Protection of information in documents by implementing individual rastering

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Abstract. *New raster elements have been developed with the goal to be applied in individualizing documents as graphic products. It is proposed to have the parameter choice method in choosing the raster element dynamic change.*

The raster element for proving assertions in this paper is derived from a mesh form. The form changes depending on the pixel blackening value, and this further depends on the pixel graphics that is the basis of the reproduction. The algorithm and code lines are given in PostScript in order to be able to use the same method repeatedly in printing documents that must be secured and individualized.

Such documents must have an image basis such as, for instance, a portrait, a sculpture picture or some specially chosen graphic pattern. Data on document and function individualization with belonging parameters in the graphic form mathematical definition are systematically recorded in the database together with the other texts and numerical data characteristics for the document in question.

This paper demonstrates the protocol on proving the originality of a document together with discussion on the impossibility to forge it.

Keywords. Security, graphic reproduction, raster

1. Introduction

Activities in the field of security printing have increased after «September 11th». Research work [2][3][4] has been carried out in several directions. Following holographic and lenticular application of multi-dimension images [1][5][8] there has been research in respect with individualized rastering systems. We have published the results achieved at various congresses in the world and recent experiments are described in this paper.

Forming of a raster element as a continuous chain structure may be described in several ways. In order for the planned relation to work, it is necessary to incorporate the raster element into a unit space of its definition in such a way as not to touch the upper and lower borders.

The border conditions in the raster element definition have been resolved on basis of the Mathematika program [6][7]. The three-dimension display of the net structure is shown on Figure 1a. Filling in of the raster cell for printing purposes is shown in a two-dimension presentation in the same picture (Fig. 1b).

Research of raster form individualization is shown in Figure 2a and 2b respectively for the deformation parameter having a value of ½. The task is set to make portraits in documents as a direct dependency of the raster element form and the blackening value derived from each image pixel separately.

2. Postscript raster procedure

The printed execution today includes PostScript procedure for image transformation in RIPing. Therefore, this paper contains those parts of the algorithm that conduct in a new way the interdependence of the pixel blackening, determination of the raster form correction, incorporation of deformation parameters and the very definition of the raster element graphics.

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further depends on the pixel graphics that is the basis of the reproduction.

Having the pixel element blackening as the basis for raster form, altering may be observed in the following algorithm:

```
/A 0.2 def
/B 1 def
portret j 1 getinterval 0 get
/nivosivog exch def
/param nivosivog 255 div def
/kor B A sub param mul A add def
/r11 { kor mul abs neg exch abs add
2 div abs 1 exch sub} bind def
```

Values A and B are borders in which is translated grayscale value of pixel in 8-bit hexadecimal form.

Transformation value must be in interval from 0 to 1. Transformation affects only on one coordinate because basic definition of net raster is symmetrical.

Figure 3 is sampled in pixel structure with values 100 x 114 pixels. This values are defined thrue variables

```
/dyy 114 def /dxx 100 def
```

and this is the beginning for describing other images coming form the database. There are no limitations for the image quality. Document rastering may be independent in respect to other images and the resolution of the unit on which the portrait is made.

The attached example shows a set resolution of 15 lines per inch, i.e. the number may vary from a very low one to the usual one in conventional printing, most often 150lpi. The rastering angle is given through the relation

```
15 45 {r11}  bind setscreen
```

within the determined screening setting. In this example 450 is given as a numerical value.

The raster form choice is linked with blackening of individual pixels and in this manner it has been achieved that there is individualization and security on pixel level, the element determining precisely every part of the image separately. It may be said that the number of raster forms is equal to the number of pixels in the image.

3. Net, cross raster

The growth function our net or cross raster is:

$$1 - \frac{1}{2}\,\mathrm{Abs}[\mathrm{Abs}[x] - \mathrm{Abs}[y]]$$

Deformation is applied on variable x and in PostScript it is as follows:

```
/r11 { kor mul abs neg exch abs
add 2 div abs 1 exch sub} bind
def
```

For value kor=1, answer is:

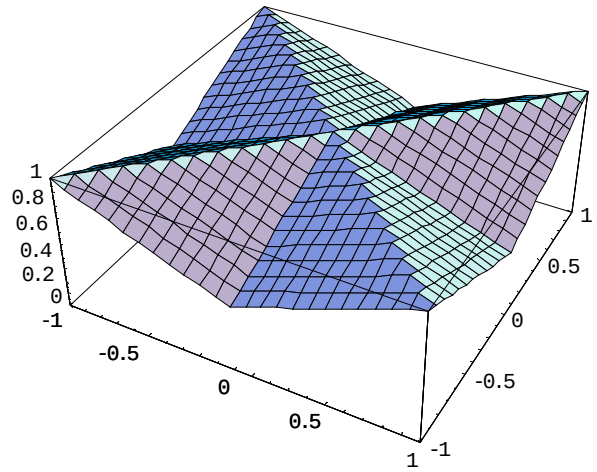

Figure 1a. 3D view of raster element

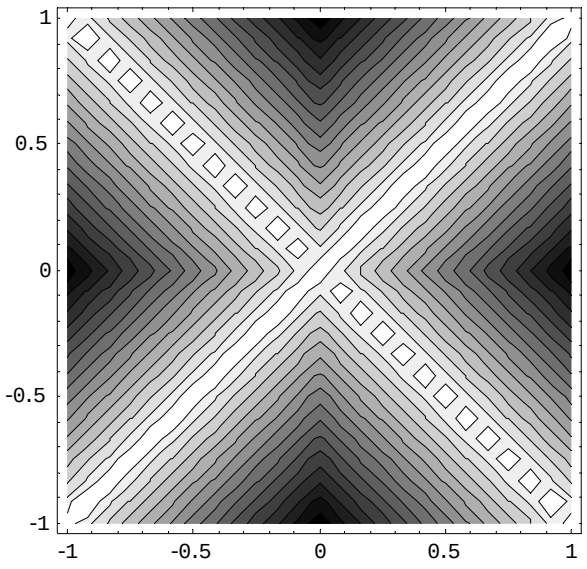

Figure 1b. 2D view of raster element

For value kor=0.5

$$1 - \frac{1}{2}\,\text{Abs}[0.5\,\text{Abs}[x] - \text{Abs}[y]]$$

with impact on the y coordinate is given in 2D and 3D as shown in Figure 2.

