THE DEVELOPMENT OF A ROTATION SURFACE GENERATED BY ASTROID

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Abstract. *This paper proposes a method for determining an development of the rotation surface is the rotation of hypocycloids around a vertical axis represents the axis of symmetry of the curve. It has been chosen a four-cusped hypocycloid called astroid , because, due to its aesthetic shape, this could be used in engineering and architecture. This paper proposes getting the development for a semi- astroidoid. It is applied the graphical method of descriptive geometry by analogy with the blank sphere drawing method of spherical gores. This approximate graphical method is applied relatively simple and can be used when a high precision is not required.*

Keywords: development, graphical method, semi-astroidoid, semi-gores

1.Introduction

Geometric shapes of bodies are very important for the technical domain as they are used to manufacturing of pieces and equipment.

The representation of geometric surfaces is absolutely necessary in the production of technical documentation.

It is necessary the knowledge of the principles and methods required to turn them from the three-dimensional space into the two-dimensional space of a sheet of paper on which a drawing is done.

Some parts are obtained by winding sheet, after previously was designed the piece's development.

Some bodies have developeable geometric surfaces, others have undevelopeable surfaces, for these being obtained approximate developments.

Descriptive Geometry provides for rotational deployment surfaces approximate graphical methods, which were dealt with in the specialty literature only for sphere, ellipsoid, paraboloid, tor, [1], [2], [3].

This paper proposes a method for determining an development of the rotation surface is the rotation of hypocycloids around a vertical axis represents the axis of symmetry of the curve. It has been chosen a four-cusped hypocycloid called astroid , because, due to its aesthetic shape, this could be used in engineering and architecture.

2. The semi-astroidoid development

It starts from a four-cusped hypocycloid called astroid, for which the rate of the director circle rays and generator circle is R / r = 4, [4], [5].

The astroid rotates around its vertical axis which is the axis of symmetry. Similarly with the ellipsoid which is obtained by rotating the rolling surface of the ellipse, it is proposed in this paper astroidoid name for the rolling surface obtained by rotating astroid.

The astrodroid is part of the involuted surfaces, in the way that it can not be developed by accurate methods such as the prism, pyramid, cone, cylinder, etc. The astrodroid can only be developed only by approximate methods. In Figure 1 is represented the cyclical curve called astroid. It is given in Figure 2 the astrodroid obtained by rotating the astroid around the vertical axis AB, which has been drawn and a time obtained by cutting two vertical planes containing the axis AB.

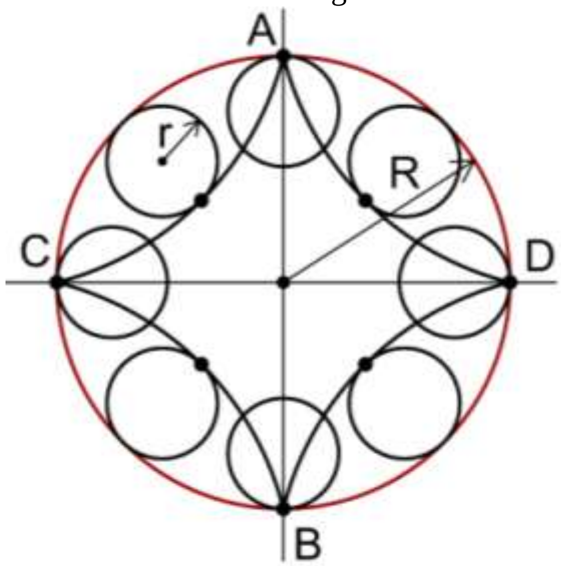

Figure 1

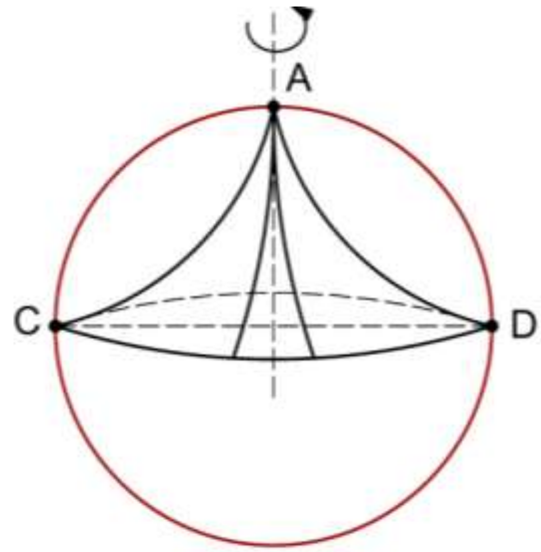

Figure 2

This paper proposes getting the development for a semi -astroidoid. It is applied the graphical method of descriptive geometry by analogy with the sphere development drawing method of spherical gores.

There are used auxiliary plans: the level plan and vertical plans.
For clarity of graphical representation it is proposed the cutting of this surface with a number of six equidistant vertical plans (P1, P2, P3, P4, P5, P6) and three planar levels (N1, N2, N3), for a 12 semi-gores.

In Figure 3 it is shown in draught a semi- astrodroid, by two screenings in the vertical projection and in the horizontal projection plan and the construction of a semi-gore.

The sectioning level surface plans determine circles that are represented in a H plan. The vertical section plans P1, P2, P3, P4, P5 and P6 is represented by their tracks in the H plan.

The vertical auxiliary plans divide the circles corresponding to auxiliary plans and the base circle in equal parts by 12 to be taken into account in the construction of a semi-gore.

