GENERATION OF AESTHETIC SURFACES THROUGH TRAMMEL MECHANISM

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Abstract: *It is being made the geometric synthesis of trammel mechanism, and structural and kinematics analysis. They generate ellipses and the successive positions of mechanism, observing that some figures are aesthetic. Performing additional rotations of ellipses, they result aesthetic surfaces .*

Keyword: trammel mechanism, aesthetic curves and surfaces.

1. Introduction

Drawing conics is necessary both to design and in workshops. Thus, are usual cases whern you should cut elliptical plates, which must first be traced or drawn to scale for oxyacetylene cutting after drawing. They are also necessary the conics generation mechanisms, for operations of welding of caps or flanges, using automatic welding devices. Such operations are still widespread, even if today there are machines with numerical command or special plotters.

Conicograf mechanisms have long been known, being widely studied in terms of geometry. Although based on simple mathematical theories, these mechanisms result quite complicated, raising issues in their analysis and synthesis.

Recently, they expanded the research on the aesthetic effects of curves and surfaces. Thus, Kanaya makes a classification of aesthetic curves and surfaces with applications in design (CAD). They are given the mathematical relations of some aesthetic curves, exemplifying their application in car's forms. Miura is studying the aesthetic aspect of logarithmic spiral, clothoid and involute curves.

They also analyze the properties of these curves based on differential geometry, indicating the mathematical generation manner, point by point. It is being exemplified by the usage of these curves to the shaping of some musical instruments, car carcasses and as models in the textile industry field. Yoshida examines a method of interactively control of aesthetic curves and surfaces, by analyzing the positions of normality and binormality, the curvature, the torsion, giving numerous tabulated examples. Trammel mechanisms have been studied by Artobolevskii, Tutunaru, Smith and others. Below are studied two trammel mechanisms andthey are shown some aesthetics forms generated by them, and by further rotation resulting aesthetic surfaces.

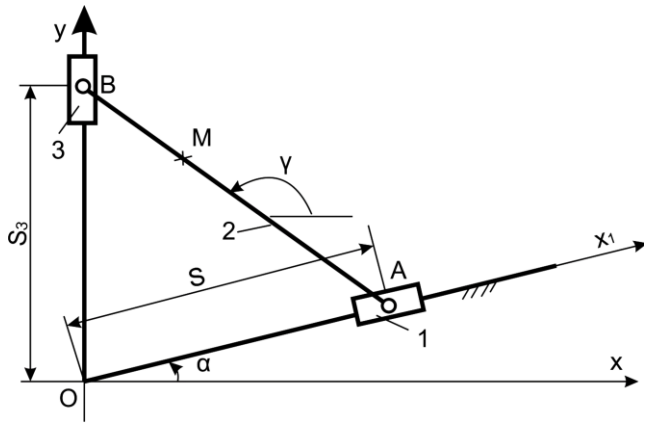
2. The trammel mechanism

It is known that Cardan's problem if a line ends moving axes x and y, then its points describe ellipses.

If axis $x_1 \neq x$ and y are not perpendicular, in [6] shows that all results conicograf mechanism (Fig. 1).

Based on Fig. 1, we write the relations:

$$x_B = S.\cos\alpha + l.\cos\gamma = 0$$
$$y_B = S_3 = S.\sin\alpha + l.\sin\gamma$$
$$x_M = S.\cos\alpha + AM.\cos\gamma$$
$$y_M = S.\sin\alpha + AM.\sin\gamma$$