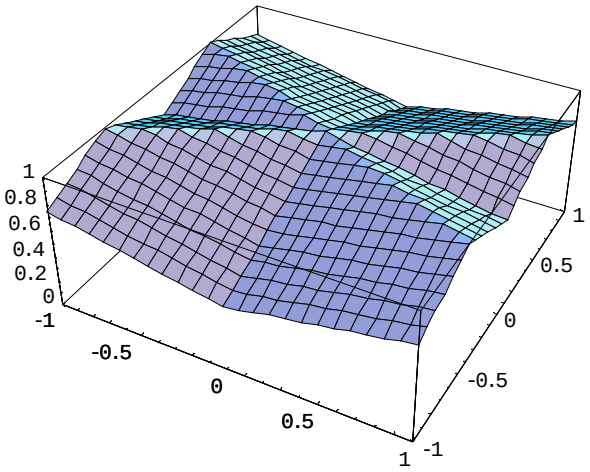

Figure 2a. 3D view of raster element

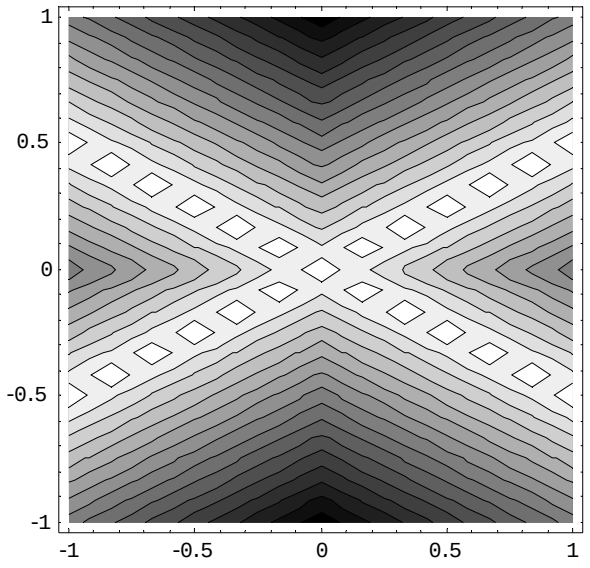

Figure 2b. 2D view of raster element

4. Experimental Results

If this algorithm were to be applied in documents that aim at a high level of security, then it may be recommended that a certain value should be incorporated into the raster form description relation that is individualized and comes out from the very portrait. It is proposed that blackening values are given for the second coordinate and that they should be opposite to the one describing the first coordinate (Fig. 3). The algorithm in PostScript is as follows:

```
kor /xx1  exch def
1 kor sub /yy1 exch def
/r11 { xx1 mul abs neg exch abs yy1
mul add 2 div abs 1 exch sub} bind
def
```

The twofold connection of pixel blackening and raster element form is an additional step in security printing of documents.

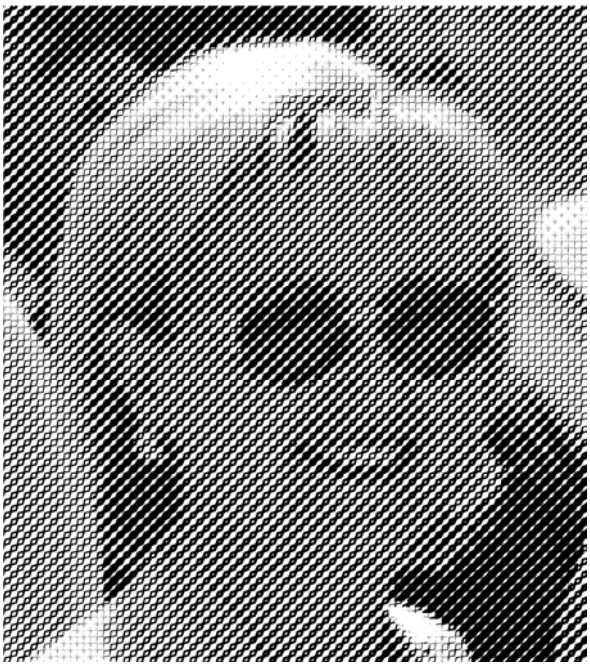

Figure 3. Security Portrait

5. Conclusion

Low liniature value is desirable if the same method is applied in packaging material design with data on the object image contained inside. Although this paper gives an illustration with one color only, it is only a minor step to have four-color print with spot colors in the graphic prepress make ready or to make it for the spot colors themselves. In this case it is necessary to arrange raster angles according to general definitions for reproduction photography.

The proof for the print's authenticity is possible to obtain by repeating the rastered image execution. For this process it is necessary to have the same parameters on the transformation that was prepared in the original reproduction, i.e. borders A and B of the

transformation parameter (one or more), the method for joining these parameter values with pixel blackening. The example in this paper is one of the possible solutions. It is a preliminary design for general application and various further implementations in security document printing.

6. References

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