TRANSFER OF COMPUTER GENERATED FORMS TO THE CONTEMPORARY TEXTILE

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Abstract: The report provides an analysis of current trends in the development of components for textile designs using computer-generated forms. It is proposed that in the use of Lissajous figures, the ratio of the main coefficients influencing the formation of the figures have to corresponds to the Golden Ratio. In creating the figures were used available software tools such as spreadsheets. Shown as example is the application of the resulting figures in the textile and interior design.

Keywords: Textile design, Lissajous figures, Golden ratio

1. INTRODUCTION

The development of designs for the textile industry is a challenge for the modern designers. They spend a lot of time to prepare elements for these patterns. Some have resorted to copying and modification of already existing elements, which sometimes borders on plagiarism. These disadvantages affect times to develop patterns and hence have a negative impact because it increases the cost of the final product [5].

One solution to these problems in the development of elements of designs for the textile industry is to use mathematical relationships for their generation. Rossing, [9] proposes the use of figures based on the method of the pendulum for obtaining elements of the braided rope. The method is based on the figures of Lissajous [4,5,7,8,9]. To generate the figures is used the software WinPlot [10].

A similar type of figures obtained by relationship between equations of the curves described by the sine and cosine function are proposed by Marfo et al [5]. The authors propose the use of such functions for generating elements for patterns in textile design, jewelry and decoration of buildings. Proposed by the authors mathematical relationships and methods for obtaining the figures can be used in the design of components for textile design, jewelry, decoration of buildings.

Parhusip, [7] proposes the use of curves represented in the complex plane to obtain decorative geometric shapes. The author points out that in addition to the basic functions based on sine, cosine and extent can be used their first and second derivatives. For this purpose created program in Matlab, realizing the proposed way to generate decorative elements. Graphically are demonstrated the resulting unconventional solutions for accessories inspired by the symmetry of these elements. They combine emblematic symbols and modern interpretations of accessories. Executed with combinations of classic floral patterns, elements from the seabed and nonstandard forms.

The presented works of motifs derived from mathematical relationships have a significant drawback of using complicated mathematical and programming systems of the class of Matlab and MathCAD. Such software products require programming knowledge to be used, which is an obstacle to their use by designers.

The report aims to develop motives for textiles patterns derived from mathematical relationships using widely available computational and software tools.

2. EXPOSURE

The program tools satisfying the requirement for accessibility in the creation of graphic elements are spreadsheets such as MS Excel, Open Office Calc.
Convenient for easy and affordable creation of decorative elements are the Lissajous figures. They are more often used by the above authors as easily can be described mathematically by two separate sinusoidal functions, oriented perpendicularly relative to each other. The tabular form of work pages of spreadsheets is a universal tool for collecting and processing data. The final result of the work often represents columns with values purely visual can be difficult to analyze. The charts allow visualization of data and more easily perform comparisons, finding uniformity, trends, dynamics of development or even the simple display a summary of the data through graphs.

Bulksheets are one of the most used software for working with spreadsheets, this is due not only convenient means of work and analysis, but also the capabilities of the product to create graphs and charts [6]. Spreadsheets provide control over how a graphical representation of data – through a few basic types of graphs contained in turn many subspecies graphics possibility of using different formatting, styles, colors, fonts and effects. A convenient combination of the right type of timetable for relevant data and numerous visual effects that can be used give a professional look of the graph, and hence the analysis report or presentation to be compiled.

The result of the analysis of the collected data or calculations from different areas of everyday life easily can be presented graphically. For example, the combination of the ability to perform statistical calculations and analyzes and very quick and convenient operation of the means of creating and setting the graphics are grounds for using spreadsheets.

The Lissajous figures describe trajectory of point, which performs periodic oscillations in two mutually perpendicular directions. This is a curve described by a point with coordinates x and y which are periodic functions of time with multiple periods. The figures of Lissajous are used in electronics for comparing two periodic signal. For example, if the horizontal deviation x on the oscilloscope is formed by a sinusoidal signal and a vertical deviation - from the cosine signal on the oscilloscope screen will form a beautiful motionless figure.

Expressed formally Lissajous figure is the chart corresponding to the system parametric equations:

\[
\begin{align*}
    x &= k \cdot \sin(p \cdot a) \\
    y &= k \cdot \cos(q \cdot a)
\end{align*}
\]  

(1)

where k is the radius and amended in the interval [1;b]; b – coefficient expressing the filling of the figure; p.a – frequency of sinusoidal signal; q.a – frequency of cosine signal.

How would it look Lissajous figure depends largely on the ratio p/q. When this ratio is 1, the figure is an ellipse, and in the particular case – circle at p=q.