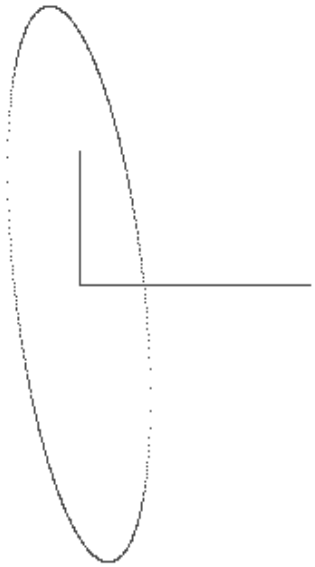
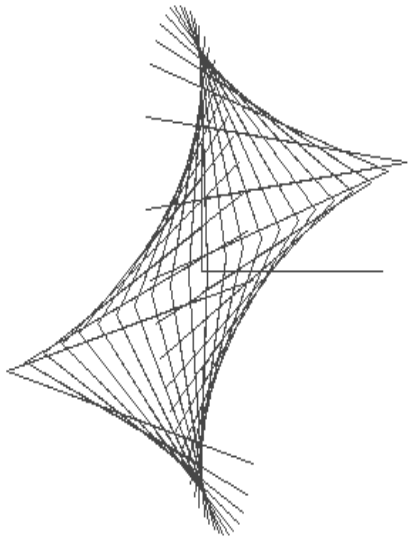
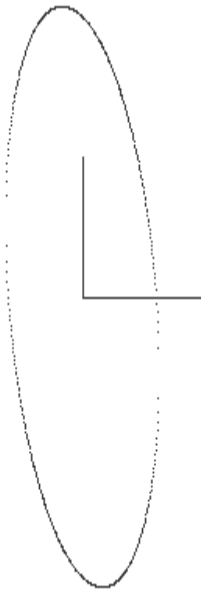


Fig. 1 ***Fig. 2***

For other dates (L, α, AM) they resulted: fig. 2, 3 (L=30, α=30, AM=30), fig. 4, 5 (L=30, α=20, AM=40).





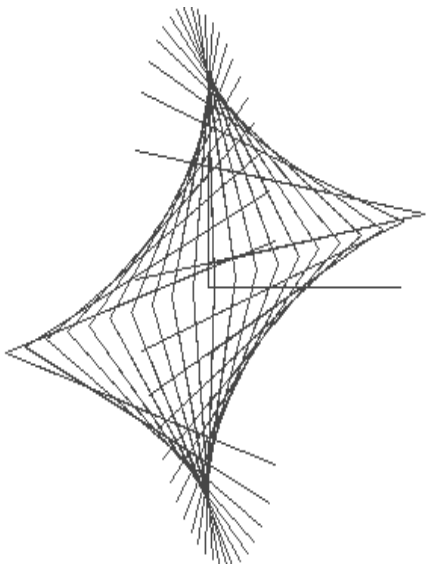


Fig. 3 ***Fig. 4*** ***Fig. 5***

For point C taken off the distance AB we can observe the ellipse described by the AC segment (Fig. 6 (L=35, α =45, AM= - 25), Fig. 7 (L=30, α =30, AM= - 30)).