There are noted the points determined in the plan H as 1, 2, 3, 4, 5, 6, 7 and 8. It is considered a line segment of length equal to the length of an astroid cusp (Lra = 6r), placed horizontally, noted A*D*.

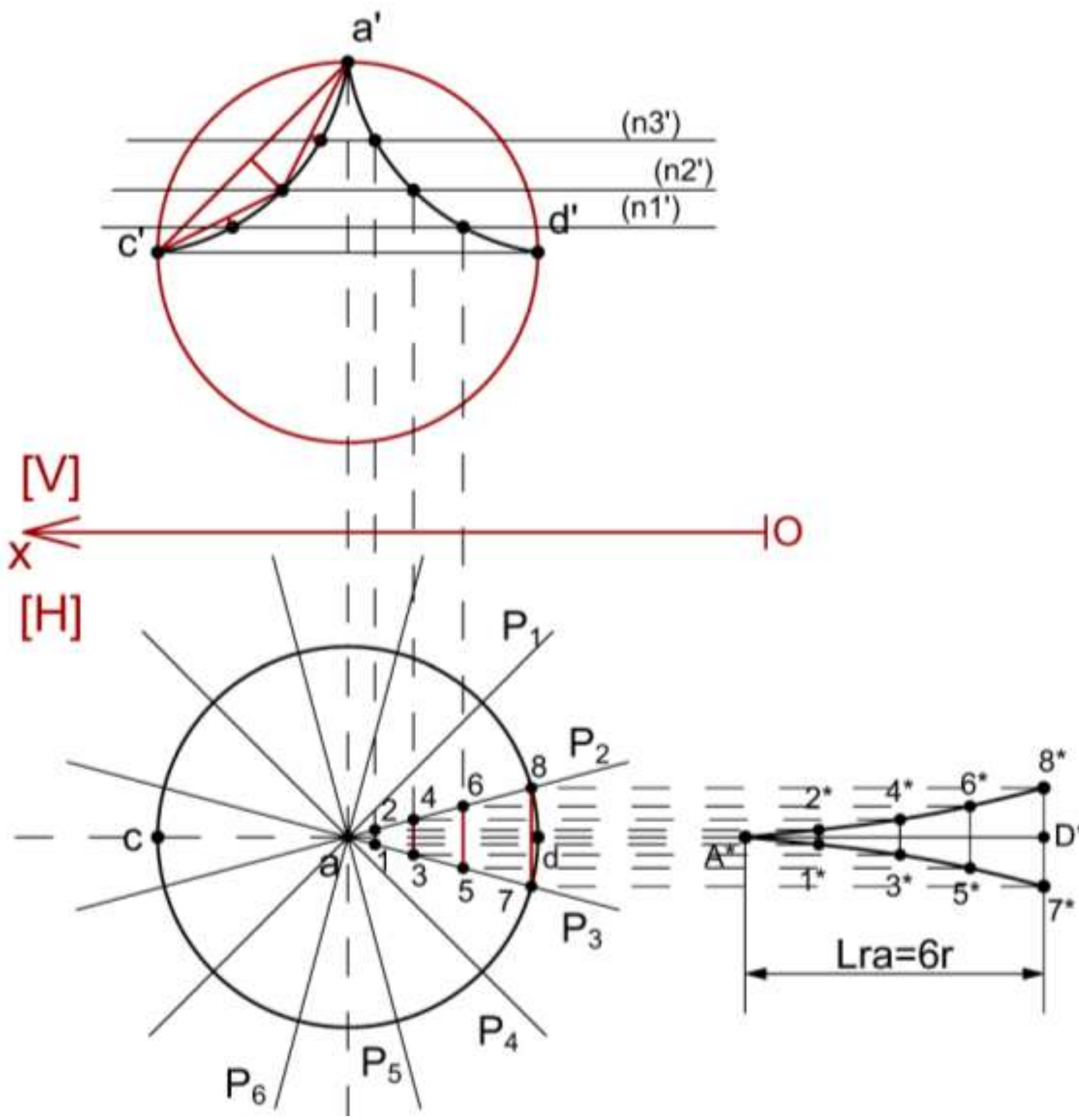

Figure 3

There are noted the points determined in the plan H as 1, 2, 3, 4, 5, 6, 7 and 8. It is considered a line segment of length equal to the length of an astroid cusp (Lra = 6r), placed horizontally, noted A*D*. This one is divided into four equal parts, there are drawn perpendicular lines in division points andon these are measured the appropriate sizes of the arcs 12, 34, 56 and 78. It is proposed here the approximation of a circular arc to the size of an arc with the size of a sub-stretched chord. There are obtained the points 1*, 2*, 3* ... 8 *. There are joined the dots with the curved line and it results the profile of a semi-gore result.

In Figure 4 it is given the evolute of a semi- astroidoid consisting of 12 semi-gores.

Figure 4

The lengths of the arc of the curve A*7* and A*8* which define the shape of a semi-gore, are greater than the length of the Lra, a difference generating a portion of the errors of these approximate methods.

Other errors result from approximating arcs with sub-extended chords, but there are inherent errors of graphic construction.

Errors are smaller as the area will be divided into a large number of semi-gores, but the number of semi-gores is limited by the need for a clear graphical representation.

3. Conclusion

The developed method proposed in this paper leads to determination of a geometric aesthetic surface that can have multiple applications.

This approximate graphical method is applied relatively simple and can be used when a high precision is not required.

The method proposed in the paper can be improved by a computerized solution.

There are Maple procedures that can be used and obtained evolutes with large numbers of semi-gores, which can not be achieved by means of graphics.

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