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USING FREE CONTOURS TO OBTAIN SPECIFIC ORNAMENTS FOR DECORATIVE ELEMENTS IN A GARDEN

Abstract: *The decorative elements and non-decorative elements from a garden may have different ornaments. Some of these are obtained by cutting out the contours previously figured on that element. In this paper, the authors present a study, of the situation in which the Inventor software is used, regarding the possibility of automating the obtaining of free contours after which the desired cutouts can be made in the decorative elements.*

Key words: *ornaments, free contours, spline curve, Read and Collect Data (RCD).*

1. INTRODUCTION

The decorative and non-decorative elements from a garden may contain different ornaments inside them. Some of these are obtained by cutting out along the contours which were drawn previously on the ornaments. The respective contours could be obtained with the help of the mathematics curves [1] or may be represented with the free hand. The authors had realized a study concerning the possibility to reproduce contours that were drawn using the free hand, in the Inventor software, to use this computer program for the activity of design of some decorative and non-decorative elements for the garden. The need to use some free-hand-represented curves occurs because it is often necessary to represent drawings made by plastic artists. These may draw contours that suggest parts of plants, like leaves or flowers or small little creatures such as butterflies, or may make their choice for abstract figures which have a certain meaning. Usually, all these are represented by plastic artists using free-hand-represented curves. From the perspective of the artistic message the contours that compose the represented form by the author have a very important role. In their turn, the contours are made from curves which are represented by the plastic artist. So, the exact reproduction of these curves is very important when it is desired to preserve the artistic level which was reached by the author of the graphical representations who will become ornaments on the decorative or non-decorative elements from a garden.

The contour which was drawn by the plastic artist on some support, must be transferable, with the help of the curves that enter into its composition, into Autodesk Inventor software. Each curve will be used by this computer program to generate volumes which will be removed from the already partially designed element. But it must be taken into account the fact that the transfer of an image in the Autodesk Inventor is not possible in a way that allows later to use this to create volumes. Furthermore, these types of software like Autodesk Inventor were not projected for artistic purposes, so the facilities for requirements of these kinds are poor.

Starting from the above findings, the authors set out to find a method of work that offers the possibility to reproduce, in the Autodesk Inventor software, curves free-hand-represented, and that does not depend on their complexity and numbers.

2. MATERIAL AND METHOD

The authors started by establishing the ways which can reproduce a free-hand-represented curve in the Autodesk Inventor software. They have analyzed two methods of working.

The first method consisted in making a photo of the curve, inserting the photograph into a sketch in Autodesk Inventor software and representing a spline curve over the curve from the photograph. So, the steps that must be followed up are:

1. The closed curve to be reproduced is first photographed, Figure 1.
2. A Cartesian system of coordinates is associated with the closed curve, its role being to help to keep the dimensions of the curve established by the designer, Figure 2.

Figure 1 Closed curve to be reproduced in Autodesk Inventor. This represents a cloud.

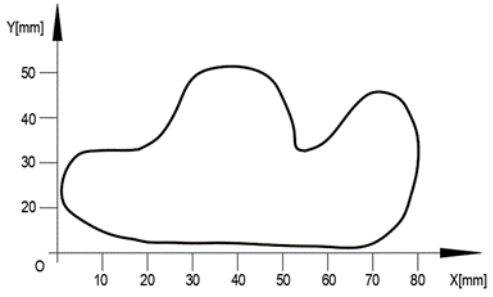

Figure 2 A fixed system of Cartesian coordinates is associated with the closed curve.

3. Establishing the number of open curves in that the closed curve will be split.
4. For each open curve, a new sketch is created using the Sketch routine from Part section of the Autodesk Inventor software.
5. For the first sketch, the dimensions of the surface that will be occupied by the photo are delimited using the construction lines, and the photography of the closed curve is imported with the Image command help. Then the dimensions of the photography are modified until the closed curve will have the dimensions established by its author, Figure 3.