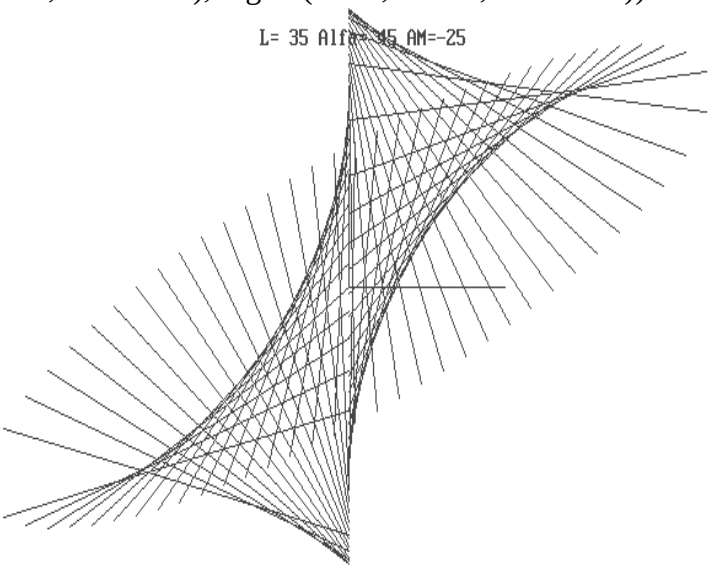


Fig. 6

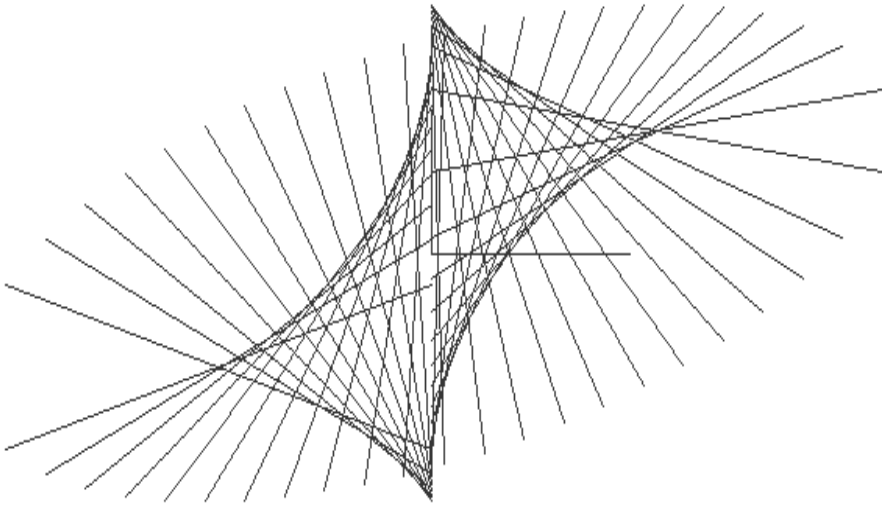


Fig .7

Note that some of the figures above have aesthetic forms.

3. Other visual effects

If the x axis in Fig. 1 **is rotating around the y axis**, then an observer which views from the z axis which is perpendicular to x and y, will see in xoy plane a series of ellipses that form a surface.

Thus, for the case in Fig. 4 it resulted the image in Figure 8.

Fig. 8

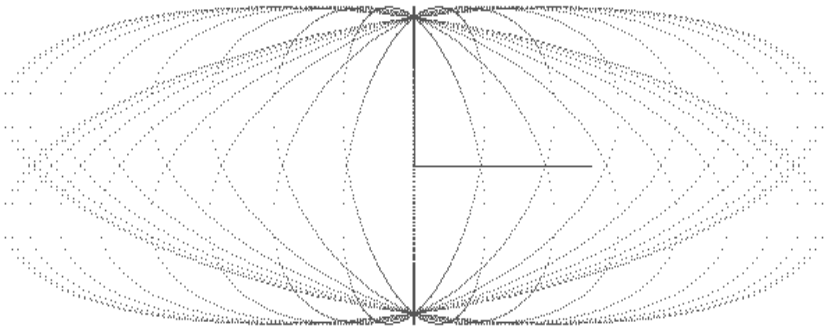


Fig. 9

For Fig. 6 was obtained the surface from fig. 9.

The generated ellipse in Fig. 7, by rotation, generated the surface in Fig. 10, with the intermediate phase in Fig. 11.

