The 18th INTERNATIONAL DAAAM SYMPOSIUM
"Intelligent Manufacturing & Automation: Focus on Creativity, Responsibility and Ethics of Engineers"
24-27th October 2007

INDIVIDUALIZATION OF MULTI-COLOR REPRODUCTION AND ITS USE FOR SECURITY GRAPHIC SOLUTIONS

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Abstract: *Security printing is spreading in defining area of figure microstructure screening. New raster elements (RE) are included in figure by random choice of three parameters i. e. shape, frequency and angle. Reproducibility of experiment and its reproduction in professional use are ensured by programmable pseudo-random algorithm which generates a range of values to start screening. The first random number is derived from numerical information which is connected with the figure. By this way the same algorithm is used for all protected graphics but with different type of seed. Intervention of outer figure as a guide in choice of RE is presented in this work. Figure with initials was used because of several reasons. This figure is used to choose RE in referent and in original figure. Figure of initials is toned according to the values of density in original figure, and by this way additional protection is added to the integral reproduction.*

Keywords: *security multi-color reproduction, security graphic solution, individualization of reproduction, new raster elements, stochastic choice of raster elements*

1. SUGGESTION AND SOLUTION

Raster element (RE) can be carrier of communication message when coarse screening and specially designed RE are used. The whole figure can be screened by low frequencies or it can be screened partially to achieve some special effects. Figures with specially shaped REs are generated to show freshness of graphic solutions (Veryovka & Buchanan, 2000). Designers take place in competitions with their solutions which are published in exclusive graphic magazines. Stochastic distribution of RE is not yet published in recent publications because very complex algorithm and several new RE are necessary at the same time and in the same reproduction (Žiljak Vujić, 2007). New solutions were obtained when behavior of RE with new definitions of their micro-shapes were researched (Group of Authors, 2003). Solutions of multi-color distribution in figures that reproduce graphics with known original are given. It is confirmed that these solutions are multi-dimensional. It is possible to add fixed and stochastic parameters to each color channel. Experiments with such free design started dynamics in creation of security graphics.

Research of stochastic adding can be divided in two directions. The first one is connection of frequency as a function of density in the frame of pixel in distinct color channel. The second one deals with dependence of angle with development of RE and density from another channel, for instance value of density in black channel defines angle of RE in yellow channel. Such experiments are base for individual solution which can be used in security printing.

In this work high protection of figure is used in real figure which contains integrated information from another figure. Only the first figure is screened i. e. density values of individual pixels determine density of figure for each single pixel. The second figure called referent figure is used for choice of RE parameters: shape, frequency and angle of screening.

Fig. 1. Two figures; portrait and signature with M M initials

Independent generators of random numbers are used, the first one for the first figure and the second one for informations from referent figure. Conditions for further experiments are as follows: if values of pixels densities in referent figure are bigger than 50% of possible density than RE are chosen by algorithm from the second generator. The first figure is portrait and referent figure has M M initials.

Connection of referent figure and figure was solved by PostScript graphic language (Fink, 1992). Parameters which determine random choice of raster shapes, frequencies and angles are included in this work. Stochastic RE choice eliminates the appearance of moiré. By coarse screening moiré would be more pronounced as an error. That is why random choice was used for all parameters that determine graphic reproduction. If it is necessary to extract fixed information (M M initials) from the environment of figure this part of reproduction has to be separated by random variables.

The idea to connect informations fro two figures was realized by independent stochastic choosing of frequency, angle and type of RE for each figure separately. For the same combination of figure reproduction two examples are presented. The first figure has screening of M M initials with the same RE «negative care cube», and the second figure has screening of M M initials with «ring shaped» RE.

Fig. 2. Fixed frequency of 10 lpi and angle at the area of M M initials

Fig. 4. Black and Cyan, frequencies from 10 to 30 lpi

Figure was screened with 12 RE and frequency from 20 to 30 lpi. M M initials (referent figure) were screened with «negative care» RE.

Obtained results represent the base for multiple applications of two figures, where referent figure is the source of informations for screening of another figure.

Frequency of M M initials in black channel is fixed and has value of 20 lpi. Figures of CMYK channel are diminished for 50%.

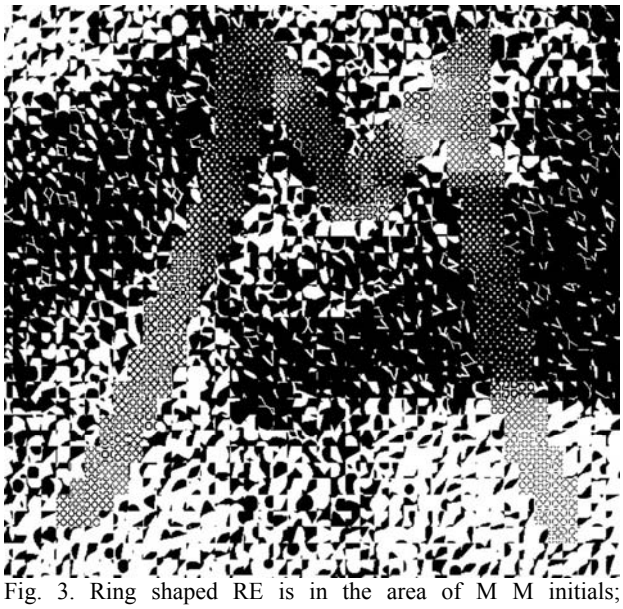

Fig. 3. Ring shaped RE is in the area of M M initials; RE of the figure are mutants M65, M66, M67 and M68

Fig. 5. Magenta and Yellow, frequencies from 20 to 30 lpi

Frequency of M M initials in black channel is fixed and has value of 20 lpi. Figures of CMYK channel are diminished for 50%.

2. CONCLUSION

New REs of various shapes in multi-color reproduction will be used for security or high protected graphics. Pseudo-random generator is used for choosing of raster microelements. Procedure of stochastic choice of raster parameter values for the figure with protected algorithm is the base of individual solution. Figure can be repeated only by the person (or institution) that has informations about initiators (seed) of random numbers generator. Original graphics or design of original posters is another area of usage. Such solutions will be used for publications as high quality graphic design in multi-color reproduction with pixel or vector definition of figure.

3. LITERATURE

Žiljak, J. (2007). PhD Thesis: *"Raster Element Modeling in Stohastic Multi-Color Reproduction",* UDK:655.3.024.004.91, Faculty of Graphic Arts University of Zagreb, Zagreb, HR

Fink, P. (1992). *PostScript Screening: Adobe Accurate Screens*, ISBN 0-672-48544-3, Adobe Press, Mountain View, CA

Veryovka & Buchanan (2000). *Texture-based Dither Matrix,* The Eurographics Association and Blackwell Publishers Ltda., Vol 19, n 1, pp. 51-64.

Group of Authors (2003). *Printing 03,* Proceedings of Papers, Lovreček, M. (Ed.), ISBN 953-199-016-6, Stubičke Toplice, February 2003, FS Ltd./Faculty of Graphic Arts, Zagreb

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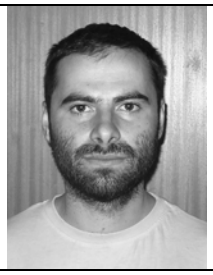
1.	
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