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

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Annotation: 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 considers the problem of finding the intersection of the surface of a sphere and right circular cylindrical surfaces with a diameter equal to its radius in the method of computer geometry and computer graphics. The surface of the sphere of radius *R* and the base of the right circular cylindrical surfaces of radius *R/2* are set in a rectangular coordinate system. 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 by a distance of *R/2*.

Logic 1:

- Gorizontal and frontal projections of a sphere with radius R centered at point O(x,y,z) are constructed.
- Gorizontal and frontal projections of a cylinder with a height of h and a radius of the base equal to R/2 are constructed.
- The line of intersection of spherical and cylindrical surfaces in the above-mentioned situation is found by the cutting planes method of drawing geometry.

Logic 2:

- To solve this problem in the computer graphics method, the drawing is transferred from the geometry model to the computer geometry model. To do this, we write the equation of the 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 right circular cylinder as follows:

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

If spherical and right-circular cylindrical surfaces are calculated from the coordinate origin, their equations are written as follows:

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

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

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

from this,

$$x^2+y^2=R_ц$$

and then we introduce the notation $x - R/2=R/2*\cos t$. In that case, $y=R/2*\sin t$ will be.

If we put the values x and y in the equation of the sphere, the following equation is obtained:

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

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 any value. Viviana's line is reminiscent of the number eight. Its rings are located on different sides of the $x0y$ plane. With the help of this line, the forms of the molds are made in a spherical shape and used in the repair of architectural monuments. If $t=0$ changes from $t=\pi$, the upper part of the curve can be determined, if $t=2\pi$ changes from $t=4\pi$, the lower part of the curve can be determined:

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

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

We analyze the intersecting lines of these surfaces in the style of computer graphics using the 3D-MAX program as follows:

- a spherical surface with given parameters and a right circular cylinder are found from the surface library.
- a cutting axiomatic relationship is established between the surface of the sphere and the surface of the right circular cylinder.

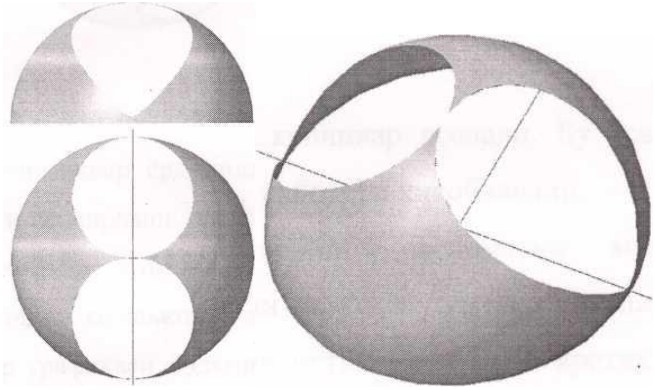

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Fig. 1.

- by entering the values of the radius of the spherical surface R and the radius of the right circular cylinder *R/2* into the software in the computer memory, we create the intersecting line of the sphere and the right circular cylinders, intersecting according to the Viviana line (Fig. 1).
- by introducing a circular motion into the situation of a right circular cylinder, we create different versions of the Viviana line on the surface of the sphere.
- the parameters of the movement changing the situations of the spherical surface and the right circular cylinder are introduced.
- We create different versions of intersection lines (Fig. 2).

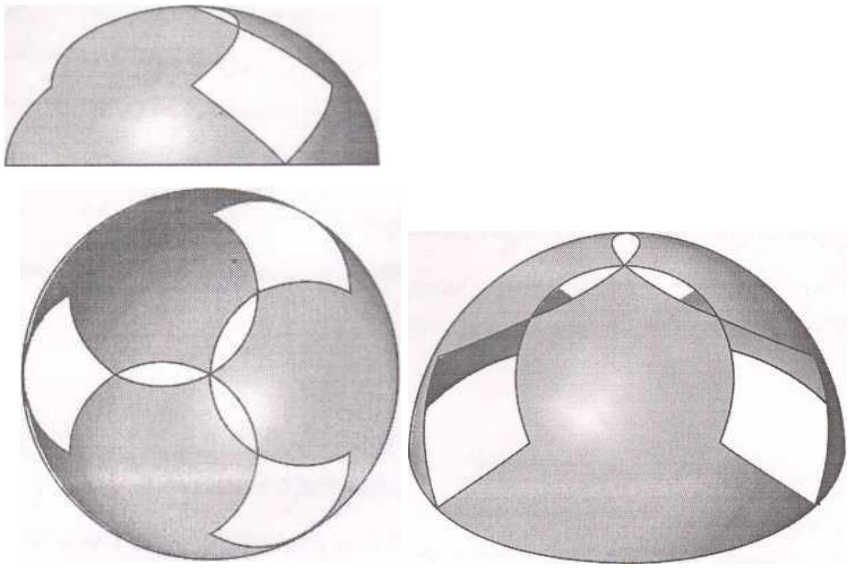

Fig. 1.

Using these lines, spherical molds are made. This is the computer information of the repair of architectural monuments.

The authors created more than 20 models of lines of axiomatic relationships of surfaces using computer graphics in the scientific direction of creating computer information (Fig. 3).

You can get acquainted with these model programs in the "Engineering graphics and computer design" department.

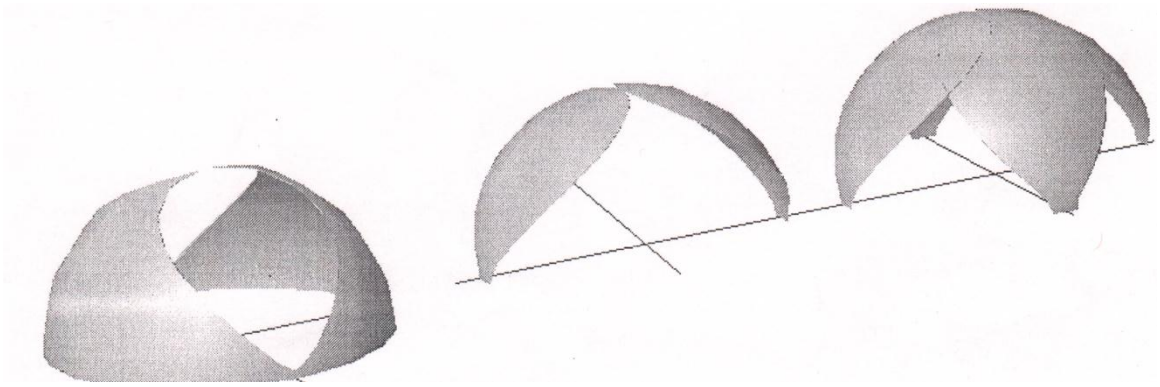

Fig. 3.

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