As a criterion for generating Lissajous figures is selected Golden Ratio, wherein the ratio between the coefficients p/q = 1,618. The reason for this is that the human eye is able to interpret images created by the proportions of the Golden Ratio, faster than everyone else. Therefore, the Golden Ratio which produces sharp shapes perceived by the eye immediately and there is interpreted by the brain.

According to theoretical study, the most effective proportions for the human eye to scan the rectangular shapes in which the horizontal is about one and a half times the vertical, which approaches the Golden Ratio. For example, 21/34 = 0,617, and 34/55 = 0,618. This attitude is denoted by the symbol Φ and amended in the range of 0,618 to 2,618. Only the ratio 0,618/0,382 provides continuous division of the segment into golden proportions, increasing or reducing it to infinity when small part refers to the large, as the vast majority of the entire segment [1,3,11].

3.RESULTS AND DISCUSSION

It is made up spreadsheet that implements the described calculations to obtain Lissajous figures. The table requires the introduction of 5 coefficients p, q, k, s, b and the frequency of the sinusoidal signal a. Then calculate the coordinates of the points along the axes x and y.

In row 1 are recorded the names of the parameters forming the figure and in row 2 – the parameter values. Figure 1 shows ways to enter the coefficients and coordinates of the figure.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>p</td>
<td>q</td>
<td>k</td>
<td>s</td>
<td>b</td>
<td>a</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>10</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
<td>1</td>
<td>-164,33</td>
<td>151,0323752</td>
</tr>
</tbody>
</table>

Figure 1. Entering values for the parameters of the Figure

Under Column F is set variation range from 1 to 200 – in cells from F2 to F201. In columns G and H are recorded formulas for calculating points from the figure in the coordinates X and Y: X for the formula is: -((SC2*SIN(SC2*F2)*2)); Y is for equality: =-((SC2*COS(SC2*F2)*2)). After they are entered the formulas for calculating the coordinates of the points from the figure are filled the necessary cells in columns G and H. The created chart represents the relationship between the calculated X and Y coordinates and obtained figure of Lissajous.

Table 1. Values of coefficients of the generated figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Parameter</th>
<th>p</th>
<th>q</th>
<th>k</th>
<th>s</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>p</td>
<td>8,899</td>
<td>5,5</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F2</td>
<td>p</td>
<td>4,854</td>
<td>3</td>
<td>90</td>
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<tr>
<td>F3</td>
<td>p</td>
<td>23,04</td>
<td>14,24</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F4</td>
<td>p</td>
<td>8,805</td>
<td>5,442</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F5</td>
<td>p</td>
<td>16</td>
<td>9,889</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F6</td>
<td>p</td>
<td>3,6</td>
<td>2,225</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F7</td>
<td>p</td>
<td>35,61</td>
<td>22,01</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F8</td>
<td>p</td>
<td>14,4</td>
<td>8,9</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F9</td>
<td>p</td>
<td>4,4</td>
<td>2,719</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
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<tr>
<td>F10</td>
<td>p</td>
<td>4</td>
<td>2,472</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F11</td>
<td>p</td>
<td>8,737</td>
<td>14,4</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
<tr>
<td>F12</td>
<td>p</td>
<td>6,6</td>
<td>4,079</td>
<td>90</td>
<td>0,5</td>
<td>200</td>
</tr>
</tbody>
</table>
Figure 2 shows in general form constructed spreadsheet to create Lissajous figures. The coefficients p and q are entered separately from the other parameters of the figure as having the greatest influence on its appearance. Twelve figures are generated with ratios shown in Table 1. With letter F are assigned different figures with their numbers. The ratio for p and q for all figures is p/q=0.618. Figure 3 presents the elements obtained with the parameters used. It is seen that even small changes in the coefficients p and q strongly influence the type of the resulting figure.

An demonstration of the use of figures generated by means of online application for creating customized textiles “Digital fabrics” [2] which can be used for textile and interior design. The results of this simulation are presented in Figure 4, where with the motif F3 was created scarf and with the motif F12 is decorated sofa.
4. CONCLUSION

1. Based on the analysis it was found that the use of a mathematical apparatus to generate geometric shapes facilitates artists and designers at the opening of beautiful forms suitable for textile and interior design.
2. It is proposed to use spreadsheets and accessible mathematical tools for generation of shapes which approach has the advantage that it is not necessary to have knowledge of programming for obtaining geometrical shapes.
3. As a criterion for generation of Lissajous figures is selected Golden Ratio used in determining the values of key factors influencing the formation of the figure because the received in this way graphic elements are perceived better by consumers.

5. REFERENCES