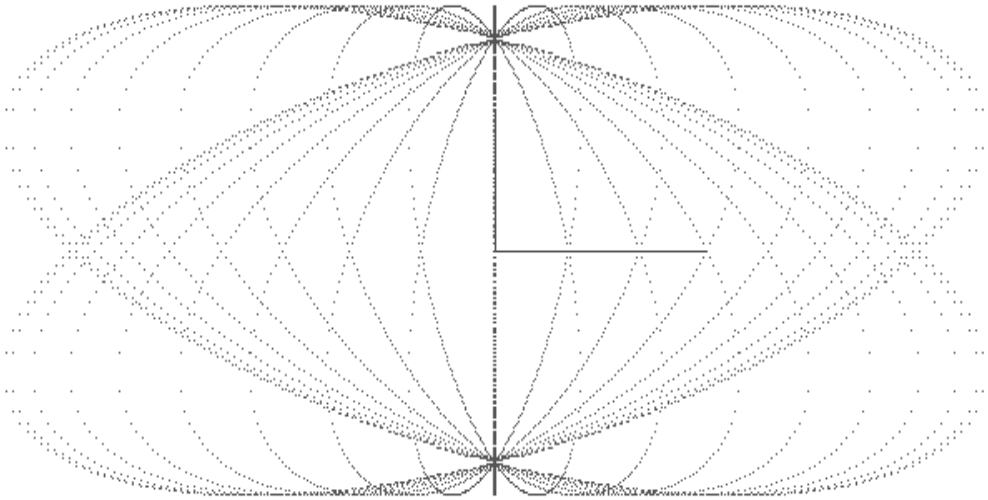


Fig. 10

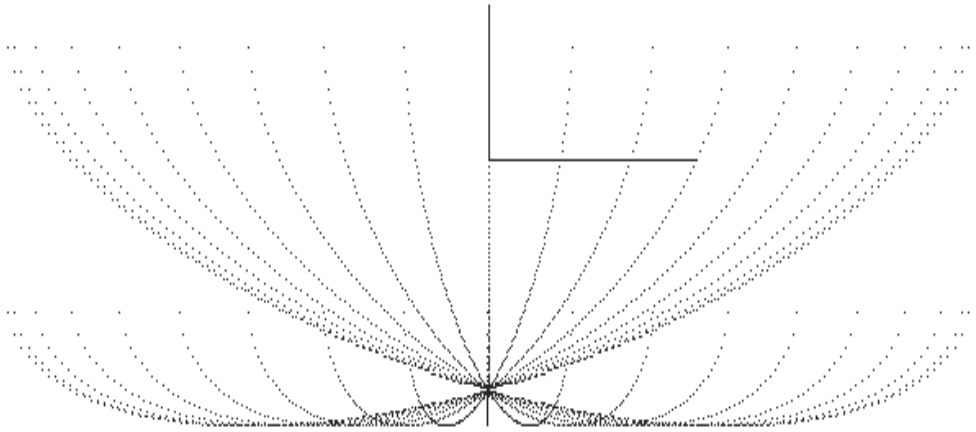


Fig. 11

It was also generated an area (L= - 50, α = - 30, AM= - 25), which is given in Fig. 12, as intermediate phase, respectively in Fig. 13, as the final form.

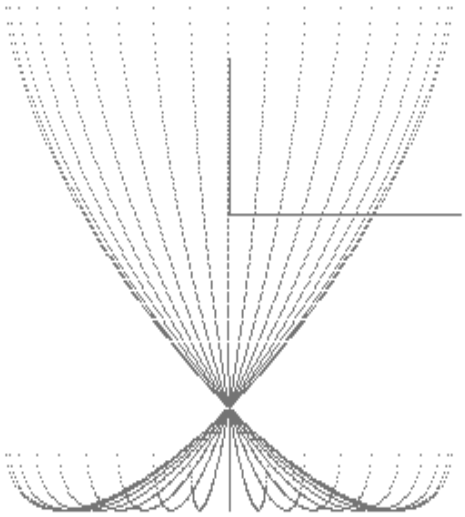


Fig. 12

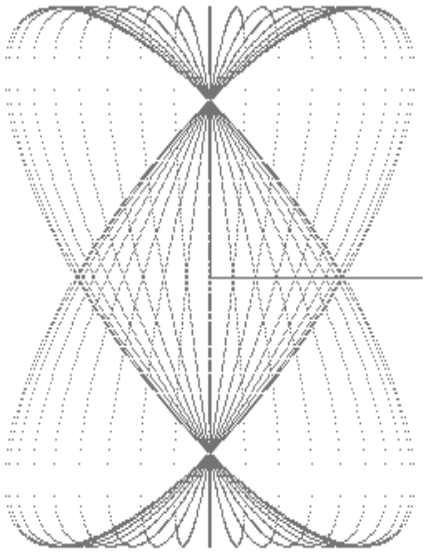


Fig. 13

If for the mechanism in Fig. 1, the resulting ellipse rotates around the x axis, aesthetic surfaces are obtained Fig. 14, for the curve in Fig. 6. Also in order to emphasize aesthetics, were not traced the axes of the coordinate system.