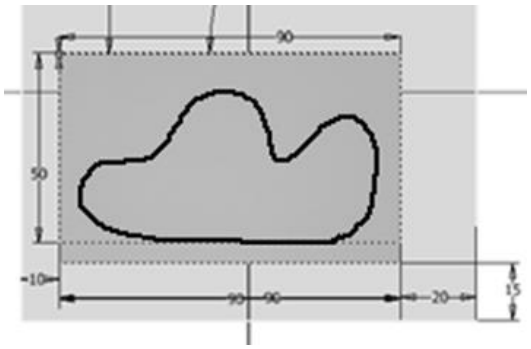

Figure 3 The delimitation of the space the photo will occupy. Is important resizing the photo.

6. The first open curve is represented using the Spline Interpolation command, Figure 4. To be used this curve must be changed into a closed curve. Achieving this goal becomes possible if one or more straight lines, obtained with the Line command, are added to the open curve.
7. Using the Extrude command the first portion of the designed model is obtained.
8. For the rest of the sketches, the already modified photography from its dimensions' point of view can be copied from the first sketch single.
9. Steps number 6, 7 and 8 are repeated for each sketch.

The shortcomings of this method reside, on the one hand, in the operations that involve copying a photo from one sketch to another, which always raises positioning problems, and on the other hand, in the difficult handling of the dimensions that define the open curve when certain corrections are necessary.

For these reasons, the authors searched for a second method of work which removes the shortcomings described above.

The second method differs from the first in that all the coordinates of the points that determine the closed curve are established with the help of another program. This eliminates the need to import the curve photo into Autodesk Inventor and the effort of sizing and positioning it for each sketch.

So, the photo is imported into the AutoCAD software. Then the dimensions of the photo are changed until the dimensions of the curve are the same as the dimensions of the curve drawn by the designer. A user coordinate system is associated with the closed curve. This is a mandatory step to obtain valid values that can be used later in sketch activities from Autodesk Inventor. Then the closed curve is divided into several open ones, Figure 5. Each of these will later be reproduced in separate sketches in the Autodesk Inventor program.

Once the open curves are established in the AutoCAD software, the Spline command is used to represent them and to establish the points that define them. Thus, a spline curve is drawn over the curve in the photo with the help of the above-mentioned command. The position of the points that determine the spline curve can be easily changed by simply moving the cursor, Figure 6. The spline curve is defined by as many points are needed to obtain a good approximation of the open curve. Only one

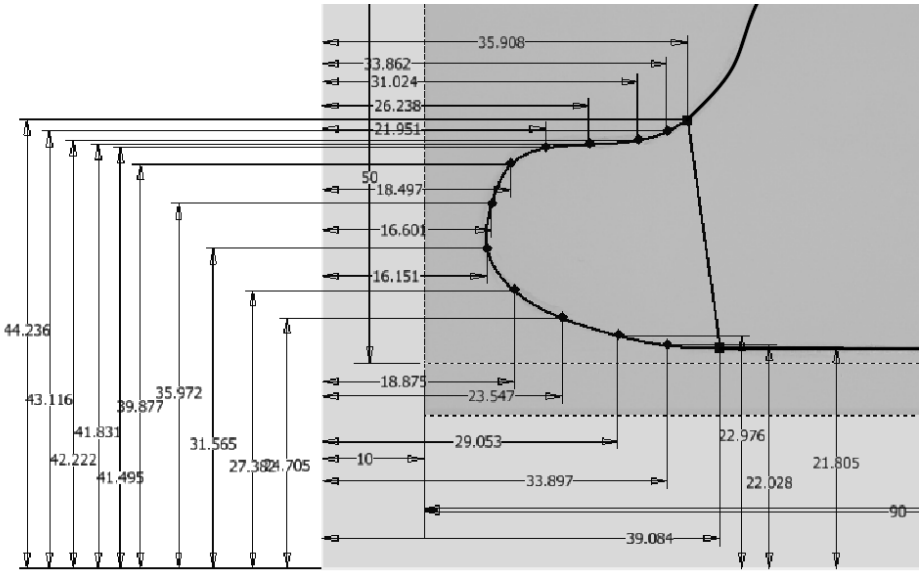

Figure 4 The first open curve is drawn.

photograph is needed to establish the points that determine all the open curves.

