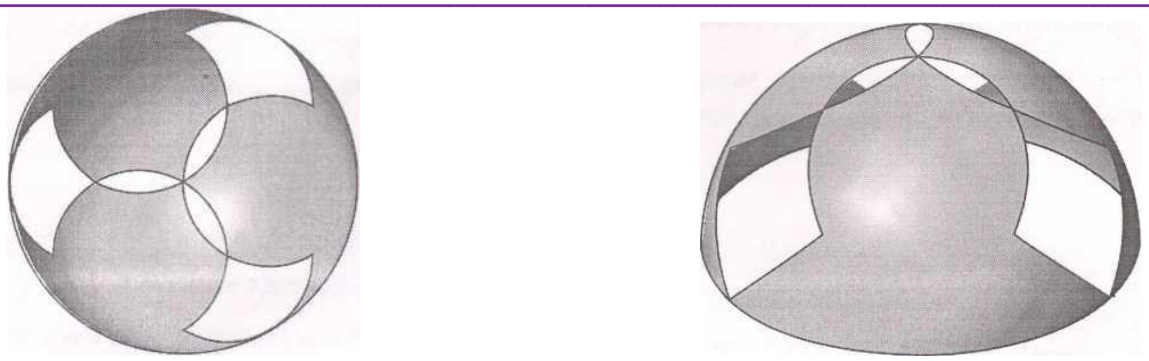

Figure 2

Spherical molds are made using these lines. This is computer information for the repair of architectural monuments.
The authors have created more than 20 models of axiomatic relations of surfaces using computer graphics in the scientific direction of computer information generation (Figure 3).
You can get acquainted with the programs of these models at the Department of "Engineering Graphics and Computer Design".

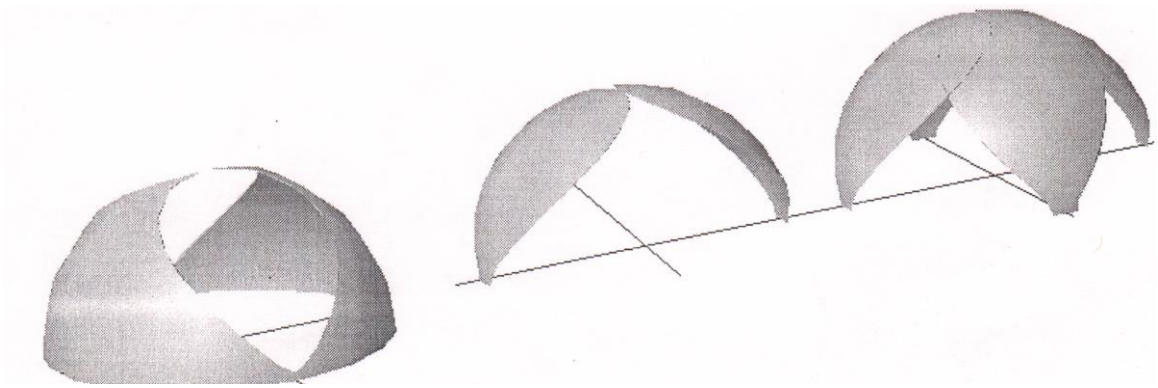

Figure 3

Conclusion. As a result, wide-air, thin-walled space surfaces in the form of spherical surfaces can be widely used in public construction.

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