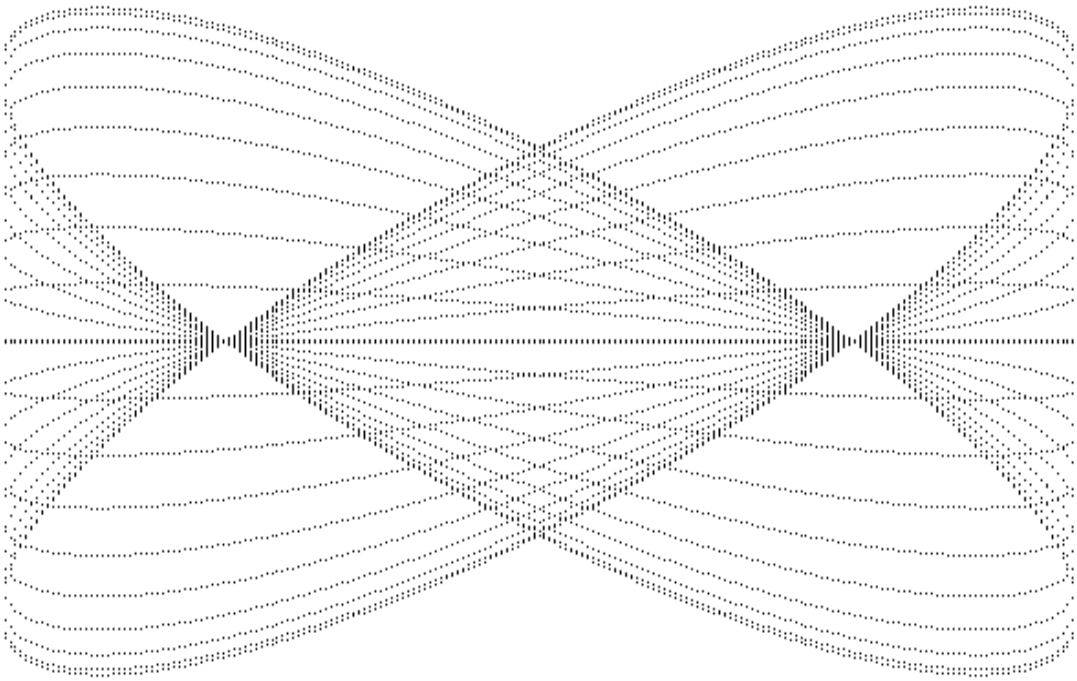


Fig. 14

If for the mechanism in Fig. 1, the resulting ellipse rotates around the z axis, aesthetic surfaces are obtained as follows: Fig. 15, for the curve in Fig. 4 and Fig. 16, for the curve in Fig. 6.

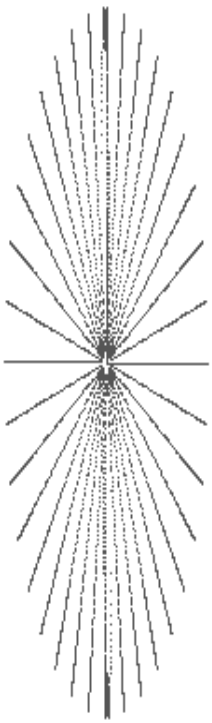


Fig. 15

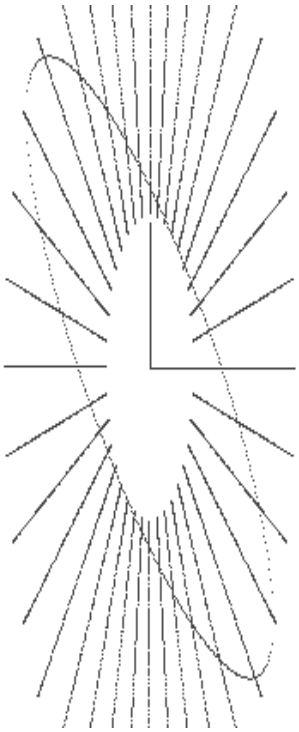


Fig. 16

Each right of these last images represents an ellipse in the plane perpendicular to the drawing.

4. Conclusions

- They have been presented one simple mechanism that trace ellipses.
- This mechanism are based on geometric properties: Cardan's circle and the ellipse graphical construction.
- There have been realised programs with which they have been drawn different ellipses and the successive positions of the generating mechanisms.
- Aesthetics forms were obtained by rotating mechanisms around the axis system.

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