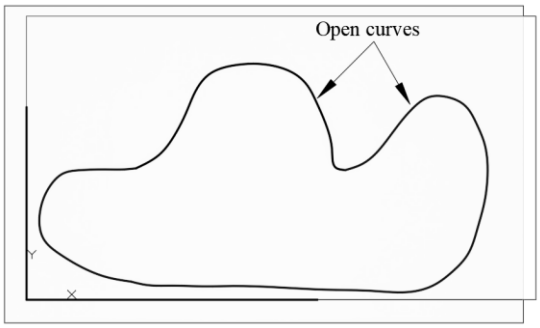

Figure 5 Open curve imported into AutoCAD and user coordinate system (UCS) aligned to the curve. The curve was divided into 3 open curves.

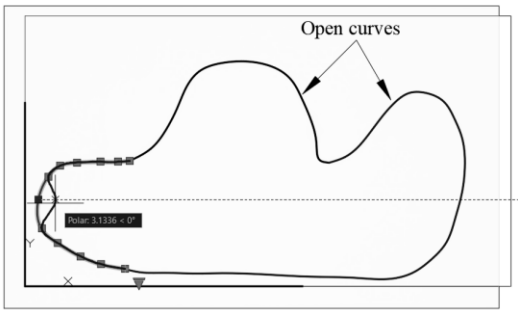

Figure 6 The position of the points that determine the open curve can be easily modified.

For the correct reproduction of the curves in the Autodesk Inventor software, the coordinates of the points that define the open curves must be known [2]. Given the way curves are constructed when sketching in Autodesk Inventor software, it is necessary to define a user coordinate system (UCS) in AutoCAD whose origin coincides with the origin of the axis system chosen to preserve the dimensions of the graphic representation.

If defining a proper UCS is a simple operation, the same cannot be said about reading the coordinate values of the points that define the open curves and exporting them to the Autodesk Inventor software. Unfortunately, the AutoCAD software does not offer any solution that allows the automatic reading of these data, their automatic storage or their transfer to another computer program.

For this reason, the authors built a computer program that they named RCD, an acronym that stands for Read and Collect Data. The RCD calculation program allows the automatic collection of the coordinates of the points defining a spline curve by selecting it with the cursor and saving them in a CSV file. The CSV file allows automatic data export to the Autodesk Inventor software [3]. During the drawing of a sketch, the Autodesk Inventor software allows the import of points coordinates using the Import Points command. It allows reading this data from an Excel file. Conversion from CSV file type to Excel file type is automatically made so, the user must indicate only the name of the file.

3. RESULTS AND DISCUSSIONS

The authors aimed to obtain a panel on which the pattern of a leaf is repeated. So, a freehand representation of the outline of a leaf was needed and the pattern shown in Figure 7 was chosen. This pattern will be executed in columns and rows on a panel.

Figure 7 The drawing of the leaf used by the authors.

The authors chose to use the second working method due to the complexity of the outline. A photograph of this leaf model was taken and entered into the AutoCAD software. The photo was resized until the outline of the leaf was fitted into a square with sides of 80 mm. A user coordinates system (UCS) was established with the origin at the lower left corner of the square. Carefully analyzing the outline of the leaf, the authors decided to form 9 open curves, Figure 8. Then over the closed curve in the photograph were represented the nine open curves using the Spline command which had the method Fit set on active mode. With the help of the RCD calculation program, the coordinates of the points that determine the 9 open curves were collected. Figure 9 shows the coordinates of the first 3 curves as they appear after their extraction and retention in an Excel file.

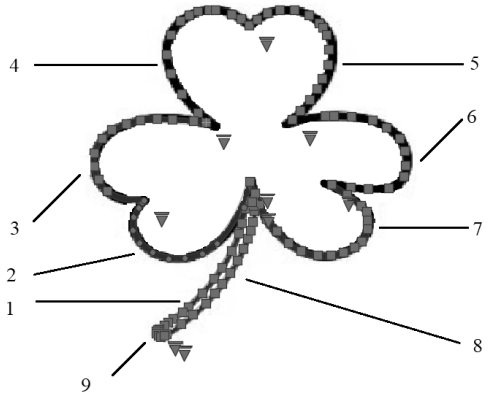

Figure 8 The graphic representation was divided into 9 open curves.

Each time a new Sketch was started in Autodesk Inventor software a new set of coordinates of the points was imported, and the points thus represented were used to create a Spline curve. Each open curve has been converted to a closed curve to allow the use of the Extrude command. To complete this operation were

added one or more straight lines. It is shown in Figure 10 the sketch of the first open curve and the straight line that transforms the obtained open curve with the Spline command help, into a closed curve. It can be seen the difficulty of achieving it due to the multitude of quotas that must be specified, this being one of the reasons why the authors opted for the second work method.

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A1

	A	B	C	D	E	F	G	H
1				18.2774	32.4428		32.1949	49.9436
2	41.9559	36.6073		15.2807	32.6249		31.5915	50.6907
3	40.7074	30.8261		11.0977	32.8791		29.8225	52.8805
4	34.6909	22.7105		7.7734	36.9728		26.5482	56.11
5	31.3528	20.4771		7.0408	40.0303		24.1735	60.6265
6	27.4552	19.419		6.7455	43.4066		22.8758	65.2848
7	23.8369	19.3273		8.5731	46.2197		23.8957	69.5381
8	20.1558	20.7637		11.0503	48.6226		25.8833	72.6391
9	17.3174	22.848		14.1721	49.6051		28.2839	74.0286
10	15.7967	25.7463		17.5303	50.6791		30.3677	75.1838
11	15.8785	28.7134		21.0613	50.8008		32.466	75.1753
12	17.1162	30.7214		25.0836	50.4729		35.0231	75.2934
13	17.9684	31.9846		28.7731	50.3444		37.4757	74.4992
14	18.2774	32.4428		31.2808	50.0507		40.0734	73.3687
15				32.1949	49.9436		41.2404	72.2916
16							41.8088	71.767
17								

Figure 9 The coordinates of the points describing the open curves number 1, 2 and 3 that are represented in Figure 8.

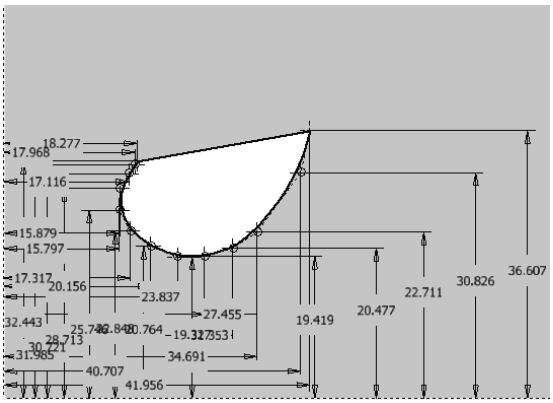

Figure 10 Open curve number 1 and the line segment that allows it to be turned into a closed curve usable for the extrude operation.

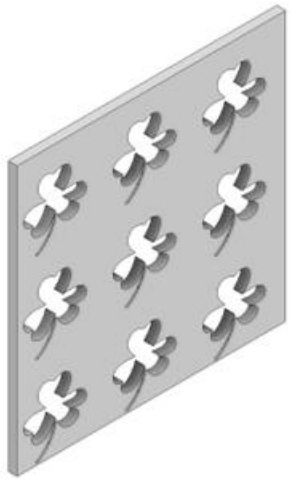

Figure 11 The leaf pattern imagined by the designer

4. CONCLUSIONS

- To reproduce different contours created by plastic artists, the authors have identified two ways in which freehand-drawn curves can be reproduced in the Scketch section of the Autodesk Inventor calculation program.
- The contour to be reproduced must be divided into several open curves. Their number depends on the complexity of the outline.
- The first method of working proposed by the authors has the advantage that it does not involve the use of other calculation programs but has the disadvantage of being difficult to apply. The second method of working has the advantage of being flexible, and easy to apply but requires the use of additional work programs to collect the points that define the open curves. Such a computer program does not exist. So, the authors built one and named Read and Collect Data having the acronym RCD.

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